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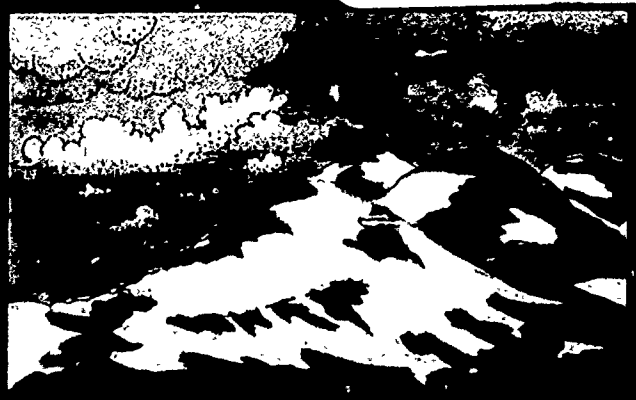
ABSTRACT

This document consists of test items which are applicable to biology courses throughout Australia (irrespective of course materials used); assess key concepts within course statement (for both core and optional studies); assess a wide range of cognitive processes; and are relevant to current biological concepts. These items are arranged under eight headings: (1) investigating the living world; (2) the variety of life; (3) organisms and environments; (4) reproduction; (5) nutrition, development and growth; (6) populations; (7) interaction and change in the natural world; and (8) the living world. Also included are brief comments on and applications of the test items. (ML)



Australian Biology Test Item Bank

Years 11 and 12

Volume I: Year 11

Editors: David W. Brown, Jeffrey J. Sewell

Australian Council for Educational Research

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Mr K. Betjeman, Education Department of WA

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Items were statistically analysed using the 'Itan 2' program written by Mr Lindsay Mackay and modified by Mr Stephen Farish.
We acknowledge permission from publishers to reproduce or modify material (see Appendix I).
In order to provide a more complete coverage of each concept area, a number of items published by Australian Educational authorities have been included in the Bank. These items and their sources have been listed in Appendix I. In some cases items have been modified to suit format requirements, or as a result of suggestions from teachers and interpretation of trial test data. ACER is grateful for the permission of each authority to use these items in this publication.

Introduction

The Australian Biology Test Item Bank Project

The commencement of this project in March 1982 was prompted by the need for new assessment material for Australian Year 11 and 12 biology courses. The recent increase in school-based assessment throughout Australia and the introduction of revised course statements and course materials have changed the emphasis in biology education. New assessment material was needed to meet these changes.

Dr Jeffrey J. Sewell was seconded to the ACER from the Education Department of Victoria to initiate and direct the first year's development of the Biology Item Bank Project, and later Mr David W. Brown was seconded from the same department to continue and complete the work.

The initial aims of the project were to develop a collection of items that would assist the teacher in assessment and evaluation, and be in keeping with the revised philosophies and objectives. Specifically, the items should:

- be relevant to current biological concepts
- assess key concepts within course statements, for both core and optional studies
- assess a wide range of cognitive processes
- be applicable to biology courses throughout Australia, irrespective of the course materials being used.

To assist in the achievement of the above aims, an advisory committee was formed, comprising
Dr J.P. Keeves and Dr J.F. Izard, representing the ACER
Mr M.C. Cropley, representing the Victorian Institute of Secondary Education
Mr I.C. Light, representing the Education Department of Victoria
Dr M.D. Martin, representing the VISE Biology Subject Committee
Mr D.G. Morgan, representing the Australian Academy of Science, ACT
Dr J.J. Sewell, project director 1982
Mr D.W. Brown, project director 1983–4

To ensure national representation, all states and territories were invited to contribute to the development of the Item Bank. Co-ordinators and teams in the ACT, NSW, SA, Victoria and WA were established, and contributed significantly to the overall balance of items selected. It was apparent that two distinct item types would be required: the 'traditional' **correct response** item most commonly used throughout Australia, and the **incorrect response** item used in the Year 12 external examination in Victoria. Both types have educational merit and are represented in this publication. They are distinguishable in the text by the difference in typeface.

The first year of the project saw an emphasis on the development of original Year 12 multiple-choice items, and the establishment of teams of item writers and reviewers in the ACT, SA and Victoria. With the return of Dr Sewell to teaching duties, Mr Brown completed the Year 12 material, developed the Year 11 material, and established the writing and reviewing teams in NSW and WA. Dr Sewell remained actively involved until the project was completed.

Throughout the project, practising biology educators wrote items directed towards the assessment of particular course statements. The items were then reviewed by panels of four teachers and were selected for biological accuracy, educational suitability, plausibility of distractors, and uniformity of terminology. The panels also (subjectively) assigned each item an approximate cognitive level according to 'Bloom's Taxonomy'[1]. The cognitive level assigned was that level thought to be the most appropriate skill being used by a majority of students when answering a particular item at the relevant year level. This is indicated with an abbreviation in the left hand margin of the text. The course statements used are summarized in the table of 'Concept Areas'. As the national courses revolve around major ideas or 'Concept Areas', rather than specific topics, a concept area approach was adopted 'Concept Areas' link together to make up a particular section of study. In this Item Bank, each 'Concept Area' has a minimum of two items per hour of teaching, and there are nearly 1 500 items in the Item Bank.

Trial testing was conducted to provide empirical evidence on the items and to obtain the comments of teachers and students. It provided statistical data on the percentage of students who answered each item correctly, and on the suitability of answers and distractors. Trial testing was performed in over 100 selected government, Catholic and independent schools in ACT, NSW, SA, Victoria and WA. In order to provide a reference point for teachers using the bank, the items in Volume I were tested at Year 11, and those in Volume II were tested at

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1 Bloom, B.S. (Ed.). *Taxonomy of Educational Objectives*. London. Longmans, Green and Co. 1956.

Year 12. Year 12 items were tested in Victorian schools from August to October 1982, and in SA, the ACT and WA from July to November 1983. Year 11 items were trialled in all these states from September to November 1983. The sample sizes ranged from 75 (in two option studies) to 390, with a mean of 190. The two smallest samples were, of course, relatively small homogeneous samples of the student population. To allow for this wide range of sample sizes in the overall presentation of items, the facility levels (percentage answering correctly) are not given. Instead, all items have been assigned a level of difficulty on a scale of 1 to 5. These levels correspond to facilities as follows:

Difficulty Level	Facility Range
1	80—100
2	60—79
3	40—59
4	20—39
5	0—19

Most of the items included in the Bank after trial testing had a point biserial correlation of 0.10 or greater. The point biserial correlation provides a measure of an item's capacity to differentiate more able students from less able students as determined from the total score for the test concerned. Items with a correlation of less than 0.10 have been included where it is believed they would be of value, and are indicated by an asterisk in the left-hand margin of the text. Items which could not be included in the trial testing program have also been given an asterisk. An asterisk does not necessarily imply that an item is unsuitable in a test.

Final selection or modification of items took into account not only the statistical data but also the very constructive criticisms made by teachers and students.

Because of the enormity of the task, some overall model was needed to ensure consistency of approach and to allow for variations in emphases on core and option studies according to the various educational authorities. As the *Web of Life* materials are the most widely used resource, and these materials were modelled on the various national courses, the third edition *Web of Life* Major Idea statements provided useful guidelines. (Note that in several course sections (sections 2, 4 and 5) the Concept Area numbering in this Item Bank differs from the Major Idea numbering in the *Web of Life* course.) Although this is not an Australian Academy of Science project, it has their support. Hopefully this Item Bank will remain useful to biology educators for years to come, irrespective of the teaching materials they may use. It should also be very useful in more specific areas of biology education.

It is hoped that this Item Bank can be updated periodically. Original items may be forwarded to the address below. Notification of errors in the text would also be gratefully received. Please write to:

The Biology Test Item Bank Project,
The Australian Council for Educational Research,
9 Frederick Street,
Hawthorn, Victoria 3122

Using the Item Bank

1 Uses for the Items

A Production of diagnostic tests

A diagnostic test is one which attempts to identify learning difficulties experienced by students and enables the provision of some form of assistance in overcoming the problems that are identified. Such tests should

(a) contain a comprehensive range of items measuring the objectives of the syllabus area that is being evaluated; and

(b) enable the provision of some form of feedback to the students after they have attempted the items.

The items in the bank have been constructed so that the choice of a particular distractor will allow the teacher to determine the nature of a student's error, and to advise the student of any appropriate remedial work necessary. Common errors could be discussed in class, and written explanations of the answer (diagnostic aids) might be provided by the teacher. The format used in this publication enables teachers to select items which are most appropriate to the emphases that they have given to various topics.

B Production of achievement tests

An achievement test is a test designed to measure a student's achievement in a particular syllabus area with a single score. Just as for a diagnostic test, it should contain a comprehensive range of items measuring the objectives of the syllabus area being evaluated. As the bank includes items of a wide range of difficulty levels, it is possible to prepare tests which:

(a) discriminate very well between students in the more able section of the class (using items with a high difficulty).

(b) discriminate well between students in the weak section of the class (using items with a low difficulty); and

(c) spread the students over a wide range of marks (using items with a spread of difficulty levels with an average difficulty of about 3).

Note that difficulty levels should be used as a guide to the *relative* difficulties of items rather than as an absolute standard. The values quoted in the bank are likely to be dependent upon factors such as the nature of the students participating in the trial testing, the time of year at which testing was peformed and the emphasis placed on the topics in different schools.
It should be pointed out that the items in this collection *alone* may not be suitable for assessment of achievement, as some course objectives may be better examined using extended answer test items or practical tasks.

C Revision

Items can be set as home study for later discussion, or used in class to generate discussion. Items particularly suiting home study may tend to be of high cognitive level and high difficulty level, as these tend to promote enquiry without the time constraints of the classroom. Items suited to class discussion may tend to be of high cognitive level and relatively low difficulty level, as these may encourage contribution by a greater range of students. All students should be encouraged to select an answer before the appropriate response is revealed.

D Introduction to a topic or concept

Comprehension items with a relatively low difficulty level seem to be useful in promoting the 'discovery' of a new concept.

E Essay framework

Many items are suitable as a framework on which to construct an essay question. The alternatives may provide a series of statements which can be argued and discussed in the light of their course of study, or of the stimulus material only. Alternatively, the stimulus and stem only might be used. Suitable items would tend to have high cognitive levels (e.g. **Analysis, Evaluation**). (See Appendix II, item 1.)

F Extended response

It is a particularly useful exercise to require students to explain their reasons for choosing a particular alternative as being the answer, and for rejecting the other three alternatives. Many items with cognitive levels higher than **Knowledge** may be suitable. (See Appendix II, items 2a and 2b.)

G True/False

When used in this way, the item may be used complete, so that all alternatives in an item require a decision by the student as being true or false. Here the teacher may alter one or more alternatives in order to achieve the required balance of true to false statements. Alternatively, the stimulus and/or stem may be simply used with only one of the alternatives. **Knowledge** and some **Comprehension** items seem well suited to this use. (See Appendix II, Item 3.)

H Debates

Some items can provoke lively discussion, and the alternatives can be used as the basis for debates. Items from sections 8, 16 and 17 seem particularly suitable for this. (See Appendix II, Item 4.)

I Research stimulus

For this use, a relatively difficult item, of cognitive level application or above, is taken and thoroughly researched. Explanations are given and evidence cited for the acceptance or rejection of each alternative. (See Appendix II, item 5.)

J Models for constructing other items

This bank provides a range of item types which could be used as models for teachers who wish to construct their own items. If items from the bank are supplemented by teacher-written items, it is suggested that the supplementary items be consistent in style. Some rules for constructing multiple-choice items are outlined on page xv.

2 Preparing Tests

In preparing a test, teachers should:

- identify the particular syllabus areas that are to be evaluated;
- be prepared to use both **correct** and **incorrect** response types of items presented in this Bank (See 1 above), although the two item types should **not** be used together in the multiple-choice section of the test. Note that they are distinguishable in the text by the difference in typeface;
- select items which appear to evaluate the concept areas under consideration;
- write items, where necessary, to provide an adequate coverage of the areas;
- place the items in a logical order. (Group items relevant to similar syllabus areas together. If possible, place the easier items early in the test, with the more difficult items towards the end of the test),
- place items based on the same stimulus material on the one page;
- ensure that one item does not supply the answer to another item;
- check that the items are not ambiguous and that each has an answer listed;
- prepare an answer key;
- ask another teacher to work through the draft, to identify errors and omissions, as well as providing a check on the answer key.

During the trial testing of items, most students completed between six to seven items every ten minutes.

3 Selecting Items

To facilitate item identification, the items have been classified according to their concept areas. These are listed in the Concept Area Table, which incorporates an alphanumeric coding to assist the location of items. The concept area codes, cognitive level, difficulty, answer and item type are given beside each item in the left-hand margin. The following example illustrates this format.

15i-1
15d
Co
2
A
(c)
*

After an area was sprayed with the insecticide DDT, it was found that some populations of mosquitoes were resistant to DDT.

The best explanation for this is that

A mosquitoes naturally resistant to DDT are more likely to survive and reproduce.

B DDT causes individual mosquitoes to become resistant to DDT.

C mosquitoes that become resistant to DDT as a result of the spraying produce offspring resistant to DDT.

D DDT acts on a particular gene causing it to produce an enzyme which destroys DDT.

- The item is most appropriate to concept area 15i. From the table of Concept Areas, 15i represents 'Natural selection changes allele frequencies'.
- This is the first item in this particular concept area.
- This item also tests concept area 15d.
- The approximate cognitive skill being used by most students when answering this item at this year level is **Comprehension**[1]. The items have been classified as follows:

  Kn = Knowledge
  Co = Comprehension
  Ap = Application
  An = Analysis
  Sy = Synthesis
  Ev = Evaluation

- The difficulty of the item, on a scale of 1 (easy) to 5 (difficult) is about 2 (i.e. 60–79 per cent of the trial group of students answered this item correctly—see Introduction) Volume I items were tested at Year 11, Volume II items at Year 12.
- The answer to the item is A.
- This is a **correct** response type item i.e. the student is required to select the one **correct** alternative as the answer. This contrasts with for example, item 14g-5 which is an **incorrect** response type item i.e. the student is required to select the one **incorrect** alternative as the answer.
- The asterisk indicates that either (a) the point biserial correlation for this item was less than 0.1 (i.e. the item did not differentiate well between the more able and less able students as determined by the total score on the trial test), or (b) the item was not included in the trial testing program.

4 Writing Additional Multiple-choice Test Items

Multiple-choice items should incorporate the following points:

- The stem and each alternative must read grammatically when taken together.
- The problem posed or the question asked must be clearly set out in the stem.
- The whole item should be as brief as its proper presentation will allow.
- To keep the alternatives brief, incorporate the major part of the idea in the stem.
- Avoid a negative stem where possible.

  If unavoidable, either
  (a) emphasize not, or
  (b) use: all of the following **except** one. Which one?

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[1] for further information, see

Bloom, B.S. (Ed.). *Taxonomy of Educational Objectives*. London. Longmans, Green and Co. 1956.

- **Incorrect** response items should **never** have a negative stem.
- All distractors should be equally attractive to the uninformed, yet the appropriate one must be unequivocally the best alternative.
- Avoid using 'none of the above' as a distractor.
  A preferred alternative is,
  for example: **D** neither **A**, nor **B**, nor **C**.
- All alternatives must be homogeneous in idea and style.
  For example: Do not mix functions and structures.
- Words such as 'all', 'never', 'always', 'only', should not be used indiscriminately.
- Information presented in the stem must be factually correct.
- Distractors must be clearly **correct** or (depending on item type) **incorrect**, and not merely incomplete.

For a more comprehensive treatment of test construction and item writing, see. Izard, J.F., *Construction and Analysis of Classroom Tests*, ACER 1977.

5 Adding Other Types of Items

This item bank may be used as the starting point for a collection of a variety of test item types. True—False, extended response and essay items may be written or collected from examination papers and included in the relevant concept areas after appropriate keying.

6 Symbols, units and terminology

In order to maintain some degree of internal consistency within this publication it has been necessary to select between the expressions in current use. It is anticipated that teachers will adapt items to their local needs where necessary. The SI units of measurement have been used, including the use of mL for millilitre.

Concept Areas: Volumes I and II

Volume I: The Living World

1 Investigating the Living World

a Organisms interact with their surroundings
b Autotrophs and heterotrophs
c Respiration

2 The Variety of Life

Kinds of Organisms

a Speciation
b Identifying and describing species
c Classifying species

Classification

d Animals
e Plants
f Microorganisms

3 Organisms and Environments

Living Things and Living Places

a Factors affecting a species' survival
b Habitats: similarities and differences; living in water

Adaptation

c Survival on land: inherited features
d Survival by response to the environment

4 Reproduction

Reproductive Processes

a Sexual and asexual reproduction
b Sexual reproduction and variability
c Reproductive systems

Reproduction and Survival

d Characteristics enabling reproduction, survival and dispersal
e Life cycles and their reproductive stages

5 Nutrition, Development and Growth

Development and Growth

a Development in a lifetime
b Growth; cell growth, differentiation, death and replacement
c Patterns of development relating to habitat and structure

Nutrition

d Food materials
e Variations in nutritional requirements

10 Function and Structure in Plants

a The variety of plant structure

Input and Output

b Vascular plant structure facilitates photosynthesis
c Gaseous exchange and water loss in terrestrial plants

Plant Structure—Function Relationships

d Transport, storage and waste disposal

Plants and the Environment

e Structural adaptations
f Germination, growth and reproduction in angiosperms
g Adaptation, efficiency and inheritance

11 Function and Structure in Animals

Input and Output

a Structure and function in organs and systems
b Digestion, absorption, assimilation, storage and elimination
c Respiratory systems and surfaces, gaseous exchange
d Mammalian excretion maintains a constant internal environment

Mammalian Internal Transport and Maintenance

e Exchange and transport by blood vascular and lymphatic systems
f Maintenance of the cellular environment
g Tissue maintenance and the immune system

Animals and the Environment

h Sense organs, body surfaces and musculo-skeletal systems
i Structural diversity, adaptation, efficiency and inheritance

12 Integration and Regulation in Multicellular Organisms

Integration and Control

a Integration and regulation of body functions; response to change
b Nervous systems and hormones control the multicellular organism
c Internal regulation by homeostasis

Chemical Regulation in Plants

d Angiosperm response throughout development; chemical control

Behaviour Patterns

e Normal functioning and reproduction aided by behaviour
f Determiners of behaviour: heredity, experience, environment, physiology

Regulation and Control in Multicellular Animals

g Nervous systems
h Endocrine systems

13 Cellular Processes

Activities within Cells

a Cell chemical composition and basic requirements
b Cell respiration
c Enzymes
d Photosynthesis as a chemical process

Cell Ultrastructure and Function

e Cell organelles and chemical processes
f Membranes as dynamic structures

Molecular Interactions

g Chemical reactions in cells, and their control
h Molecular structure; its effect on chemical and physical processes

14 Heredity

Inheritance as a Phenomenon

a Inheritance and environment determine characteristics
b Chromosomes; transfer during life processes, homologous pairs
c Meiosis and fertilization maintain chromosome sets
d Sexual reproduction aids variability within the species
e Chromosomes and genes determine inheritance

Patterns of Inheritance

f Alleles and their origin; types of dominance
g Gamete and genotype frequencies; monohybrid crosses, multiple alleles
h Independent assortment of two or more genes on different chromosomes
i Linkage, crossing-over, chromosome mapping

DNA, Genes and Chromosomes

j Chromosomes and genes consist of DNA; DNA may be extranuclear

Gene Action

k How gene structure determines protein synthesis
l Phenotype as gene expression
m Gene activity controls cellular activities

15 Life—Its Continuity and Change

Life from the Past

a Fossils and their formation; geological time scale
b Evidence of change in the fossil record

Natural Selection and Change

c Speciation, variation, selection and evolution
d Survival and changes in populations
e Environmental effects on population characteristics
f Mutations provide the raw material for evolutionary change
g The development of new species

Mechanisms of Evolution

h Convergence, sex differences and mimicry
i Natural selection changes allele frequencies
j Formation of subspecies and new species by adaptation and isolation
k Population distributions related to changes in land forms

16 The Human Species

Homo sapiens

a Human characteristics and their variation
b Human origins and fossil evidence

Science and Society

c Human cultures result from learning and communication
d Scientific approaches to problem solving; technology
e The effects of science and technology on culture and the biosphere
f The effects of applying scientific knowledge to human problems

17 Science and the Scientific Process

a Science as a part of human culture

How a Scientist Works

b Apparent relationships may be found between observations
c Questions are posed, observations made, data collated and compared
d Hypothesis, predictions, experimental design to test hypothesis
e Experimental results and hypothesis evaluation
f The scientist is thorough, logical and objective

The Scientist in the Scientific Community

g Development and use of appropriate tools and techniques
h Internationally accepted names, symbols and units
i Reports assist with accurate communication
j Publication: a record for dissemination, inviting scrutiny and duplication
k Scientific ideas: acceptance, predictability, re-examination

The Scientist in Society

l Awareness of the consequences of investigations
m Some issues are beyond the limits of science
n Science and its effects on culture and the biosphere

1 INVESTIGATING THE LIVING WORLD

1a—Organisms and their surroundings

CORRECT response items

The next 3 items refer to the following information:

In a research investigation, mould was grown on agar plates containing different concentrations of vitamin B_6. Measurements were made daily on the size of the mould colonies, and the following results recorded:

Concentration of vitamin B_6 (micrograms per 25 ml of nutrient medium)	Average growth rate of mould (cm per day)
0.004	2.0
0.015	2.0
0.030	4.5
0.060	8.5
0.250	10.0
1.000	10.0

1a-1 17b Co 2 (c) B

Which one of the following hypotheses is being tested in the experiment?

A The diameter of the mould colony determines the concentration of vitamin B_6 used.
B Mould growth rate varies with vitamin B_6 concentration.
C Vitamin B_6 is needed for mould growth.
D Vitamin B_6 concentration determines the growth rate of living things.

1a-2 17f An 4 (c) D

Which of the following statements may be reasonably concluded from the data?

A Mould will not grow when vitamin B_6 is absent.
B 2.00 micrograms per 25 ml of vitamin B_6 would result in an average growth rate of 20.0 cm per day in the mould.
C The mould will grow most rapidly if the vitamin B_6 level is between 0.015 and 0.060 micrograms per 25 ml.
D With a vitamin B_6 concentration of 0.050 micrograms per 25 ml the average growth rate would be less than 8.5 cm per day.

1a-3 17d Co 3 (c) A

The variable being investigated in this experiment was the

A concentration of Vitamin B_6 in the nutrient medium.
B growth of mould on the nutrient medium.
C temperature at which the experiment was done.
D time during which mould growth occurred.

The next 5 items refer to the following information:

Scientists tested two groups of five people to see if pulse rate increased with the amount of activity. Group 1 individuals were identified as Q, R, S, T and U. Group 2 individuals were identified as V, W, X, Y and Z. The pulse rate of each individual was taken on arrival at the laboratory, then group 1 individuals rested for five minutes, while group 2 individuals underwent vigorous exercise. All pulse rates were then immediately recorded. The results were tabulated as follows:

Group 1			Group 2		
	Pulse rates (beats per minute)			Pulse rates (beats per minute)	
Individual	On arrival	After 5 mins resting	Individual	On arrival	After 5 mins exercise
Q	70	65	V	68	68
R	68	70	W	70	85
S	72	70	X	75	88
T	72	74	Y	69	71
U	74	71	Z	69	95

1a-4
17c
Co
1
(c)
B
*

What were the experimenters attempting to investigate?

A a comparison between groups of people
B the relationship between activity and pulse rate
C the types of activity carried out
D the pulse rates of the individuals

1a-5
17c
Co
2
(c)
C
*

Measurements were being made directly on the

A type of activity.
B smoking habits of the individuals.
C pulse rates.
D individual's fitness.

1a-6
17e
An
2
(c)
B
*

Consider the hypothesis that 'pulse rate increases with activity'.

The hypothesis is **best** supported by the data from individuals

A Q and V.
B U and W.
C R and Y.
D U and V.

The next 2 items refer to the following ADDITIONAL information:

When experiments are carried out, the investigator must have a clear understanding of which factors can change in his experiment i.e. which are the *variables*. These *variables* are often classed as *independent* or *dependent*, and may be defined as follows:

Independent variable. a factor whose variation the experimenter is using in order to see how the dependent variable is affected. This factor is often under the experimenter's control, but may not be.

Dependent variable. the variable over which the experimenter takes no direct control, and which is measured to see how it is affected by changes in the independent variable.

1a-7
17d
Co
2
(c)
A
*

The *independent variable* being investigated by the experimenters was the

A amount of activity.
B smoking habits of the individuals.
C change in pulse rates.
D individual's fitness.

1a-8
17d
Co
2
(c)
C
*

The *dependent variable* being investigated by the experimenters was the

A amount of activity.
B smoking habits of the individual.
C change in pulse rates.
D individual's fitness.

1a-9
1c
Kn
3
(c)
B

Which of the following is a characteristic of living things?

A They exist independently of the non-living world.
B They obtain energy by breaking down complex substances.
C They are composed of many cells.
D They can be clearly defined as plants or animals.

1a-10
17k
Ap
3
(c)
D
*

Xanthorrhoea (native grass tree) is a remarkably long-lived tree with leaves up to one metre long. One investigator propagated the trees from seeds under the trees' natural conditions. He observed that they added, on average, two leaves per year for ten years. He suggested that a means of estimating the age of old specimens is to count the total number of leaves and divide by two. Recently a botanist has criticized this technique.

The most likely basis of his criticism is that

A no adequate control was used.
B all *Xanthorrhoea* trees should produce leaves at the same rate.
C as no other trees investigated showed this relationship, it is unlikely to apply to *Xanthorrhoea*.
D the number of leaves added yearly after ten years may have varied.

INCORRECT response items

1a-11
–
Ap
3
(i)
C
*

The table shows inputs and outputs of substances by sugar gliders in one day.

Input (grams)		Output (grams)	
Insects	4	Faeces	2
Sap	20	Urine	10
Gum	10	Growth	2
Total	34	Total	14

Based on the above information and your knowledge of animal functioning, the following statements may be made.

A Animals modify material taken in before returning it to the environment.
B The amount of material taken in is considerably more than the amount of material retained by an animal.
C The difference between an animal's inputs and outputs is approximately equal to the energy it releases as heat.
D An animal's activities determine its inputs and outputs.

1b—Autotrophs and heterotrophs

CORRECT response items

1b-1 – Kn 1 (c) B

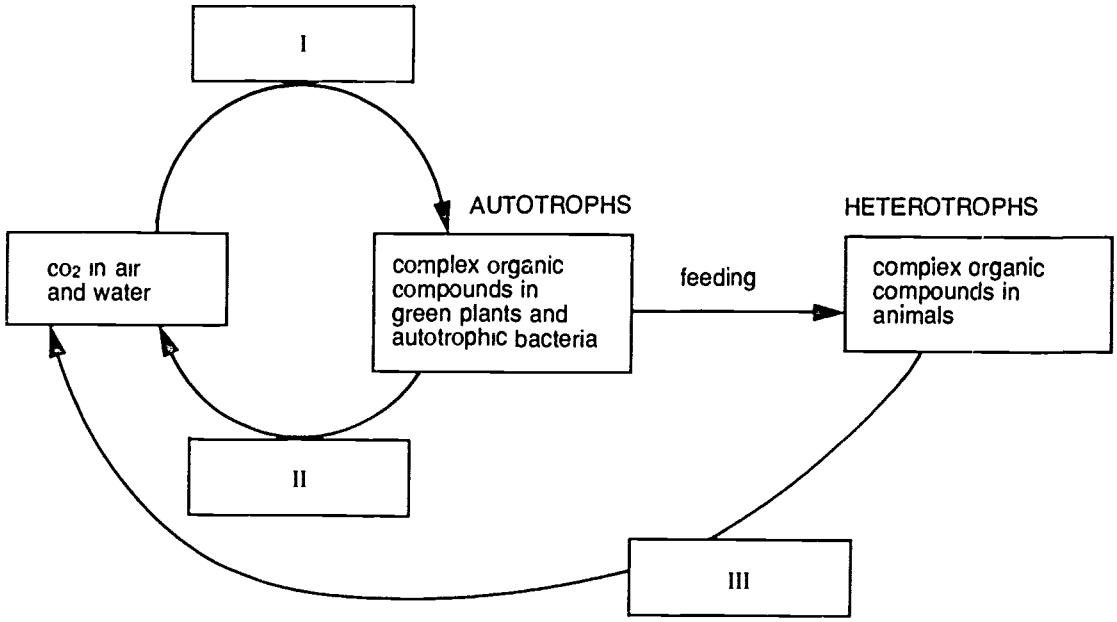
When green plants photosynthesize, they produce complex organic substances.

In this process,

A chemical energy is converted into and stored as light energy.
B light energy is converted into and stored as chemical energy.
C light energy is converted into and stored as kinetic (movement) energy.
D heat energy is converted into and stored as chemical energy.

The next 2 items refer to the following information:

This is a simple diagram of the carbon cycle.



1b-2 – Co 2 (c) C

Process I would best be called

A chemosynthesis.
B respiration.
C photosynthesis.
D diffusion.

1b-3 – Co 2 (c) B

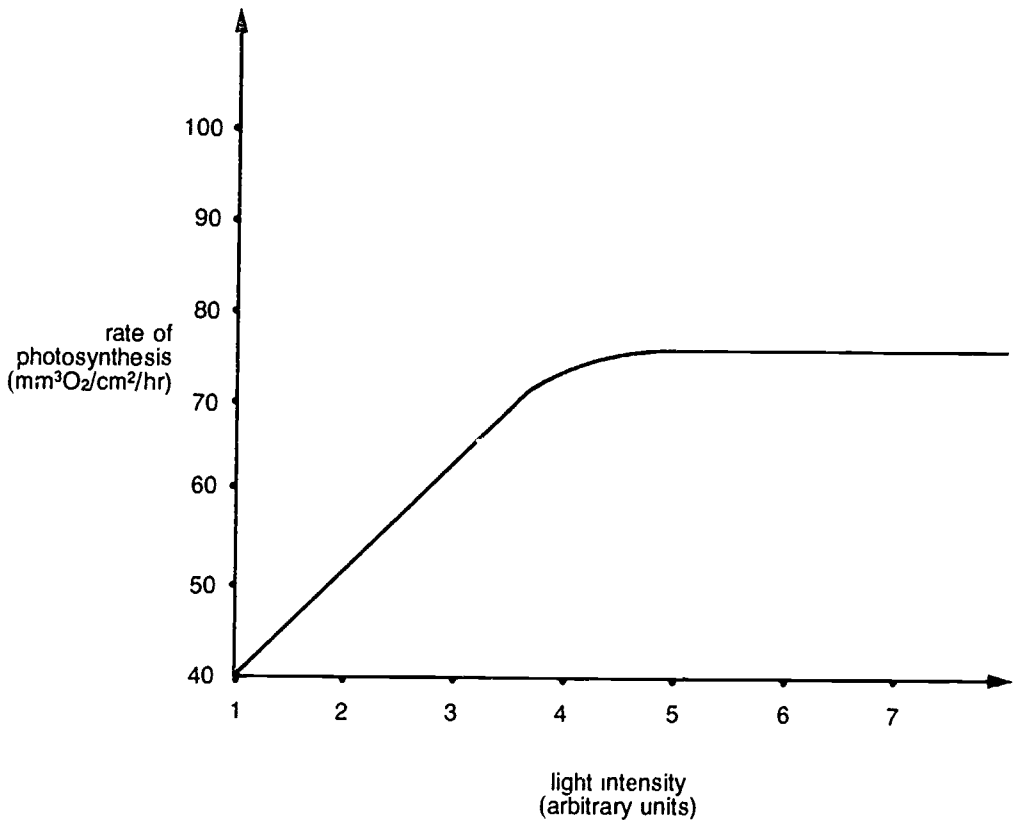
Processes II and III would best be called

A chemosynthesis.
B respiration.
C photosynthesis.
D diffusion.

The next 2 items refer to the following information:

A biologist subjected a plant to a series of light intensities. The rate of photosynthesis was determined at each intensity by measuring the amount of oxygen given off per square centimetre of leaf per hour. The temperature and the concentration of carbon dioxide were kept constant.

The results were graphed as follows:



1b-4 The experiment was designed to investigate whether

17d Co 1 (c) B

A constant temperature and carbon dioxide concentration were required for a constant rate of photosynthesis.

B varying light intensity affects rate of photosynthesis.

C oxygen was a product of photosynthesis.

D carbon dioxide was required for photosynthesis.

1b-5 The best interpretation of these results would be that

Ap 1 (c) C

A there is a continuing increase in photosynthesis with increasing light intensity.

B the concentration of carbon dioxide does not alter the rate of photosynthesis.

C there is a limit of light intensity beyond which no further increase in rate of photosynthesis takes place.

D the rate of photosynthesis is independent of light intensity.

1b-6 – Kn 2 (c) B

The main difference between heterotrophic organisms and autotrophic organisms is that heterotrophic organisms

A do not have plant characteristics.
B cannot synthesize food using only inorganic materials.
C produce waste products from cellular activities.
D obtain energy by the process of respiration.

1b-7 – Kn 2 (c) D

In the process of photosynthesis,

A complex organic molecules are broken down into simple inorganic molecules.
B light is used to produce heat and kinetic energy.
C carbon dioxide is given off and oxygen used up.
D light energy is converted into chemical energy.

1b-8 – Kn 3 (c) D

Many substances are exchanged between a heterotroph and its environment.

These exchanges include

A input of carbon dioxide.
B output of oxygen.
C input of light energy.
D output of water.

1b-9 17f An 2 (c) A

A scientist was investigating the factors needed to produce the green pigment chlorophyll in seedlings.

Four groups of broad bean seedlings were grown from seed under identical conditions except that the presence of magnesium ions (Mg^{2+}), chloride ions (Cl^-) and light was varied as shown in the table.

A stock nutrient solution was used. This solution contained all mineral ions necessary for healthy plant growth, except for Mg^{2+} and Cl^- ions. These two ions were added only where indicated in the table.

(+ = presence of the factor
– = absence of the factor)

	Nutrients used				
Group	Stock nutrient solution (no Mg^{2+} or Cl^-)	Magnesium ions (Mg^{2+})	Chloride ions (Cl^-)	Growth conditions	Observations after 20 days
I	+	+	–	light	green shoots
II	+	+	+	light	green shoots
III	+	+	+	dark	white shoots
IV	+	–	+	light	white shoots

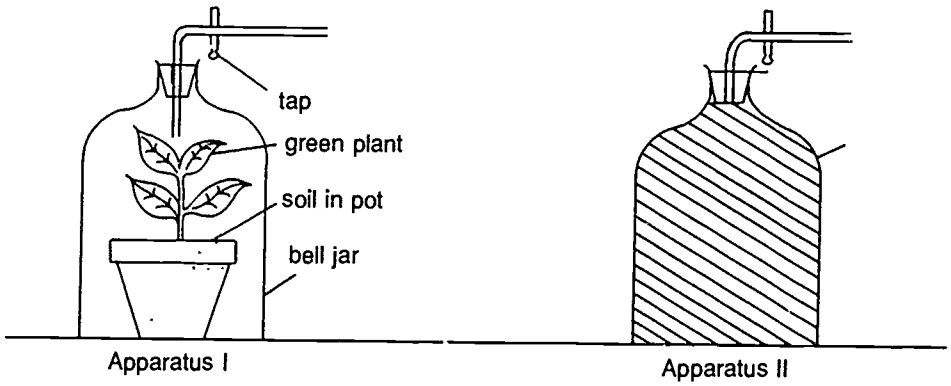
From the above results it would be reasonable to conclude that, for chlorophyll production,

A chloride ions are not needed.
B magnesium ions are needed only when light is absent.
C the presence of either magnesium or chloride ions is sufficient.
D magnesium ions reduce the effects of chloride ions.

The next 4 items refer to the following information:

A student set up the following experiment. She placed a healthy green potted plant inside a sealed bell jar. The bell jar had a tap which could be used to remove gases for analysis.

A second bell jar was set up identical to the first situation, except that it was completely covered with black cardboard.



1b-10 Which of the following best states the hypothesis being tested?

17d
An
2
(c)
D

A Green plants use water and carbon dioxide.
B Continuous darkness inhibits new growth in plants.
C When exposed to light, green plants grow.
D Light affects a green plant's carbon dioxide uptake.

1b-11 This is an example of a controlled experiment because

17d
Ap
2
(c)
C

A the student was aware of all the factors involved.
B the air in the two jars could be analysed at any time.
C apparatus II differed from apparatus I in one respect only.
D identical bell jars were used for both experiments.

1b-12 If I and II were placed in sunlight for 6 hours, and the air in each jar then analysed, it would be reasonable to expect that

17k
Ap
3
(c)
A

A II would contain more carbon dioxide than I.
B I would contain less oxygen than II.
C I would contain more carbon dioxide than II.
D I and II would both contain less oxygen

1b-13 If the plant in I were placed in a pot filled with cotton wool soaked in distilled water, and the tap and stopper removed, it would be expected that

17k
Ap
3
(c)
A

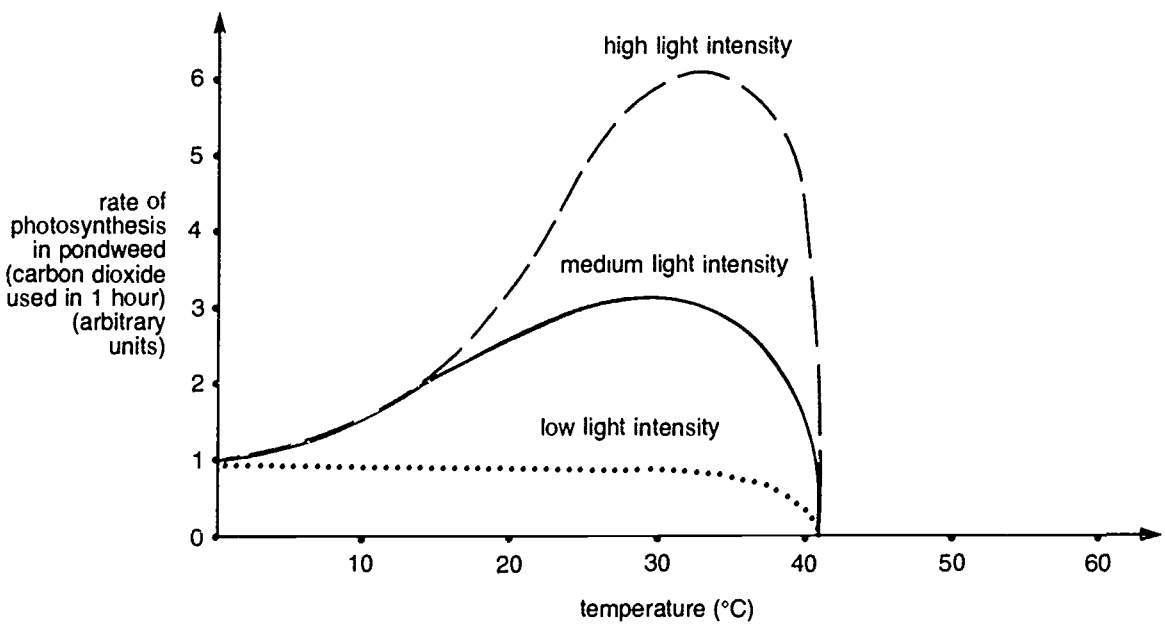
A yellowing of the leaves would occur after a time.
B no growth would occur at all.
C the air would provide substances essential for growth.
D the leaves would die within 24 hours.

1b-14 Which one of the following substances is classed as an organic compound?

–
Co
4
(c)
C

A H_2O (water)
B CO_2 (carbon dioxide)
C C_2H_6O (ethanol)
D C (carbon)

1b-15 The rate of photosynthesis of a species of pond weed was investigated under various conditions of light
17k and temperature. The results were presented as follows.
An
3
(c)
A



Which of the following generalizations can be made from the information in the graph above?

A At 50 °C the rate of photosynthesis would be zero at all light intensities.
B The rate of photosynthesis increases as the temperature increases from 20 °C to 30 °C.
C The rate of photosynthesis is dependent upon the carbon dioxide concentration in the water.
D In the dark carbon dioxide would not be produced by the plant.

1b-16 Many substances are exchanged between an autotroph and its environment.
– Kn 3 (i) C *

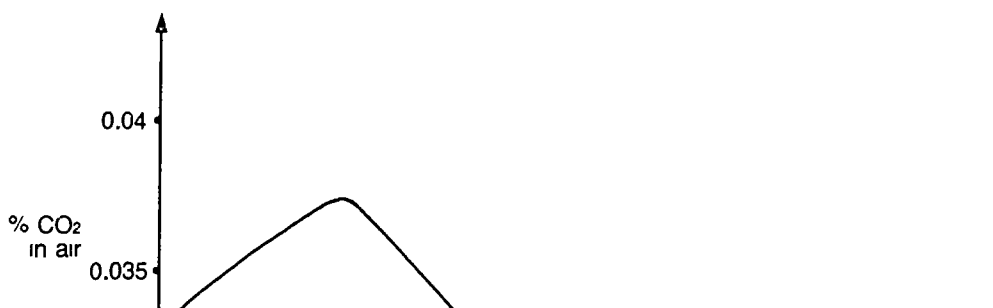
These exchanges include

A output of carbon dioxide.
B output of oxygen.
C input of organic nutrients
D input of water.

1b-17 The rate of photosynthesis by a plant would be decreased by reducing
– Co 2 (i) A

A the concentration of oxygen available to the plant.
B the amount of chlorophyll in the leaf of the plant.
C the light intensity of the plant's environment.
D the carbon dioxide concentration in the air surrounding the plant.

1b-18 The graph below represents the relationship between the percentage of carbon dioxide in the air within a forest community and the time of day. During the time represented, no wind was blowing.
10b An 4 (i) C *



From your knowledge of plants and the data given in the graph, it would be reasonable to conclude that

A between 2.00 and 3.00 p.m. the net production of carbon dioxide by this community is zero.
B the net respiration rate for the community is constant between midnight and 5 a.m.
C the net rate of photosynthesis is a maximum at noon.
D photosynthesis began to occur at about 6 a.m.

1c—Respiration

CORRECT response items

1c-1 Which of the following is a characteristic of all living things?

–
Kn
2
(c)
D

A They release oxygen to the surroundings.
B They absorb carbon dioxide for respiration.
C They take in complex organic substances and break them down into simpler substances.
D They obtain their energy needs by converting one form of energy into another.

1c-2 When a possum awakens and begins foraging for food, its

–
Co
2
(c)
D

A carbon dioxide intake increases.
B oxygen output increases.
C heat energy production decreases.
D water vapour output increases.

The next 2 items refer to the following information:

The table shows energy expenditure related to speed of walking and oxygen consumption for a man weighing 72.58 kilograms.

Speed of walking (km/h)	Energy expenditure (kJ/min)	Oxygen consumption (mL/min)
1.25	13.44	82
1.60	15.96	98
1.90	18.48	121
2.15	21.00	140
2.50	24.36	167

1c-3 Which of the following statements may be deduced from the data?

–
An
1
(c)
B

A If the speed of walking increases three-fold, the energy expenditure will increase at the same rate.
B As the speed of walking increases, the rate of oxygen consumption increases.
C As the speed of walking increases, the rate of carbon dioxide production increases.
D As the rate of energy expenditure increases, the rate of carbon dioxide consumption increases.

1c-4 More energy is expended as the speed of walking is increased.

–
Co
3
(c)
A
*

This occurs because the rate of respiration

A depends on the rate at which oxygen is supplied.
B depends on the frequency with which food is taken.
C directly determines the rate of water production.
D directly determines the body temperature.

1c-5 – Ap 3 (c) A *

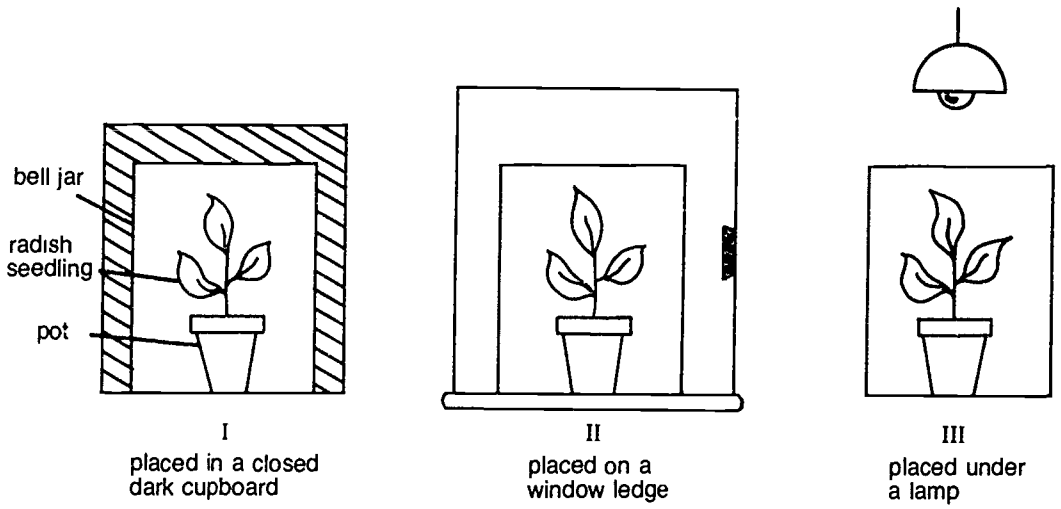
In an investigation, a plant weighed 89 grams at the beginning of the experiment. After 10 hours in total darkness, it showed a reduction in weight.

This weight reduction is most probably because the plant has been losing

A carbon dioxide.
B heat.
C oxygen.
D mineral ions.

The next 3 items refer to the following information:

A scientist had three young radish seedlings growing in pots of equal size and containing the same soil type He weighed each one then placed them in three different positions, as indicated below. After three days they were reweighed.



1c-6 17c Co 3 (c) B

It was observed that plant III gained the most weight over the three days.

The most likely reason for this is that a plant

A respires only in the dark.
B photosynthesizes only in the light.
C always respires at a greater rate than it photosynthesizes.
D always photosynthesizes at the same rate as it respires.

1c-7 17c Ap 3 (c) C

The experimental variable is

A the weight of the radish seedling.
B the growth of the radish seedling.
C the amount of light.
D the amount of moisture.

1c-8 17c Ap 3 (c) D *

A scientist wishes to make a generalization about his findings from this experiment.

Which of the following would be **least** useful for him to do?

A performing similar experiments with different types of seedlings
B repeating this experiment with a large number of radish seedlings
C continuing this experiment for a longer time period
D performing a similar experiment without bell jars

The next 3 items refer to the following information:

Oxygen is carried around the body by the blood, which is pumped by the heart. The body uses the oxygen to produce energy for various activities.

Look at the following table.

Activity	Volume of blood pumped out of the heart (litres per minute)	Total amount of oxygen used by the body (litres per minute)
Rest	5	0.25
Walking 3 km/h	10	0.8
Walking 8 km/h	20	2.5
Running 12 km/h	25	3.0
Extreme activity	34	4.0

1c-9
17b
An
2
(c)
D

Which of the following statements is most likely to be supported by the results in the table?

A As a person changes his or her activity from walking to running the heart beats faster but the volume of blood it pumps per minute stays the same.

B When the body is at rest no energy is being produced.

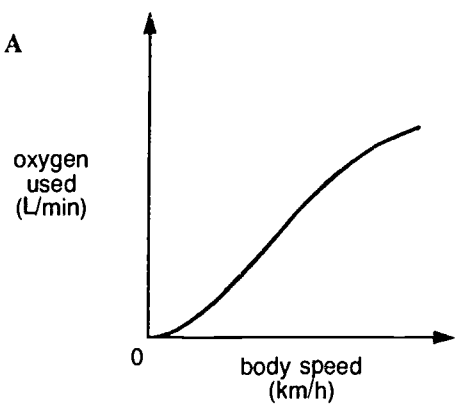
C The body requires 25 litres of oxygen per minute when running at 12 km/h.

D Walking at 5 km/h would require about 1.5 litres of oxygen per minute.

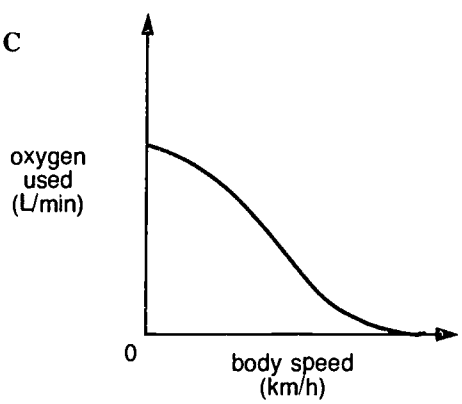
1c-10
17b
An
1
(c)
D

If a graph was drawn to relate the speed of movement of the body to the total amount of oxygen used, the graph would look most like:

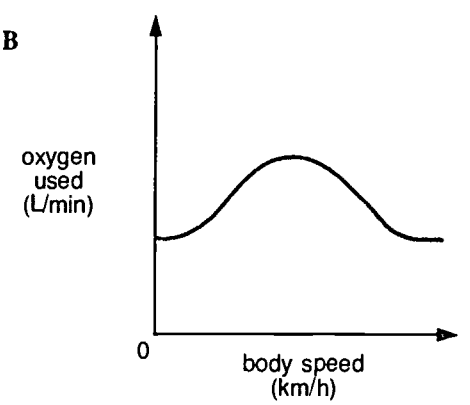
A



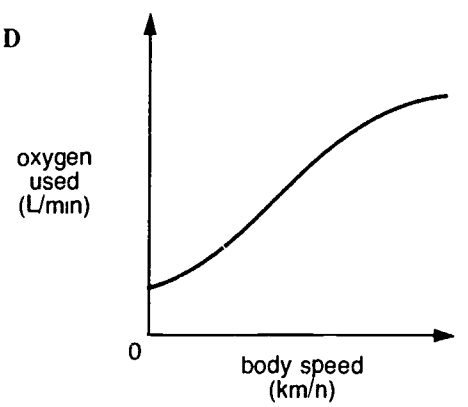
C



B



D



1c-11 17b An 3 (c) C

Which one of these statements does **not** follow from the table of results?

A When the body is at rest, one litre of oxygen in the blood would last for 4 minutes.

B As exercise increases, the total amount of oxygen used by the body increases at a faster rate than does the volume of blood pumped by the heart.

C The six litres of blood in the body can contain about one litre of oxygen.

D The table shows how fast oxygen is being used when the body is performing various tasks.

INCORRECT response items

1c-12 – Ap 3 (i) A

A new technique has been developed for transporting soft fruits e.g. bananas, pears and paw paws from the Carribean to Hong Kong through the hot temperatures of the tropics without using costly refrigeration to prevent over-ripening. This involves the use of 'Prolong', a spray which forms a protective skin on the fruit. It does not alter the flavour of the fruit, while reducing the rate of respiration and preventing loss of cell turgor.

The following properties of 'Prolong' would assist its success.

A allowing diffusion of oxygen into the fruit

B being insoluble in water and thus not being easily washed from the surface

C restricting the passage of water out of the fruit

D being composed of molecules too large to penetrate the skin of the fruit

2 THE VARIETY OF LIFE

Kinds of Organisms

2a—Speciation

CORRECT response items

2a-1
2b
Ap
3
(c)
A

Students on a field excursion were asked to collect various pieces of data on the plant *Tetratheca pilosa*. When the complete results were available, it was found that two students had each reported finding a plant on which one of the flowers had five petals instead of the usual four.

Of the following, which is the **best** conclusion regarding these observations?

A Slight variations in the number of petals may occur due to accidental changes during development.

B All plants having four petals produce some flowers with five petals.

C These flowers are actually the start of a new species and in a few years this group of plants will have formed two species.

D Unusual findings like this sometimes occur and can safely be disregarded.

2a-2
2d
An
3
(c)
A

Flowers of four different plant species have the characteristics listed below. Use them to decide which two plants are most closely related.

I blue, small petals 5, stamens 5, ovaries 2, borne on large-leafed tree

II white, large petals 5, stamens 5, ovaries 2, borne on small-leafed bush

III blue, large petals 4, stamens 4, ovary 1, borne on small-leafed bush

IV blue, small petals 4, stamens 10, ovaries 4, borne on large-leafed bush

In which one of the following pairs are the plants likely to be the most closely related?

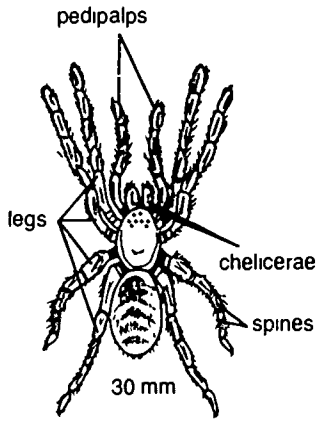
A I and II

B III and IV

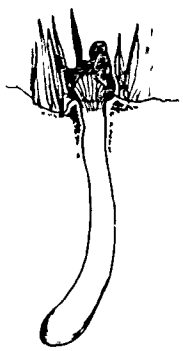
C II and III

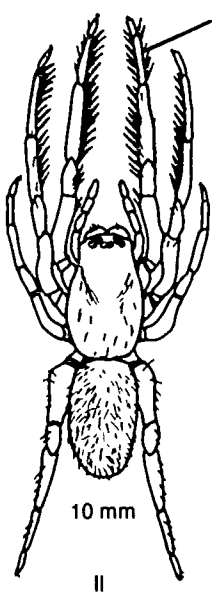
D I and IV

The next 3 items refer to the following diagrams and key:

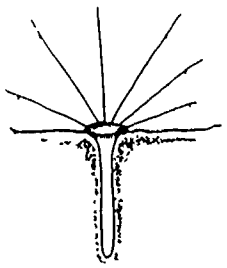


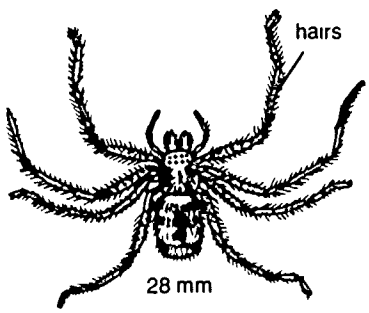
I





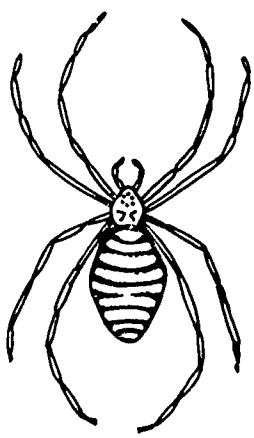
II





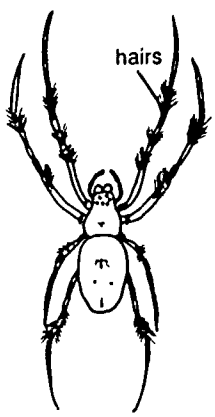
no web· lives under bark and stones

III



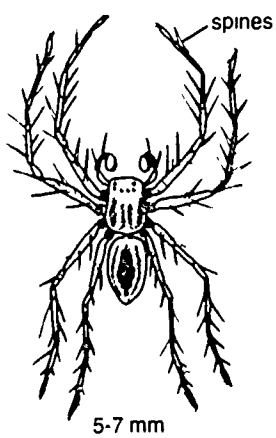
spins a web

IV



spins a web

V



hunter does not spin a web

VI

Key to Families

1(a) eight eyes present	go to 2
1(b) six eyes present	go to 3
2(a) pedipalps almost as long as walking legs	Ctenizidae
2(b) pedipalps much shorter than walking legs	Sparassidae
3(a) spins a web	Argiopidae
3(b) spins no web, or web is associated with a burrow	go to 4
4(a) chelicerae visible from above, few spines on legs	Dysderidae
4(b) chelicerae not visible from above, many spines on legs	Oxyopidae

2a-3 2b Co 4 (c) C *

Use the key to identify spider II. To which family does it belong?

A Sparassidae
B Argiopidae
C Dysderidae
D Oxyopidae

2a-5 2b Co 3 (c) C

Which two of the spiders illustrated are classified in the same family?

A I and II
B I and III
C IV and V
D V and VI

2a-6 2b Ap 4 (c) C

If you were asked to construct a completely new key to identify the six spiders with the same family level as before, which one of the following characteristics would you be **least** likely to include in your key?

A length of pedipalps
B type of web
C size of the spider
D arrangement of eyes

The next 3 items refer to the following information:

In 1977, a cricket-like insect about 5 cm long, was found in the Cooloola National Park, Queensland. The strange insect was unlike any seen before and was at first considered to be a fraud. However, the insect which became known as the 'Cooloola monster' was genuine. An adult specimen first observed had underdeveloped wings, very short antennae and legs modified for digging.

Other specimens located in the park and on Fraser Island had the same features. These specimens were male and lived most of their lives in burrows deep in sandy soils. But at night they were observed to come up to the surface, particularly when it was wet, and walk around in a curious stomping fashion. After more searching the females were located. They lived all their lives underground, were totally wingless, had a very large abdomen and much shorter, stouter legs than the males. They also showed some behavioural differences from the males. All other characteristics were common to both sexes.

The 'monster' was classified as *Cooloola propator.*

(From *Ecos* Spring 1982, No.33 page 32.)

2a-7 2c Ap 3 (c) B *

The male and female 'Cooloola monsters', despite their differences, were classified as members of the same species.

Which of the following statements is the best reason for this classification?

A Male and female members of the same species often look quite different.
B The male and female insects had many structural features in common.
C Since all the specimens found on the surface were males, those found underground were most likely to be females.
D Examination of the faeces of each revealed very similar diets.

2a-8
2c
Ap
3
(c)
C

Further investigations some time later located another 'Cooloola monster' in the Tableland near Dingo, Queensland. It was observed one wet night walking around with the characteristic stomping action of *C. propator*. It looked very similar but was smaller. A further 10 adult specimens were collected in the Dingo area, and the investigator observed that the predatory behaviour and diet of these specimens were different from that of *C. propator*.

The researcher classified the smaller 'Cooloola monster' as a second species of the genus *Cooloola*.

Which of the following factors would be the **primary** reason for their classification as separate species?

A geographic separation
B differences in diet
C structural differences
D differences in behaviour

2a-9
2c
Ap
3
(c)
D
*

The 'Cooloola monster' was placed in a new family on its own called the Cooloolidae. It was the first addition to the order Orthoptera at the family level for 75 years. On first appearance it could have been placed in the Gryllotalpidae, the 'mole' cricket family. Members of this family have their front legs modified for digging and many species can fly. Another family group which could have accommodated the 'monster' was the Cylindrichetidae. Members of this family of cricket like insects live underground, have no wings, their legs are quite short and their bodies are long and cylindrical.

The **best** reason for creating a new family is that

A no new families in the order Orthoptera had been designated for 75 years.
B depending on which features were considered, it could have been placed in either of the existing families.
C a previously undiscovered insect requires a new family for correct classification.
D many of its structural features were very different from those of existing families.

INCORRECT response items

2a-10
2c
Co
2
(i)
C

When confronted with up to 1 million different kinds of organisms biologists have found it necessary to classify these organisms into groups.

Classification of organisms

A can be based on almost any characteristic.
B succeeds more often if structural characteristics are used.
C demonstrates that possession of one common characteristic is usually sufficient for classification.
D shows that common structural features are associated with common functions and types of behaviour.

2b—Identifying and describing species

CORRECT response items

2b-1 2a Co 1 (c) B

In an area of the African section of the Western Plains Zoo at Dubbo, it has been observed that male zebras patiently track female rhinoceroses during periods of sexual arousement. They will even compete with male rhinos in an attempt to attract the female rhino.

(*Biology in Action*, No.4, June 1982).

The zebra and rhinoceros could be regarded as members of the same species if they

A live naturally in the same geographical area.
B mate and produce offspring that can interbreed successfully.
C are attracted to each other in their natural environment.
D have some common structural features that are very similar.

The next 2 items refer to the following information:

In Victoria the mountain ash is *Eucalyptus regnans.*
In Tasmania the swamp gum is *E. regnans.*
In Victoria the swamp gum is *E. ovata.*
In Britain the mountain ash or rowan is *Sorbus aucuparia.*
In Britain the ash is *Fraxinus excelsior.*

2b-2 2e Co 2 (c) D

In which one of the following are the trees of the same species?

A *S. aucuparia* and *E. regnans*
B *E. ovata* and *E. regnans*
C the British mountain ash and Victorian mountain ash
D the Victorian mountain ash and the Tasmanian swamp gum

2b-3 2e Ap 3 (c) C

Which one of the following comparisons is correct?

A *S. aucuparia* and *F. excelsior* differ only in their habitats.
B Since *Sorbus* and *Fraxinus* are both ash trees they are members of the same family.
C The Tasmanian and Victorian swamp gums cannot be the same species.
D Since mountain ash is an alternative name for rowan and swamp gum they must have similar habitats.

2b-4 – Ap 1 (c) C *

An amateur bird watcher sighted two robins which were both black, red and white in colour, but one had red head feathers and the other had black head feathers. One robin was male and one was female. The birdwatcher was unsure whether or not they belonged to the same species.

In order to be certain, he would need to

A determine whether the two robins would mate, under natural conditions.
B refer to a catalogue of type specimens of robin species.
C determine whether the offspring produced by the mating of these two robins could themselves produce offspring.
D refer to preserved specimens of robins which had been collected and labelled by experts.

2b-5 – Ap 2 (c) C

A taxonomist found a population of gum trees in which the individual trees did not appear to be significantly different from trees named *Eucalyptus baxteri*, he therefore identified the new population as *Eucalyptus baxteri*. It was subsequently found that interbreeding was not able to occur between the new population and other trees positively identified as *Eucalyptus baxteri*.

The most appropriate next step for the taxonomist would be to

A discard the name *baxteri* for both the original population and the newly found population.
B create a new genus and species for the newly found population.
C give the more recently named population another species name.
D look for trees able to interbreed with both populations.

2b-6 2c Ap 2 (c) D

In which one of the following pairs would the two plants have most characteristics in common?

A *Ehrharta longiflora* and *Epacris longiflora*
B *Epacris lanuginosa* and *Erica lusitanica*
C *Epacris longiflora* and *Erica longifolia*
D *Ehrharta distichophylla* and *Ehrharta longiflora*

2b-7 – Ap 3 (c) C

Euglena is an organism with the following characteristics:

I can be found in freshwater, marine and land habitats;
II consists of a single cell, 100 micrometres long, with a flexible outer covering;
III possesses a whip-like flagellum for movement;
IV contains chloroplasts when living in light;
V can survive if light is not available.

Biologists cannot agree on whether *Euglena* should be classified as a plant or an animal.

Which of the following sets of characteristics, considered apart from the others, would **best** suggest that *Euglena* be classified as an **animal**?

A I, II and III
B I, III and V
C II, III and IV
D II, III and V

2b-8 – Ap 4 (c) C

Whilst passing through a sparse area of woods and grasslands we found the Mermecolion, a marvellous hybrid of the lion and ant. Its generation is caused by the seed (sperm) of the lion falling on the ground and impregnating the eggs of ants.

Although it has a ferocious appearance, the Mermecolion is harmless as it is very short lived being unable to find suitable nourishment because of its hybrid nature.

A modern-day biology student reading this passage would accept that

A harmlessness is related to length of life.
B hybrid organisms find it difficult to obtain suitable food.
C lions can produce offspring by interbreeding with another species.
D the lion and ant should be considered members of the same species because they can produce offspring.

2b-9
2c
Ap
3
(c)
B

The barramundi, a fish found in the waters of northern Australia, is scientifically named *Lates calcarifer*.

According to the rules of biological nomenclature the name

A *calcarifer* cannot be used for any other type of fish.
B *calcarifer* can be used for an organism in a genus other than *Lates*.
C *Lates* can only be used again in a different phylum.
D *Lates* cannot be used with any other species name.

INCORRECT response items

2b-10
–
Co
1
(i)
B

A useful classification system has the following properties:

A It aids the thinking of and communication between scientists.
B It may lead to different names for the same organism.
C It is widely accepted by the scientific community.
D It groups structurally similar organisms at the various levels.

2b-11
–
Co
2
(i)
D

In order to find the specific name of a species in the wild, a biologist would need to have

A access to handbooks and field guides of organisms of that area.
B a general idea of the type of organism being dealt with.
C some idea of the use of a classification key.
D a detailed knowledge of all phyla present in the area.

2b-12
–
Co
2
(i)
A
*

A taxonomist has the important task of identifying and describing new species.

The taxonomist must

A have a detailed knowledge of the functioning of that organism.
B show that some characteristics are consistently different from those of related species.
C provide a detailed description and an appropriate scientific name for the organism.
D be reasonably sure that the different characteristics are not just slight modifications within one species.

2b-13
–
Co
4
(i)
D
*

A biologist found a group of organisms X which were similar to a known species Y, but which differed from individuals of species Y in some aspects of colour, pattern, shape and size.

Before the biologist could be sure that the group X was a 'new' separate species he would need to determine whether

A the breeding seasons overlapped.
B members of the group X would mate with members of species Y.
C the offspring of a cross between an organism X and a member of species Y would interbreed.
D the group had been described and named by another biologist.

2b-14
–
Co
3
(i)
C

The following are established and accepted rules about applying scientific names to organisms.

A A species name consists of two words.
B The same generic name may be applied to several different kinds of organism.
C A specific name may be used more than once within each genus.
D The generic name must start with a capital letter.

2c—Classifying species

CORRECT response items

2c-1
2d
Co
2
(c)
B

A frog was examined by two biologists and each biologist placed it in a different family.

Which one of the following is the **most likely** reason for this disagreement?

A One biologist observed the frog in much more detail than the other biologist did.

B There is a difference of opinion as to which characteristics should be used in classification.

C One biologist compared the frog with frogs from locality X, the other biologist compared it with frogs from locality Y.

D The biologists disagreed about the details of the life cycle of the frog.

2c-2
–
Co
2
(c)
D
*

Two biologists classified a particular animal into different species, even though they were using the same biological key.

The **most likely** reason is that

A one of the biologists had seen the animal before and the other had not.

B the key was not dichotomous and therefore inaccuracies crept in.

C the key did not include labelled diagrams of type specimens.

D the characteristics used in the key could be interpreted differently.

2c-3
–
Co
3
(c)
D

The Australian National Insect Collection kept in Canberra is a collection of about 5 million insect specimens, representing about 70 000 different species.

Which of the following would be **least** likely to be a purpose of such a collection of organisms?

A to help in the identification of organisms

B to preserve killed specimens before the species become extinct

C to help demonstrate relationships between organisms

D to provide a source of organisms for experimentation

2c-4
17k
Co
3
(c)
A

Scientists sometimes disagree about the correct classification for a particular organism.

The main reason is that

A the categories into which organisms are placed are artificial and are subject to different interpretations by different people.

B organisms are changing at the present time, so that some members of a species will be highly developed, while others will show very primitive characteristics.

C organisms are given different names in different districts or countries and so will naturally be classified differently.

D the characteristics considered important by one scientist may not be present in those members of the species being studied by other scientists.

Classification

2d—Classifying animals

CORRECT response items

2d-1 1b Kn 2 (c) B

A student observing an unfamiliar organism had difficulty in deciding whether the organism should be called a plant or an animal.

Which one of the following pieces of information about the organism would be of greatest value to the student in solving this problem?

A details about the place where the organism lives
B the way in which the organism obtains its food
C whether the organism responds to stimuli
D whether the organism is capable of movement

2d-2 – Co 2 (c) C *

Which of the following groups contains organisms that are **most** closely related?

A shellfish, cat fish, silver fish
B sea snake, eel, alligator
C possum, bat, whale
D green tree frog, lizard, cane toad

2d-3 – Co 2 (c) B

A zoologist returned from a trip to Central Australia with an unidentified animal he had found. His report read:

> The animal is 5 cm long with 4 appendages. Its body is devoid of body cover except for a thin pink skin. It is nocturnal and sleeps with its whiskered snout tucked between its back legs.

From this report, the animal appears to be

A a mollusc.
B a mammal.
C a reptile.
D an amphibian.

The next 2 items refer to the following information:

Consider three animals

a crustacean:	*Anasphides spinulae*
a crustacean:	*Anasphides tasmaniae*
an insect:	*Diphlebia lestoides*

2d-4 2c Co 3 (c) C *

We can say that these three animals are in

A the same family but are different species.
B the same class but in different families.
C the same phylum but are three different species.
D the same phylum but in three different genera.

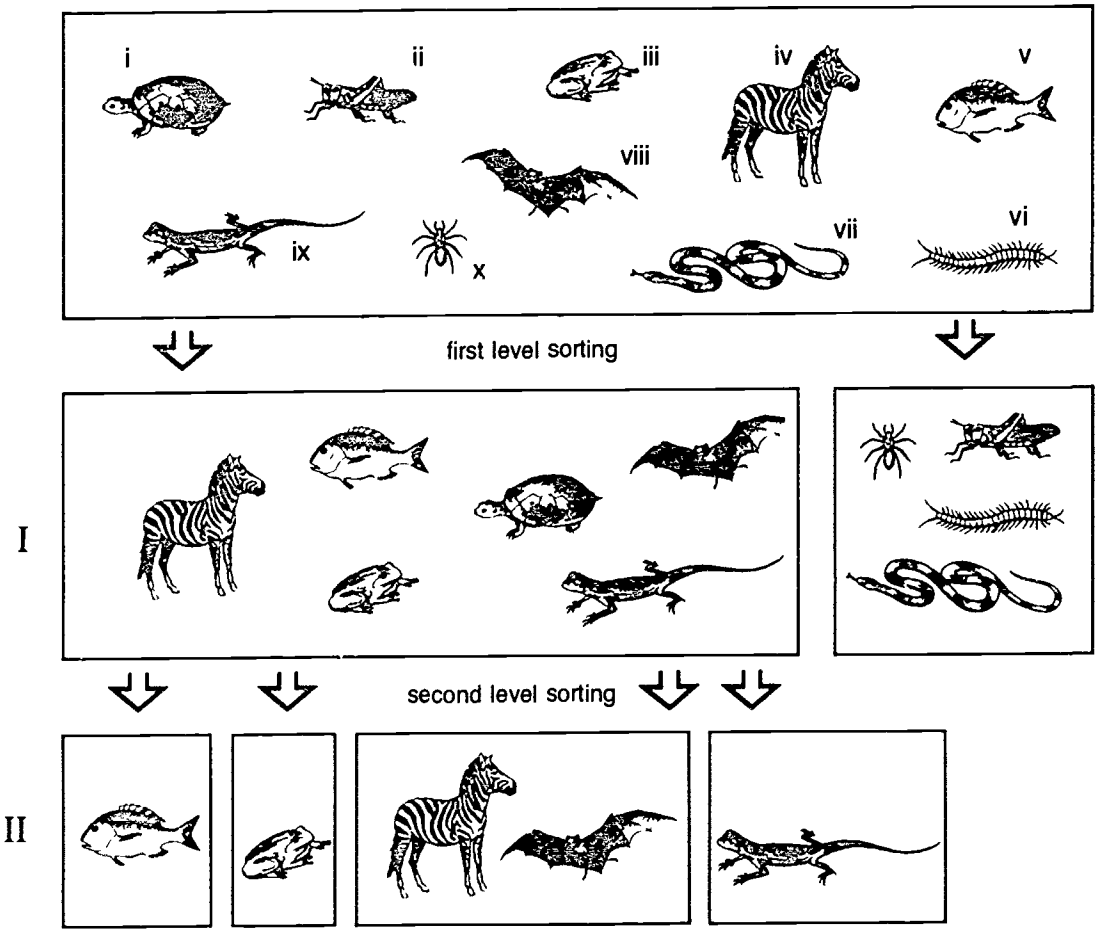
2d-5 2c Co 4 (c) B *

If *Anasphides tasmaniae* was for some reason later placed in a separate family from *A. spinulae*, these two crustaceans would then

A retain the same generic name but be in different families.
B be in two distinct families and two distinct genera.
C continue to be in the same phylum but be in different classes.
D continue to be considered as closely related as before but have distinct generic names.

The next 6 items refer to the following information:

A student was asked to sort a set of animals, with the following results:



2d-6 In the first-level sorting, the student has incorrectly classified animal

--
Co
2
(c)
C

A II.
B V.
C VII.
D IX.

2d-7 Considering the first level sorting, the student probably attempted to sort according to

-
Ap
3
(c)
C

A structures used in reproduction.
B the type of outer body cover.
C presence or absence of an internal skeleton.
D the type of body symmetry.

2d-8 The results of a second-level sorting produces four groups.

– Co 3 (c) D This level of classification sorts animals into

A phyla.
B orders.
C families.
D classes.

2d-9 Animal VIII is classified as a mammal.

– Kn 2 (c) C The least important reason for placing it in such a group is

A the possession of mammary glands.
B the outer body cover of hair.
C the ability to move by flying.
D the presence of four kinds of teeth.

2d-10 The most important distinguishing feature used to place animals II and VI in the same group is

– Co 3 (c) A

A the presence of a jointed body cover and limbs.
B the presence of feelers used as sensory organs.
C the presence of more than two pairs of legs.
D the ability to move by walking.

2d-11 Animals IV and VIII are placed in the same group and are called placental mammals.

– Kn 2 (c) B This is because the animals

A feed their young on milk from mammary glands.
B nourish the developing young inside the female's body.
C care for the developing young in a pouch.
D lay eggs from which the young hatch.

2d-12 Which of the following organisms would have a dorsal nerve cord and a ventral heart?

– Co 3 (c) B *

A earthworm
B rat
C cray fish
D sea urchin

2d-13 A particular single-celled organism has the following characteristics:

2c Co 4 (c) B

I a whip-like flagellum used for locomotion;
II a light-sensitive eye-spot containing a pigment found elsewhere in the Phylum Arthropoda;
III a flexible cell covering which enables the organism to change shape;
IV large chloroplasts.

If a scientist classified this organism into the 'animal kingdom' which of the above characteristics would support his classification?

A I, II, III, and IV
B I, II, and III only
C I and III only
D I and II only

The next 3 items refer to the following information:

Phylum Annelida

Marine, freshwater, or terrestrial. Bilaterally symmetrical. Body internally and externally segmented. Appendages either not jointed or lacking.

Phylum Arthropoda

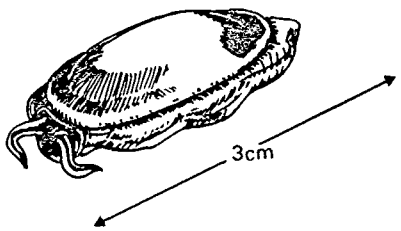
Marine, freshwater, or terrestrial. Bilaterally symmetrical. Body segmented, but segments often fused. Jointed appendages. Jointed exoskeleton.

Phylum Mollusca

Marine, freshwater, or terrestrial. Bilaterally symmetrical or unsymmetrical. There is usually a limy shell which may be external or internal. No segmentation.

Phylum Echinodermata

All marine. Adults radially symmetrical, radiating sections (when present) are called 'arms'. Internal limy skeleton.



2d-14 – Co 1 (c) C To which phylum does the animal in the above drawing belong?

A Annelida
B Arthropoda
C Mollusca
D Echinodermata

2d-15 – Co 2 (c) D Another animal was found in the same rock pool as the animal in the drawing above. It had an internal limy supporting structure.

It would probably be correctly classified in the phylum

A Arthropoda.
B Mollusca.
C Arthropoda or Mollusca.
D Mollusca or Echinodermata.

2d-16 – Co 2 (c) A A terrestrial animal was found that was bilaterally symmetrical, unsegmented, and had no visible skeleton.

In which one of the following phyla could it be correctly classified?

A Mollusca
B Annelida
C Arthropoda
D Echinodermata

The next 2 items refer to the following table:

Level	Animal I	Animal II	Animal III
Phylum	*Chordata*		
Class	*Mammalia*		
Order	*Carnivora*		
Family	*Canidae*	*Canidae*	
Genus	*Canis*	*Vulpes*	*Canis*
Species	*familiaris*	*vulpes*	*lupus*

2d-17 Which animal(s) belong(s) to the Order Carnivora?

–
Co
2
(c)
D
*

A I
B I and II
C I and III
D I, II and III.

2d-18 Any animal which belongs to the Class Mammalia must also belong to the

–
Co
2
(c)
A
*

A Phylum Chordata.
B Order Carnivora.
C Order Carnivora and the Family Canidae.
D Phylum Chordata, the Order Carnivora and the Family Canidae.

2d-19 What relationship would you expect between the number of families of the Order Coleoptera and the number of genera of the Order Coleoptera?

2c
Co
3
(c)
B
*

A There would be more families than genera.
B There would be more genera than families.
C There were be about the same number of families as genera.
D It would be necessary to know the number of species of Coleoptera to decide between A, B, and C.

2d-20 Consider the following five types of organisms.

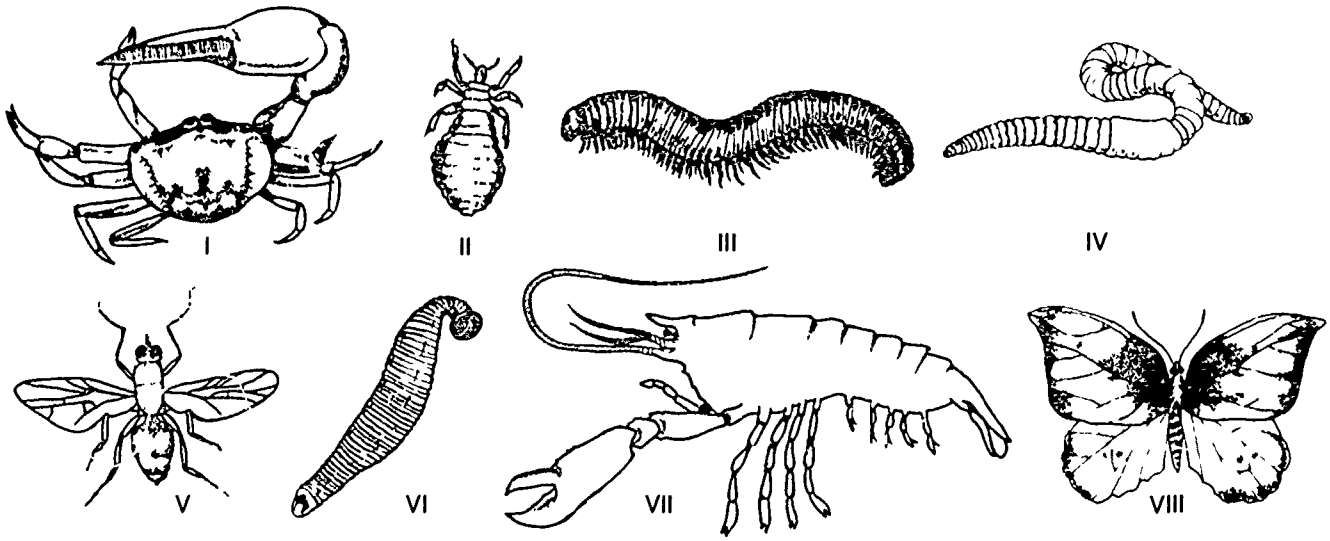
2f
Ap
3
(c)
B

I decay causing bacteria
II photosynthesizing bacteria
III mould fungi
IV flowering plants
V animals

If these organisms are classified into two groups on the basis of their type of nutrition, which arrangement **best** shows this classification?

	Group 1	*Group 2*
A	I and II	III, IV, and V
B	I, III, and V	II and IV
C	I, II, and III	IV and V
D	I, II, III, and IV	V

The next 2 items refer to the following diagrams:



2d-21 2c Co 3 (c) A

Which one of the following characteristics could be used to classify the eight organisms into two groups?

A presence or absence of jointed appendages
B bilateral or radial symmetry
C presence or absence of body segmentation
D presence or absence of tentacles

2d-22 2c Ap 4 (c) C

Examine the eight organisms carefully.

Which of the following pairs would **not** be classified in the same class?

A I and VII
B II and VIII
C III and IV
D V and VIII

2d-23 – Ap 3 (c) A *

Some biologists classify two groups of Australian parrots on the criterion that the members of one group scratch their heads by reaching over the wing with the foot while the members of the other group reach under the wing.

Which of the following statements is correct?

A This is a valid taxonomic feature because the behaviour is inherited.
B This is not a valid taxonomic feature because it can only be observed in live animals.
C This is a valid taxonomic feature because the two types would live in different areas.
D This is not a valid taxonomic feature because only structural features can be used to classify organisms.

INCORRECT response items

2d-24 When considering organisms of the Phyla Chordata and Arthropoda,

Kn 2 (i) D

A they have different types of skeleton.
B they both possess a nerve cord.
C most Arthropods have segmented bodies.
D the Arthropod nerve cord is dorsal.

2d-25 The classification of animals uses mainly structural features to distinguish the various groups from each other.

Kn 3 (i) B *

The members of the Class Mammalia have the following features in common.

A hair on the body surface
B a placenta for nourishment of young before birth
C mammary glands to nourish the young after birth
D a back bone to protect the nerve cord

2d-26 The following criteria are used extensively to classify organisms into the Phylum Arthropoda.

Kn 2 (i) C

A presence of body segmentation
B type of appendages
C possession of a dorsal nerve cord
D possession of an exoskeleton

2e—Classification of plants

CORRECT response items

2e-1 – Kn 1 (c) D *

The main part of the body of a fungus which is essential for breakdown and absorption of food material is the

A spore.
B fruiting body.
C cap.
D mycelium.

2e-2 10e Kn 2 (c) C *

Ferns and mosses are both regarded as being primitive plants.

The main difference between these two groups is that

A mosses reproduce by spores, whereas ferns have seeds.
B mosses occur mostly in moist places, whereas ferns are usually found in dry places.
C mosses do not possess well-developed conducting tissues, whereas ferns have distinct roots, stems, and leaves.
D mosses are autotrophic organisms, whereas ferns are heterotrophic organisms.

2e-3 – Kn 2 (c) C

Lichens are not usually classified into a phylum.

The reason for this is that

A they vary in colour (black, orange, grey, green).
B some are leaf-like while others form a flat crust on rocks.
C the body of the lichen is made up of fungal hyphae and algae.
D they are found in an extremely wide variety of environments from the equator to the Antarctic.

2e-4 2d Ap 2 (c) D

The following table lists some characteristics of four organisms. A tick (✓) indicates that these characterisitcs have been observed.

Organism	Characteristic				
	Movement of whole organism (motile)	Reproduction by spores	Autotrophic	Heterotrophic	Cell wall
W (1st stage of life cycle)	✓			✓	
(2nd stage of life cycle)		✓		✓	✓
X	✓		✓		
Y			✓		✓
Z				✓	

From these observations, which of the following is true?

A Organism W is an animal.
B Organism X is a plant.
C Organism Y could be either a plant or an animal.
D Organism Z could be an animal.

2e-5 One of the main reasons for the small size of mosses is that

– Kn 2 (c) D

A because they grow in very wet places, they are unable to get sufficient oxygen for growing into large plants.

B they cannot produce food materials for themselves, but must obtain them from the environment in which they are growing.

C the amount of soil in which they grow is not able to supply enough minerals for a larger plant.

D they have no special tissues to transport water, minerals, and food materials throughout the plant.

The next 3 items refer to the following information:

A biologist interested in taxonomy visited a strange land where people were divided according to whether or not they knew their biological facts. Those that knew them were classified into Kingdom Sapientia. Those that did not were classified with the plants into Kingdom Vegientia.

The people wished to classify further the members of these kingdoms, but were not sure of the best method. So the taxonomist taught them the classification that is used by today's bright biology students, taking as an example a nearby organism that he named *Puella biologica*.

2e-6 In the classification of this organism,

2c Ap 2 (c) C

A *Puella* is the specific name, *biologica* the generic name.

B *Puella* is the generic name, *biologica* the varietal name.

C *Puella* is the generic name, *biologica* the specific name.

D *Puella* is the specific name, *biologica* the varietal name.

The next 2 items refer to the following ADDITIONAL information:

To see if the people really understood his lesson, the taxonomist gave four combinations of words that could be used to further classify the organism *Puella biologica*. The combinations he gave were:

	Phylum	*Class*	*Family*
I	Educophyta	Pupilopsida	Ecolaceae
II	Educophyta	Pupilia	Ecolaceae
III	Educata	Pupilopsida	Ecolidae
IV	Educata	Pupilia	Ecolidae

2e-7 If *Puella biologica* were a plant of the Kingdom Vegientia, it would be further classified by the combination

2c Ap 4 (c) A

A I.
B II.
C III.
D IV.

2e-8 However, if *Puella biologica* were an animal of the Kingdom Sapientia, it would be classified by the combination

2c Ap 3 (c) D

A I.
B II.
C III.
D IV.

2e-9
2a
Co
2
(c)
A
*

Greater diversity of flower structure would be expected between the various members of a genus than between the members of

A a species.
B a family.
C an order.
D a phylum or division.

2e-10
2a
Co
3
(c)
B
*

Two flowering plants are classified into the same genus.

This means that they would be classified in

A different families.
B the same class and the same order.
C the same class but different orders.
D the same order but different classes.

INCORRECT response items

2e-11
–
Kn
3
(i)
D
*

A botanist could distinguish monocotyledons from dicotyledons by comparing

A seed structure.
B leaf veins.
C number of flower parts.
D position of ovary.

2e-12
–
Kn
3
(i)
C
*

The following plants are all members of the group of plants called gymnosperms.

A cycads
B conifers
C palms
D ginkgos

2e-13
–
Kn
3
(i)
D

When comparing two general groups of plants—Phylum Tracheophyta (vascular plants) and Phylum Bryophyta (mosses and liverworts), obvious structural differences are seen.

These differences include

A true roots, stems and leaves possessed by Tracheophytes but lacking in Bryophytes.
B the size of the plants, Tracheophytes generally being considerably larger than Bryophytes.
C possession of a well developed internal transport system in Tracheophytes but not in Bryophytes.
D reproduction only by seeds in Tracheophytes, compared with only spores in Bryophytes.

2e-14
2f
Kn
4
(i)
C

Fungi are usually classified as plants because of the plant-like characteristics they possess, including

A reproduction by spores.
B growth of fruiting bodies.
C using light in food manufacture.
D possession of distinct cell walls.

2e-15
–
Co
3
(i)
C

Lichens are likely to be found growing

A on a rock without a trace of soil.
B on other plants such as trees.
C in a cave into which no light enters.
D on a painted fence.

2f—Microorganisms

CORRECT response items

2f-1 17g Kn 2 (c) D

Several students were required to use sterile water during a practical exercise, but each disagreed with the others as to a convenient source.

Who made the **best** suggestion?

A Dave suggested water from the laboratory bottle of distilled water.
B Audrey suggested water which had been boiled in a beaker and allowed to cool.
C Jeff suggested water from the rainwater tank.
D Eileen suggested water boiled in a pressure cooker and cooled while the lid is still on.

The next 2 items refer to the following information:

A petri dish containing nutrient agar was left exposed to the air for a number of hours and then incubated at 37 °C for a few days. At the end of this time a number of round furry patches and many small round shiny patches could be seen growing on the surface of the agar.

2f-2 – Kn 2 (c) C

The round furry patches are most likely

A bacterial colonies.
B viral colonies.
C mould fungi.
D yeast growth.

2f-3 – Kn 2 (c) A

The small shiny patches are most likely

A bacterial colonies.
B mould spores.
C fungal secretions.
D viral colonies.

2f-4 17g Kn 2 (c) D

In microbiology, sterility means the absence of all living organisms. Although 100 °C is well above the heat required to break down protein, heating to 100 °C cannot ensure sterility.

This is because

A bacteria are extremely small in size.
B viruses do not contain protein.
C spherical bacteria are resistant to 100 °C heat.
D some bacteria can form resistant spores.

2f-5 – Kn 2 (c) C

A petri dish containing a nutrient agar medium was exposed to dust-laden air for several minutes and then incubated at 25 °C. After 48 hours several tiny bacterial colonies appeared, about the size of a pin's head. The colonies continued to grow in diameter until, after four days, no further increase in size could be detected.

The best explanation for these observations is that

A after four days the number of bacteria dying remains constant.
B bacteria have a short life span and all are dead after four days.
C the conditions in the agar have been changed by the bacteria and are now unsuitable for their growth.
D bacterial colonies can grow only to a certain maximum size and it takes about four days to reach that size.

2f-6 – Kn 3 (c) C

Photosynthetic and chemosynthetic bacteria would resemble each other in that they both

A require sunlight for their continued existence.
B utilize the carbon dioxide in their environment.
C convert inorganic material to organic material.
D give off oxygen as a product of cellular respiration.

2f-7 – Kn 3 (c) A

Some bacteria are able to carry out photosynthesis, others chemosynthesis.

These two groups are alike because both

A are able to manufacture 'food'.
B possess chlorophyll.
C require light to survive.
D are completely independent of other living organisms.

2f-8 – Kn 3 (c) A

Yeasts are single-celled organisms that are widespread in nature and used in the processes of brewing and baking.

Yeasts are classified as

A fungi.
B viruses.
C bacteria.
D rickettsias.

2f-9 – Kn 5 (c) B *

A biologist isolated a rod shaped microorganism that was only just visible using a light microscope. Tests showed that the organism could only be grown inside a living cell.

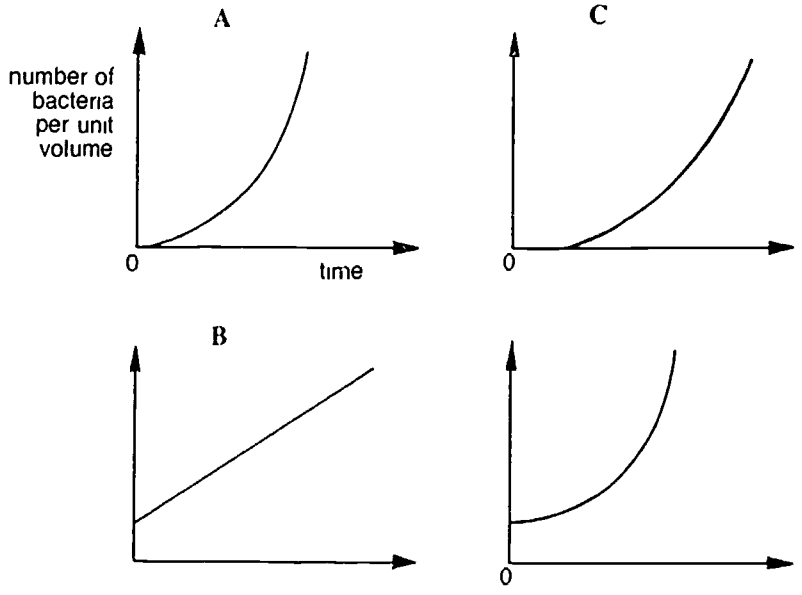
It would be reasonable to conclude that this organism was a

A blue-green bacterium.
B rickettsia.
C slime mould plasmodium.
D virus.

2f-10 6b Co 4 (c) D

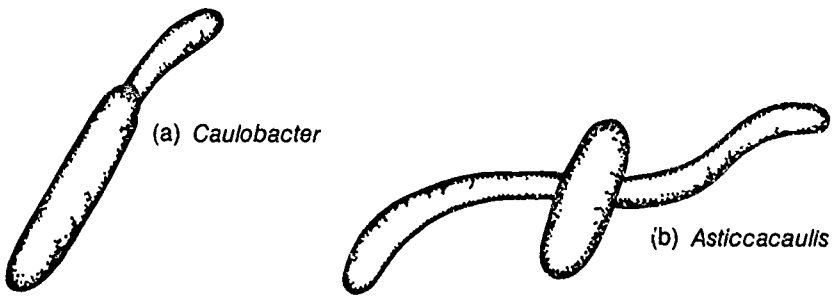
A bacterium divided in 15 minutes into two separate bacteria, these again divided in a further 15 minutes. After inoculating a broth culture with a number of the dividing cells, samples were taken every 15 minutes and the results were plotted on a graph.

Which of the following best represents the graph that would be obtained?



The next 2 items refer to the following information:

Bacteria are one of the simplest forms of cellular life, but there is a considerable diversity in shape and appearance. Some bacteria have been found which possess long stalks e.g. *Caulobacter* (a) has one stalk, *Asticcacaulis* (b) sometimes two.



2f-11 – Co 3 (c) D

The function of the stalks may be in reproduction where small buiges form at the tip, break off, and swim away.

This process is an example of

A binary fission.
B spore formation.
C sexual reproduction.
D budding.

2f-12 – Kn 2 (c) C

Which one of the following characteristics would *Caulobacter* and *Asticcacaulis* have in common with other bacterial species?

A size
B shape
C unicellular structure
D food requirements

2f-13 – Co 2 (c) B

Microorganisms were known to exist for nearly 200 years before surgeons started to use antiseptics on a regular basis.

This delay was due to the

A lack of effective antiseptics.
B failure to associate disease with microorganisms.
C difficulties in classifying microorganisms.
D failure to identify microorganisms as living things.

2f-14 – Co 3 (c) C

Although it is difficult to recognize the presence of viruses in healthy human skin, it is unlikely that viruses can grow in the outer layers because

A glands secrete oil onto the upper layers of the skin.
B the skin's surface temperature is unsuitable for viruses.
C the upper layers of the skin contain dead cells only.
D the fine hairs of the skin act as an effective barrier.

The next 5 items refer to the following information:

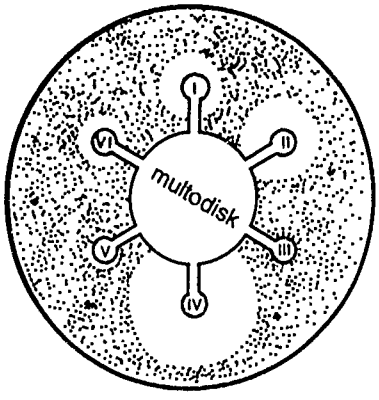
The sensitivity of bacteria to different antibiotics and drugs can be tested by the use of paper discs soaked in antibacterial chemicals. These can be placed on an agar plate which has been exposed to the bacterium being studied.

A multodisk is made of sterile filter paper with the tip of each arm soaked in a different antibacterial chemical. After exposure to the bacterium, the subsequent growth on the agar plate is observed.

Below is a typical example.

I tetracycline II chloramphenicol III erythromycin

IV sulphafurazole V penicillin G VI streptomycin



2f-15 Each of the spots growing on the agar plate represents a

7c Kn 3 (c) C

A bacterium.
B spore.
C colony.
D virus.

2f-16 The clear zones which surround the arms of the disc vary in size because

7c Ap 2 (c) B

A the chemicals diffuse from the discs at different rates.
B the bacterium has a different sensitivity to each of the chemicals.
C the bacteria have grown at different speeds over the surface of the plate.
D the chemical-soaked arms are in different positions on the plate.

2f-17 The clear zones are circular in each case because

7c Co 3 (c) A

A the chemical diffuses radially from the tip of each arm.
B the bacterium is sensitive to and will not grow near the sterile filter paper.
C the species of bacterium always grows in regular circular patterns.
D the bacterium grows in a regular pattern towards the tip of each arm.

2f-18 To which chemical is the bacterium most sensitive?

7c Co 1 (c) C

A tetracycline (I)
B erythromycin (III)
C sulphafurazole (IV)
D penicillin (V)

2f-19 To which chemical is the bacterium most resistant?

7c Co 1 (c) B

A tetracycline (I)
B erythromycin (III)
C sulphafurazole (IV)
D penicillin (V)

2f-20 Consider the following groups of organisms:

2d Ap 4 (c) D

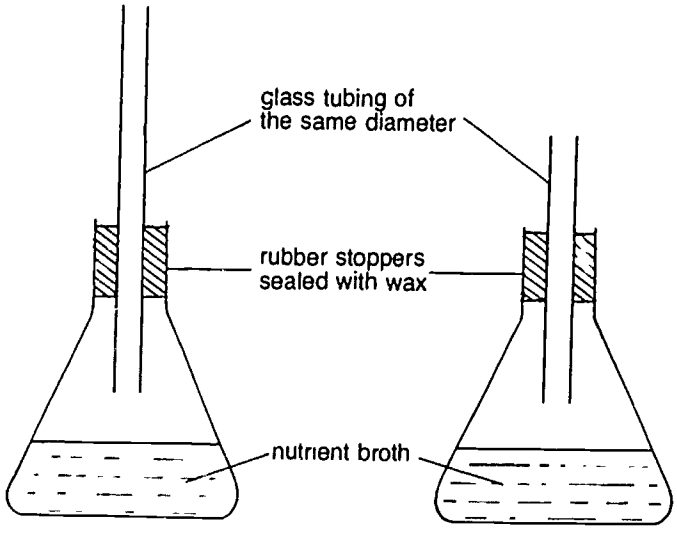
I grasses
II dogs
III amoebae
IV blue-green algae
V slime moulds
VI eucalypt trees

Which of the following alternatives correctly divides them into two (2) groups on the basis of their nutrition?

A I,V,VI and II, III, IV.
B III, IV, V and I, II, VI.
C I, IV, V, VI and II, III.
D I, IV, VI and II, III, V.

2f-21 17b An 1 (c) B

During a class experiment, one group of students set up the apparatus on the left and a second group set up the one on the right. Both flasks were autoclaved together and left for 3 weeks. At the end of this time there was a bacterial suspension in the flask with the short tube but none in the flask with the long tube.

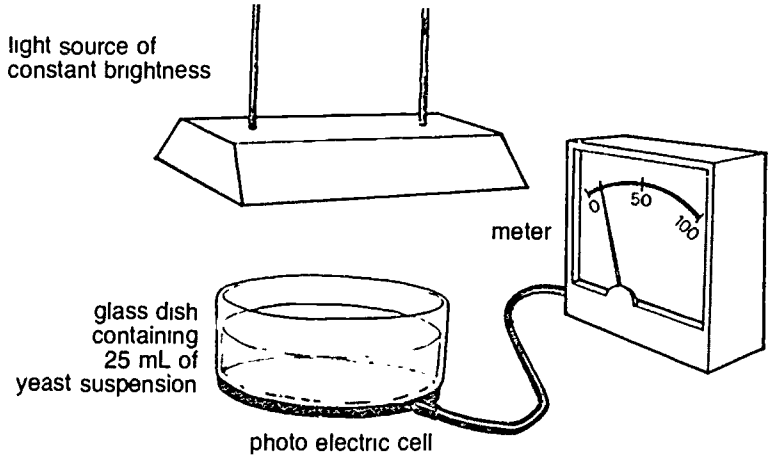


In searching for a reason for the difference, which one of the following hypotheses would be the **most** appropriate to test?

A Short tubes cause infection while long tubes keep flasks sterile.
B The length of the glass tubing affects the chances of bacteria reaching the broth.
C The flask with the shorter length of tube in the original experiment was not sterilized correctly.
D A flask with an infinitely long glass tube will never become infected.

The next 5 items refer to the following information:

Using a photoelectric cell attached to a meter, it is possible to measure the rate at which yeast cells reproduce under different experimental conditions. The figure below shows the arrangement of the apparatus.



The determination of this rate involves two procedures.

Procedure 1

Eight separate samples of yeast suspension were prepared containing 1, 2, 3, 4, 5, 6, 7, and 8 grams of dry yeast mixed thoroughly with 250 mL of pure water. Standard sized glass dishes containing 25 mL portions of each suspension were taken and placed, in turn, on the photoelectric cell. Meter readings indicate the amount of light transmitted through the yeast suspensions, these are given in Table 1.

Table 1

Dry wt of yeast in g/250 mL water	0	1	2	3	4	5	6	7	8
Light meter reading (arbitrary scale)*	93	84	76	69	64	61	58	56	55

* Each entry is the average of six separate readings.

Procedure 2

Three glucose solution were prepared. (Glucose dissolves in water to form a colourless solution.)

The first contains 18 g of glucose/1000 mL of solution; the second 36 g/1000 mL; and the third 54 g/1000 mL.

One litre (i.e. 1000 mL) of each solution is prepared, and 4 g of yeast are added to each litre. A sample of 25 mL of each mixture is then placed in separate glass dishes.

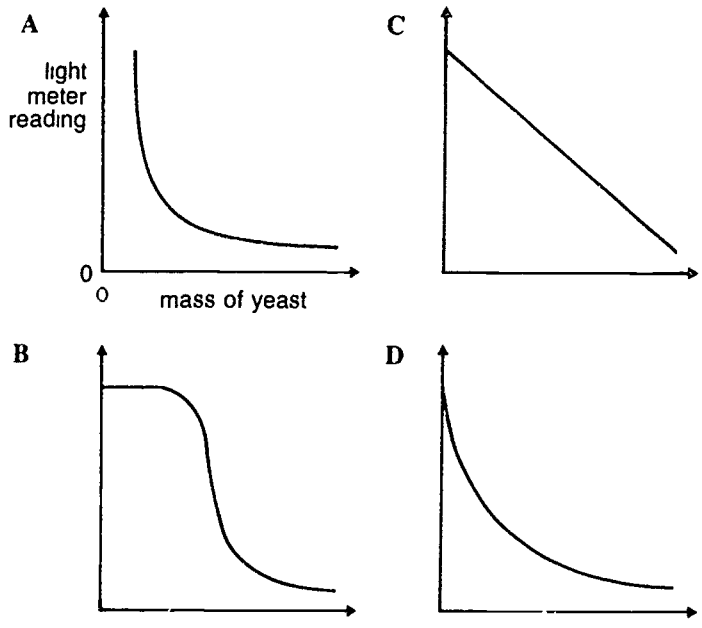
Measurements are made over a period of 12 days, using the same experimental arrangements as in Procedure 1. Some results are shown in Table 2.

Table 2

Time (days)	Meter reading*		
	1st solution	2nd solution	3rd solution
3	81	82	83
6	77	79	74
9	73	71	69
12	72	70	68

* Each entry is the average of six separate readings.

2f-22 Which of the following graphs **best** represents the relationship between the measurements in 17b Procedure 1?
Co
2
(c)
D



2f-23 The best explanation of the results of Procedure 1 is that
17b
Ap
2
(c)
D

A light is necessary to stimulate the growth of yeast.
B as time proceeds, the yeast grow and reproduce.
C the yeast die because sugar is not present in the solution.
D increasing the concentration of yeast results in less light being transmitted through the suspension.

2f-24 The purpose of Procedure 1 in this experiment was **most likely** to
17d
Co
4
(c)
A

A provide a basis for estimating the amount of yeast present in suspension in Procedure 2.
B investigate the effect of yeast concentration on the rate of yeast growth.
C investigate the optimum conditions under which yeast would grow.
D investigate the effect of light on the rate of yeast growth.

2f-25 Which one of the following meter readings would be most likely for the first glucose solution in 17f Procedure 2 on the day 0 just after mixing in the yeast?
An
3
(c)
C

A 64
B 80
C 84
D 93

2f-26 Of the following 3 day periods in Procedure 2, the fastest growth of yeast occurred between
17f
An
3
(c)
B

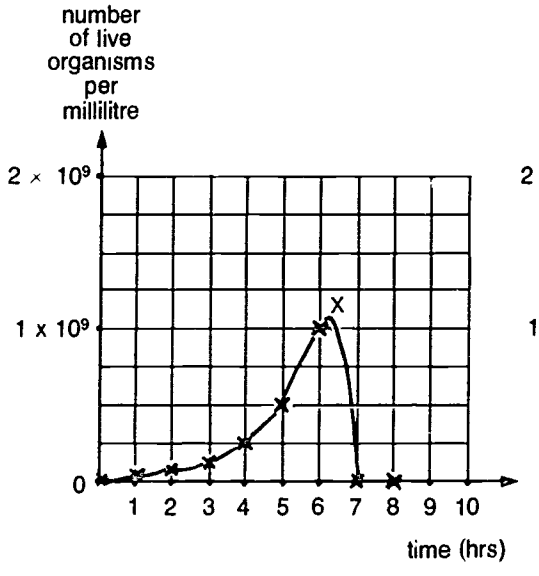
A days 0 and 3 in the third solution.
B days 3 and 6 in the third solution.
C days 0 and 3 in the second solution.
D days 3 and 6 in the second solution.

The next 3 items refer to the following information:

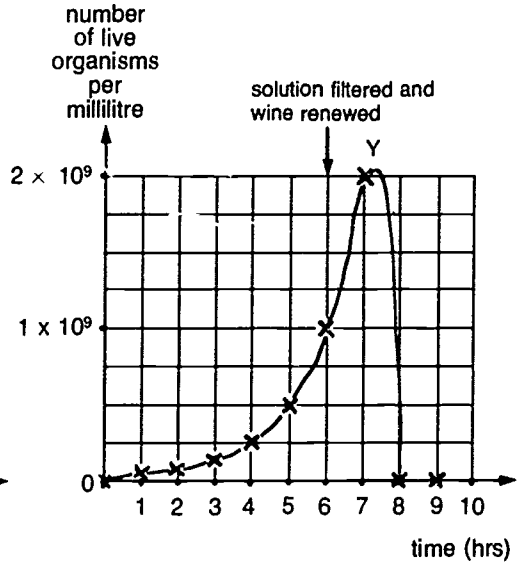
Two experiments were carried out, using acetic acid bacteria which convert alcohol to acetic acid.

Experiment 1

Wine was inoculated with acetic acid bacteria and the number of organisms per millilitre measured hourly. Graph 1 shows the result of observations made over eight hours.



Graph 1 (Experiment 1)



Graph 2 (Experiment 2)

Experiment 2

In a separate experiment, the same number of acetic acid bacteria was placed in an identical volume of the same wine and kept under the same conditions. Just before the bacteria reached a concentration of 10^9 live organisms per millilitre, the solution was filtered through a fine porcelain filter and the bacteria, thus separated, were mixed with an identical volume of the same wine. Graph 2 shows the result of observations made during experiment 2.

2f-27 The most likely reason for the sudden drop in the number of organisms at X and Y is that
17c Ap 4 (c) B

A the organisms ran out of carbon dioxide for photosynthesis.
B the organisms were being killed by their own waste.
C alcohol acted as a preservative and killed the bacteria.
D the organisms were too crowded and died.

2f-28 When concentrations of acetic acid in the solutions at times X and Y were tested, it would have been found that the concentration of acetic acid
17c An 4 (c) B *

A at X was three-quarters that of the concentration at Y.
B at X was the same as the concentration at Y.
C at X was twice that of the concentration at Y.
D at Y was twice that of the concentration at X.

2f-29 17c An 4 (c) C *

A third experiment could be carried out, where the wine is replaced just before the bacteria reached the concentrations of 1×10^9 and again at 2×10^9 live organisms per millilitre.

It would be reasonable to predict that the bacteria would reach a maximum concentration of

A 2.5×10^9 live organisms per millilitre.
B 3×10^9 live organisms per millilitre.
C 4×10^9 live organisms per millilitre.
D 8×10^9 live organisms per millilitre.

2f-30 17b Ap 3 (c) D

In 1926 Alexander Fleming noted that a plate culture of *Staphylococcus* (a spherical bacterium) growing in his laboratory had been contaminated by the mould *Penicillium notatum*. Around the area of growth of this mould, the staphylococcal colonies had broken down.

Which of the following hypotheses would be **least** acceptable as an explanation?

A *Penicillium notatum* deprived the staphylococci of nutrients.
B *Penicillium notatum* used the staphylococci as a nutrient source.
C *Penicillium notatum* secreted a substance which killed the staphylococci.
D *Penicillium notatum* growth was stimulated by a staphylococcal secretion.

2f-31 3c Ap 5 (c) D

Fruit does not 'go off' (i.e. undergo bacterial decay) when it is put in a concentrated sugar solution as in the making of jam.

The main reason preventing this bacterial action in the fruit is the

A chemical destruction of bacteria by the sugar.
B lack of bacterial nutrients.
C lack of oxygen.
D loss of water from the bacterial cells.

INCORRECT response items

2f-32 Different bacterial species can be distinguished by their
–
Kn
2
(i)
A
*

A methods of reproduction.
B waste materials produced.
C structural characteristics.
D nutritional requirements.

2f-33 The existence of viruses was proposed before they were actually seen.
–
Kn
2
(i)
A
*

It was found that viruses could

A reproduce themselves in a host by binary fission.
B pass through a fine filter.
C be crystallized out of solution.
D appear non-living when outside a living organism.

2f-34 Each of the following is a eukaryote.
–
Kn
2
(i)
A
*

A blue-green bacterium
B brown alga
C slime mould
D protozoan

2f
17g
Kn
3
(i)
B

Many different varieties of bacteria have been identified, resulting in classification into several large groups.

Characteristics enabling their classification include

A their shape, including rods, spheres and spirals.
B their size, some being macroscopic, although most are microscopic.
C the formation of colonies which look different from one another when grown on culture medium.
D their different reactions to stains and dyes.

2f-35 Most communities contain autotrophic organisms.
1b
Kn
4
(i)
A

These can be described as organisms which

A all derive energy from light to make their own food.
B use inorganic materials to manufacture complex organic compounds.
C may be chemosynthetic organisms.
D may be photosynthetic autotrophs.

2f-36 Viruses differ from bacteria in that viruses
–
Kn
4
(i)
C

A can be seen only with the electron microscope.
B may be crystallized.
C reproduce by binary fission.
D can only be cultured in living cells.

2f-37 Attempts to culture a particular bacterium failed.
17g
Kn
4
(i)
C
*

This failure may have been because

A the agar used did not contain a specific nutrient.
B the temperature of incubation was too low.
C the bacterium will not grow on any nutrient agar.
D the oxygen level in the air was too high.

2f-38 – Co 2 (i) C *

A laboratory worker wishes to identify a bacterium isolated from a diseased plant.

A test that could be useful in this identification process is

A a microscopic examination of the bacterium.
B to attempt to grow the bacterium on a variety of nutrient media.
C to determine the method of reproduction of the bacterium.
D an examination of the shape of the colonies of the bacterium after growth on an agar plate.

2f-39 – Ap 2 (i) C

Some biologists have suggested that viruses may be examples of the earliest forms of life present on our planet.

This is supported by the following statements.

A The overall structure of a virus is relatively simple in relation to higher organisms.
B Viruses contain only a limited range of chemical substances.
C Viruses are able to reproduce only inside host cells.
D Viruses are amongst the smallest particles which are able to reproduce themselves.

2f-40 17g Co 3 (i) B *

A microbiologist inoculated an agar plate with a drop of culture developed from a single bacterium. After the plate had been incubated for 36 hours it was noticed that, as well as colonies of that bacterium, there were several colonies of other types of bacteria growing on the plate.

A possible explanation for this observation is that

A several bacteria from the air settled on the agar during inoculation.
B the other types of bacteria grew from the spores of that bacterium.
C the micro-biologist did not flame the inoculating loop before use.
D the agar plate had not been properly sterilized.

2f-41 17g Co 4 (i) C *

Robert Koch found he could grow microorganisms outside the body in a culture medium. He was the first to use a solid rather than a liquid medium.

The solid medium was an advantage because

A each cell could reproduce to form a colony of cells.
B different microorganisms would produce separate colonies.
C more microorganisms would grow on a solid than in a liquid medium.
D pure cultures of a single species could be obtained.

2f-42 2e An 4 (i) D

The table lists some features of four organisms.

	Number of cells	Mode of nutrition	Mode of reproduction
Organism I	unicellular	photosynthetic	asexual
Organism II	multicellular	autotrophic	asexual and sexual
Organism III	unicellular	chemosynthetic	asexual
Organism IV	multicellular	heterotrophic	sexual

One might correctly conclude that

A Organism I is a blue-green bacterium.
B Organism II is an angiosperm.
C Organism III is an autotrophic bacterium.
D Organism IV is a prokaryote.

3 ORGANISMS AND ENVIRONMENTS

Living Things and Living Places

3a—Factors affecting species survival

CORRECT response items

3a-1 – Co 4 (c) C

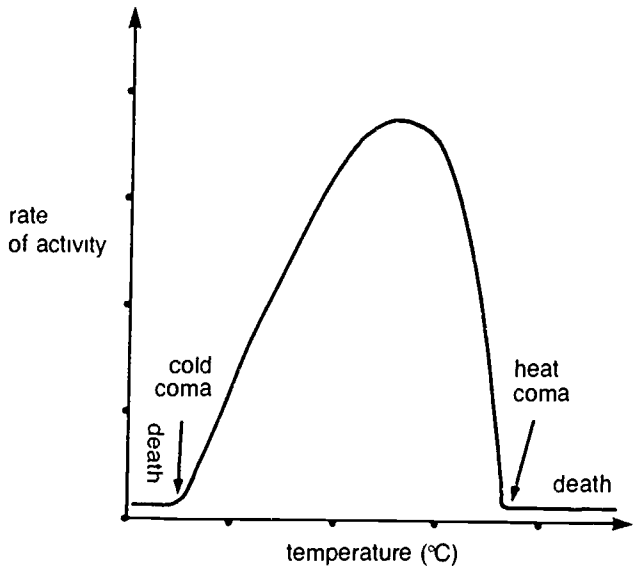
Twelve fish, all of a species which tolerates temperatures of between 15 °C and 25 °C, have been successfully kept in a large aquarium in a room with a constant temperature of 18 °C. The temperature of the room is suddenly changed to a constant temperature of 22 °C. The fish now come to the water's surface to gulp air much more frequently than before, and after a few days three of the fish are dead; following this no more of the fish die.

The fish probably died because

A there was a sudden temperature change.
B they inhaled too much air.
C there was insufficient oxygen.
D diffusion at the surface of the water increased.

3a-2 – Co 2 (c) A

The graph shows the effects of temperature changes on the activities of cells in a fish.



The graph illustrates

A that a fish has a particular range of temperatures at which it can be active.
B the way in which physical conditions can change over a period of time.
C the way in which biotic factors affect the fish's chances of survival at a particular temperature.
D that tolerance limits of a fish enable it to be active in both marine and freshwater habitats.

The next 3 items refer to the following information:

The tables present data obtained in germination experiments with three species of plants.

Table 1 gives the percentage germination of three species tested at different temperatures and at different ages (i.e. weeks after maturation on the plant). No washing of seeds was carried out before testing for germination.

Table 1

Species	Age of seed (weeks after maturation)	Temperature of germination °C 5	10	20	30	40
I	1	0	0	0	0	0
	4	0	0	0	0	0
	8	3	30	60	10	0
	16	8	70	100	20	0
II	1	10	40	100	100	0
	4	15	43	98	100	0
	8	12	38	100	94	0
	16	10	40	95	100	0
III	1	0	0	0	0	0
	4	0	0	0	0	0
	8	0	0	0	0	0
	16	0	0	0	0	0

Table 2 gives the percentage germination of the same three species at 20 °C. In this case all the seed samples were eight weeks old and each sample was washed a varying number of times with fresh changes of distilled water prior to planting. Each washing lasted two hours.

Table 2

Species	Number of washings 0	1	2	4	8	16
I	60	68	65	68	70	65
II	100	98	95	98	100	98
III	0	0	15	47	95	100

3a-3 17e Co 3 (c) C *

In arriving at the results presented in Table 1, three of the following procedures could or would have been employed by trained botanists.

Which one would **not**?

A Seed boxes of the same size would have been used for each species.

B The seeds of each age would have been randomly allocated to each temperature treatment for each species.

C More water would be provided for the 40 °C seeds than 5 °C seeds of the same species.

D All seed boxes would have contained soil from the same batch.

3a-4 17e An 3 (c) B

From the data presented in Table 1 we could reasonably conclude that

A seeds of Species I, planted 16 weeks after maturation, germinate better than II or III.

B 8 weeks after maturation, seeds of Species II germinate more readily than I or III at a temperature of 25 °C.

C the seeds of Species III are dead.

D the age of the seeds significantly affects germination in Species II.

3a-5 17e An 4 (c) C *

From the data presented in Tables 1 and 2 we could reasonably conclude that

A Species III seeds must be older than seeds of the other species before they will germinate.

B Species I is better adapted to a moist warm environment than Species II.

C Species III would be best adapted for survival in a desert-like environment.

D if the experiment that gave the results in Table 2 had been conducted at 30 °C instead of 20 °C, the germination for Species I with no washings would have been about 30 per cent.

3a-6 3c Ap 2 (c) D

Many slugs do not survive during hot weather, while snails that are able to 'cement' themselves to a flat surface by a hardened glue-like material generally do survive.

The most probable reason for this difference is that

A predators eat slugs more frequently than they eat the snails which are stuck to flat surfaces.

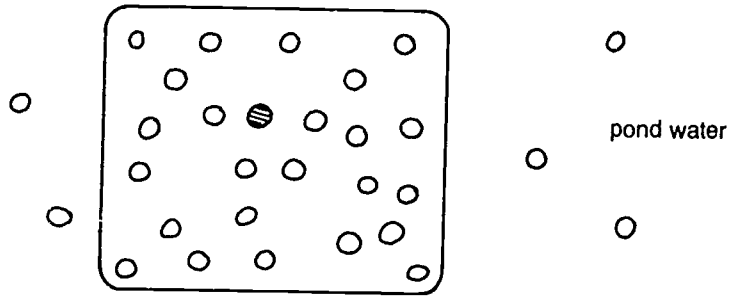
B the body temperature of a slug increases in hot weather, whereas a snail's temperature remains relatively constant because its surface area to volume ratio is large.

C the snails expend less energy since they are unable to move about until the next rain washes away the hardened glue-like material.

D the snails are almost completely sealed from the dry atmosphere by the glue-like material, and experience less severe water loss than slugs.

3a-7 – Ap 4 (c) D *

Consider the figure below of a freshwater algal cell living in a sample of pond water The circles represent sodium ions (Na^+). The *shaded* circle represents a particular sodium ion.



The concentration of sodium ions in the cell is 26 millimoles/Litre and the concentration in the pond water is 1.5 millimoles/Litre. Assume that the cell is permeable to both sodium ions and water.

The particular sodium ion which is shaded and shown inside the algal cell will

A move out of the cell by diffusion due to the concentration gradient.

B remain in the cell due to the effect of osmotic pressure.

C be carried out of the cell by the diffusion of water.

D move in a direction which cannot be predicted from the above data.

3a-8 – Ap 4 (c) B

Studies have shown that 87 per cent of emperor penguins in the Antarctic and 98 per cent of rabbits in New South Wales, fail to survive to maturity.

Such observations indicate that

A species have many predators which reduce their chances of survival.

B for a species to survive more offspring must be produced than can live to maturity.

C species have fairly narrow tolerance limits.

D few species are well adapted to the environment in which they live.

The next 2 items refer to the following information:

All of the animals listed below are mammals belonging to the Order Primates.

Animal	Common name	Scientific name	Locality	Habitat	Diet
I	Black handed spider monkey	*Ateles geoffroyi*	Central and South America	Lowland rain forest	Fruits and nuts
II	Geoffroy's tamarin	*Saguinus geoffroyi*	Central America	Tropical rain forest	Insects, fruit, leaves, seeds
III	Woolly spider monkey	*Bracnyteles arachnoides*	South America	Tropical rain forest	Fruit, leaves, seeds
IV	White fronted marmoset	*Callithrix geoffroyi*	South America	Temperate rain forest and savanna	Insects, fruit, leaves
V	White footed tamarin	*Saguinus leucopus*	South America	Temperate rain forest	Uncertain

3a-9 2c Ap 4 (c) D

Which two animals would be most closely related?

A I and III
B II and IV
C I and II
D II and V

3a-10 – An 4 (c) D

Between which two species would one expect to find the most competition?

A II and III
B I and II
C III and IV
D IV and V

3a-11 – Ap 4 (c) C

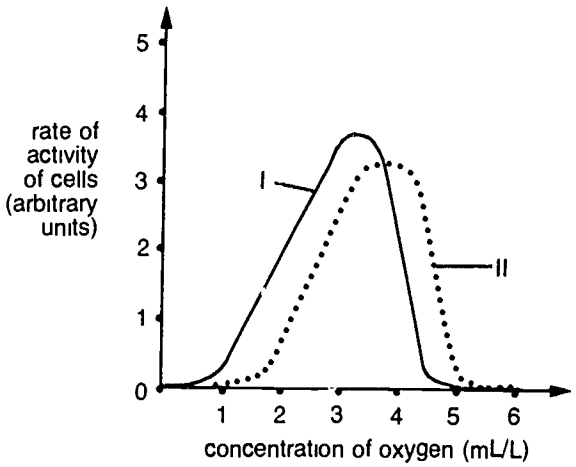
Four species of marsupial were studied in their natural environment and were found to have the following food preferences, habitats and shelter requirements:

Species	Food preference	Habitat	Shelter requirement
I	ants	open woodland	burrows
II	shoots & leaves	open woodland	hollow logs
III	ants	dense forest	hollow logs
IV	berries & roots	dense forest	hollow logs

Which two species would compete most with each other?

A I and III
B I and II
C III and IV
D II and IV

The next 3 items refer to the following graph:



The Effects of Oxygen Concentration on the Activities of Cells of Multicellular Organisms I and II Living in Water

3a-12 Above what concentration of oxygen will organism II die?

17f An 3 (c) D

A 2 mL/L
B 4 mL/L
C 4.5 mL/L
D 5 mL/L

3a-13 The tolerance limits for oxygen concentration for organism I are

17f An 3 (c) B

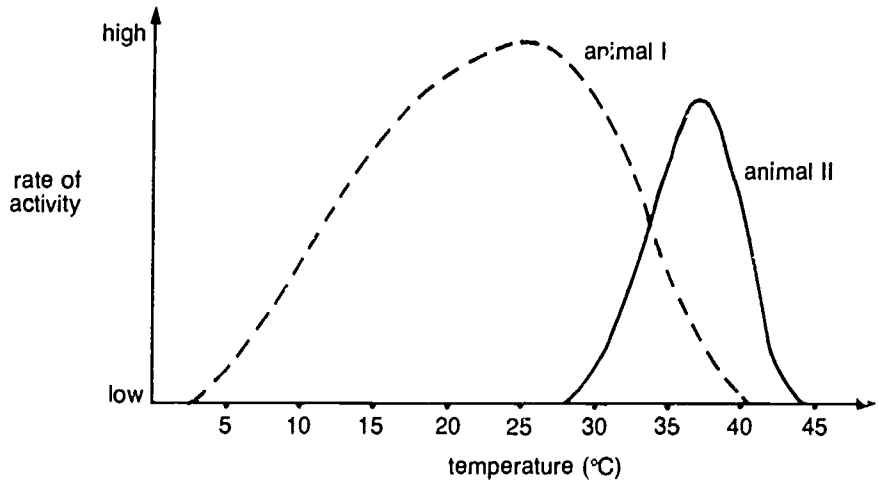
A 1 to 3 mL/L .
B 1 to 4.5 mL/L .
C 3.5 to 4.5 mL/L .
D 0 to 5.5 mL/L .

3a-14 Assuming that all other environmental factors are suitable, between which of the following ranges of oxygen concentration will both organisms I and II be able to live?

17f An 4 (c) B *

A 0 to 5.5 mL/L
B 2.0 to 4.5 mL/L
C 3.0 to 4.0 mL/L
D 3.0 to 3.5 mL/L

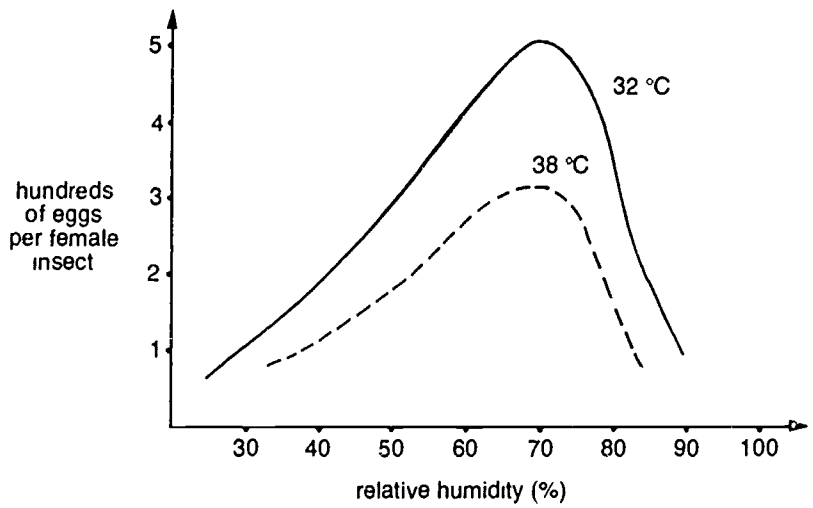
3a-15 The graph below shows cell activity levels of two different animals.
17f
An
3
(c)
B
*



Which of the following is true for animal II?

A The lower limit of temperature tolerance is higher than the upper limit of temperature tolerance for animal I.
B The optimum temperature is approximately 12 °C greater than that for animal I.
C The optimum temperature is less than that for animal I.
D The animal can live in a greater range of temperatures than animal I.

3a-16 The following graph shows the influence of relative humidity on the egg-laying of an insect.
6a
An
3
(c)
B
*



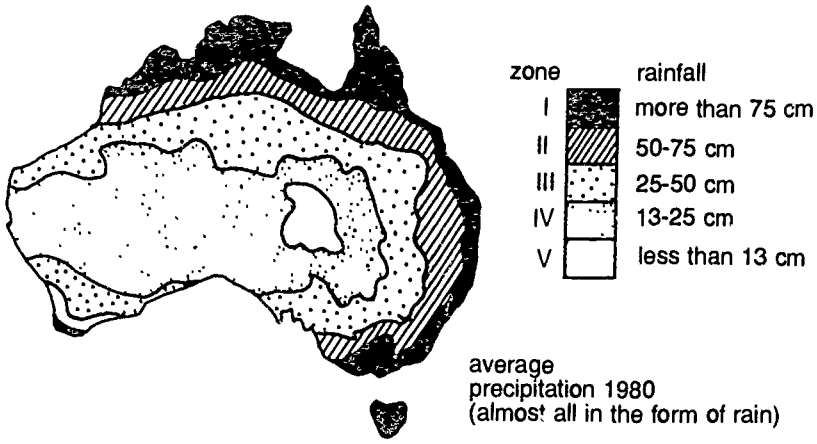
Which of the following can be concluded from the data?

A At any given relative humidity, the rate of egg-laying increases with temperature.
B Temperature has a maximum effect on egg-laying at 70 per cent humidity.
C The rate of egg-laying is greater at 32 °C than at 38 °C.
D There is zero egg-laying at 10 per cent humidity.

INCORRECT response items

The next 2 items refer to the following information:

The precipitation in 1980 in Australia is shown by the following map.



3a-17 – Co 2 (i) B *
The upper and lower tolerance limits for water for plant X are defined by an average yearly rainfall between 12 cm and 75 cm.

Considering water requirements only, plant X could be found in the following zones during 1980.

A III and IV
B I and IV
C II and V
D II and III

3a-18 – Co 3 (i) C *
Another plant Y has upper and lower tolerance limits for water defined by an average yearly rainfall of 80 cm and 18 cm.

Considering water requirements only, plants X and Y could be found in the following zones during 1980.

A II and III
B III and IV
C I, IV and V
D II, III and IV

3b—Habitats: similarities and differences; living in water

CORRECT response items

3b-1 – Kn 3 (c) A

Oxygen deficiency in a body of water can be caused by the water being too

A still.
B turbulent.
C cold.
D shallow.

3b-2 – Kn 3 (c) A

Compared with land-dwelling seed plants, those living submerged in water generally have

A poorly developed root systems.
B well developed supporting tissue in the stem.
C well developed waxy layers around the leaves.
D very little photosynthetic tissue.

3b-3 – Kn 3 (c) B

Which of the following physical conditions does an organism need to tolerate in order to survive in an aquatic environment?

A the negligible resistance that water has when organisms move around
B the strong upward force or upthrust that water has on objects in it
C the high concentration of dissolved oxygen found in water
D the large degree of pressure generated by water near the surface

3b-4 – Co 2 (c) B

Phytoplankton samples were collected from four different depths of the ocean, and the effect of light intensity on the rate of photosynthesis in each sample was measured. The data are presented below.

Photosynthesis per cell (arbitrary units)

	Light intensity (arbitrary units)				
Sample	5	10	20	40	60
I	74	95	58	30	27
II	28	50	72	91	95
III	34	68	95	81	58
IV	70	96	55	30	26

The sample most likely to come from closest to the surface is

A I.
B II.
C III.
D IV.

3b-5 – Ap 3 (c) C

A tadpole is placed in water which has dissolved solutes at a much higher concentration than that of the tadpole's normal environment.

The effect on the tadpole's body would be to

A increase in size because water is absorbed into its body.
B be more active because of the dissolved solutes.
C lose water and eventually die because of lack of water in its body.
D neither lose water nor increase in size because it is adapted to an aquatic environment.

The next 2 items refer to the following information:

Some 100 mL metal flasks were completely filled with sea water and sealed with screw-down caps. Each flask contained the same quantity of phytoplankton. The oxygen concentration of the sea water used was 7.82 mL/Litre.

After the flasks had been submerged for 9 hours at various depths in the sea, the oxygen concentration of the sea water in each bottle was determined. The results are shown below.

Depth (metre)	Temperature (°C)	Final oxygen concentration (mL/Litre)
0	10.9	7.11
8–10	10.4	7.32
16–20	10.0	7.42
24–30	6.0–9.0	7.47
32–40	5.0–6.0	7.54
40–50	4.0–5.0	7.61

3b-6 1b Ap 3 (c) C

After the 9 hours there was a decrease in the oxygen concentration in all flasks because

A no photosynthesis was carried out.
B phytoplankton contains many animals.
C the phytoplankton used oxygen.
D the concentration of waste gases increased.

3b-7 – Co 3 (c) A

The variation in final oxygen concentration with depth was most probably attributable to the variation in

A temperature.
B pressure.
C light intensity.
D salinity.

3b-8 – Kn 3 (c) B

A common characteristic of many vertebrate animals living in fresh water is their ability to

A excrete salts in their urine.
B produce dilute urine.
C excrete salts through their gills.
D reabsorb water from their urine.

3b-9 – Ap 3 (c) D *

When small ponds dry out during summer the water often becomes very brackish.

Which of the following statements applies to the cells of a freshwater alga living in such a pond?

A They become filled with water and swell up.
B They lose water and become smaller.
C Water is actively transported out of the cells.
D The cell contents shrink due to water loss.

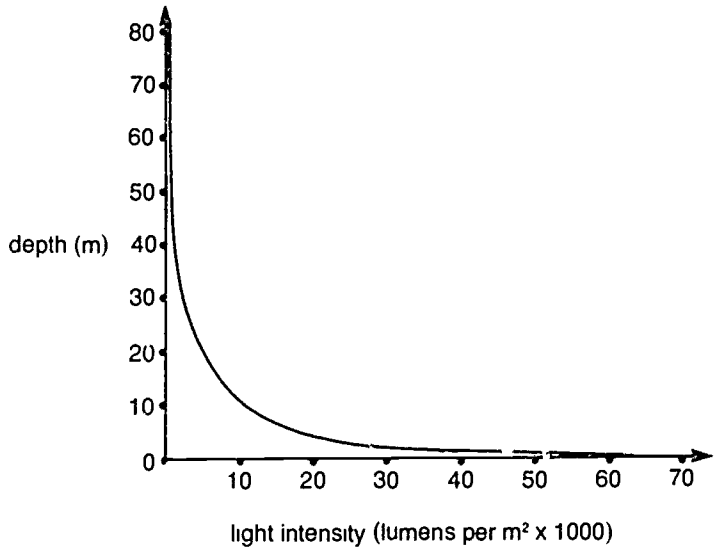
3b-10 – Ap 4 (c) D *

Recently a 'square bacterium' has been discovered that is microscopic, very thin and square! It was discovered in highly concentrated salt pools on the Sinai Peninsula in 1980.

The major problem for such a bacterium in this environment would be

A support of the organism's body by the upthrust from the surrounding water.
B lack of protection from high light intensity.
C diffusion of salt from the surrounding water into the organism.
D loss of excess water from its own body to its surroundings.

The next 2 items refer to the following graph:



Light Intensity Change with Depth of Water

3b-11 The most significant interpretation of the above graph is that deepwater organisms require adaptations for

Co
4
(c)
B

A moving in colder water.
B sensing their environment.
C tolerating the greater density of water.
D coping with the higher pressures.

3b-12 The observation which **cannot** be explained by the above data is that in the ocean

Ap
4
(c)
A

A the concentration of ions increases with depth.
B the number of organisms decreases with depth.
C the reliance on non-visual sensory organs increases with depth.
D the oxygen concentration tends to decrease with depth.

The next 2 items refer to the following information:

The degree of acidity or alkalinity of a solution can be measured as the pH on a scale from 0 to 14. pH = 0 is the most acid medium, pH = 7 is a neutral solution, and pH = 14 is the most alkaline solution. Different types of bacteria have varying pH requirements; the following table shows the pH range that some species of bacteria can tolerate.

Bacteria	pH range for growth		
	Minimum	Optimum (most suitable)	Maximum
E. coli	4.4	6.0–7.0	9.0
Nitrobacter sp.	6.6	7.6–8.6	10.0
Thiobacillus thiooxidans	0.0	2.0–2.8	4.0–6.0
Salmonella typhosa	4.5	6.5–7.2	8.0

3b-13 2f An 3 (c) C One of these bacteria produces a by-product which is rapidly converted to sulfuric acid. Which is it most likely to be?

A *E coli*
B *Nitrobacter sp.*
C *Thiobacillus thiooxidans*
D *Salmonella typhosa*

3b-14 2f An 2 (c) C Which two species of bacteria would be unable to grow in the same environment?

A *E coli* and *Nitrobacter sp.*
B *E coli* and *Thiobacillus thiooxidans*
C *Thiobacillus thiooxidans* and *Nitrobacter sp*
D *Thiobacillus thiooxidans* and *Salmonella typhosa*

Adaptation

3c—Survival on land—inherited features

CORRECT response items

3c-1 – Kn 2 (c) C

All animals require water to survive. Yet the kangaroo rat which lives in deserts does not drink water, and Libyan desert mice die if given a drink.

The kangaroo rat and Libyan mice continue to survive because they

A are able to store large quantities of water in their bodies.
B produce dilute concentrations of urine.
C obtain their water requirements from the breakdown of carbohydrates.
D do not have sweat glands and therefore do not lose water.

3c-2 – Kn 2 (c) D

Some exothermic (or ectothermic) animals, such as reptiles and insects, bask in the sun to absorb solar radiation.

After they move out of the sun to a lower temperature, their body temperature will

A fall and become colder than that of their immediate surroundings.
B remain constant in spite of the change.
C fluctuate until it returns to normal.
D fall until it assumes the same level as its immediate surroundings.

3c-3 3a Kn 2 (c) D

Which combination of weather conditions would lead to the greatest water loss in land plants?

A high humidity, low temperature and no wind
B high humidity, low temperature and high winds
C low humidity, high temperature and no wind
D low humidity, high temperature and high winds

3c-4 – Kn 4 (c) B

In a hot desert environment animals are likely to

A be able in most cases to maintain constant body temperature.
B have larger surface area to volume ratios than those in colder regions.
C have regular reproductive life cycles.
D grow at a uniform rate all the year round.

3c-5 – Kn 4 (c) C

Uric acid is excreted by some animals instead of urea because it

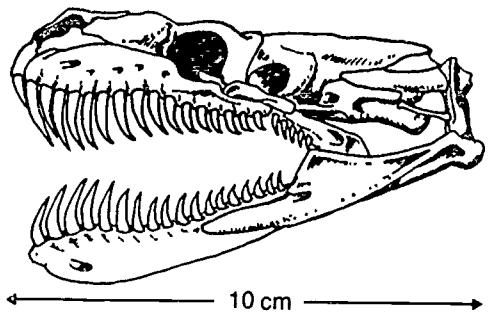
A is less poisonous than urea.
B is more easily formed by the body than urea.
C can be excreted as a solid or semi-solid.
D can be stored for longer periods than urea.

3c-6 – Co 2 (c) A

Given that an organism shows adaptations to its environment, a tall tree with small, cylindrical leaves would most likely be found

A in a dry hardwood forest community.
B in a tropical rain forest community.
C near a freshwater swamp.
D on a river bank.

3c-7 Consider the reptile skull illustrated below:
2d
Co
2
(c)
B



The teeth of this reptile are most likely to be used for

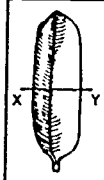
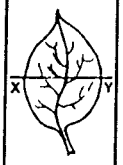
A chewing prey prior to digestion.
B grasping prey prior to swallowing.
C injecting venom.
D crushing prey prior to digestion.

3c-8 Plants growing in swift-flowing fresh water are most likely to be
–
Co
2
(c)
C

A floating algal communities.
B floating planktonic communities.
C provided with roots or hold-fasts.
D non-existent.

3c-9 The diagrams below shows the outlines and cross-sections of leaves taken from four land plants. All of the plants have similar leaf surfaces, and approximately the same number of leaves.
–
Co
3
(c)
B

Which plant would be **least** likely to occur in a dry environment?

plant	A	B	C	D
outline of leaf				
cross-section at XY				

3c-10 In which one of the following pairs of areas would you be most likely to find ephemerals?
–
Co
3
(c)
B

A swamp and coastal heath
B alpine plain and hot desert
C tropical rain forest and tropical swamp
D cold desert and marshland

The next 2 items refer to the following information:

The apparatus shown in the diagram was used to measure the insulating capacity of fur from various animals. The results are plotted on the graph.

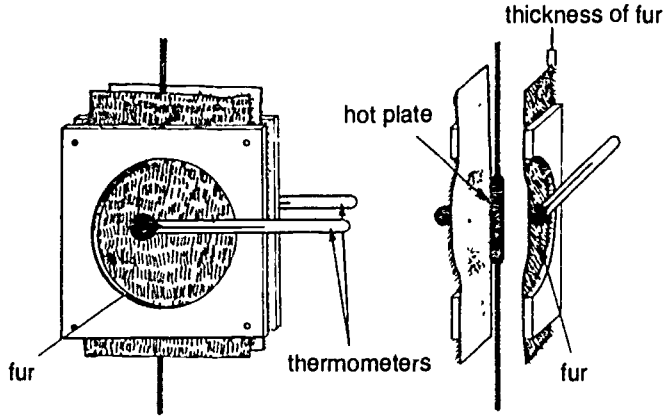
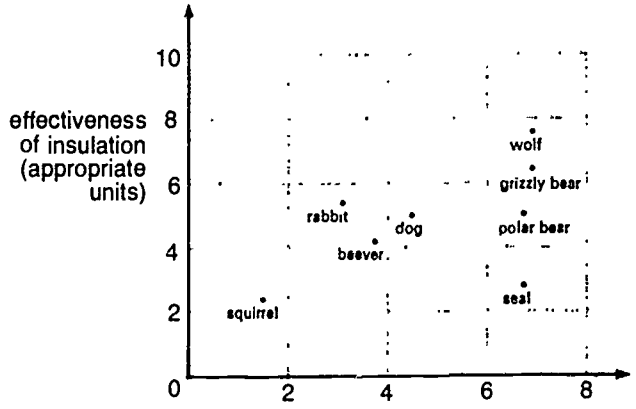


diagram I section of diagram I



3c-11 From these results it can be concluded that

An 3 (c) D

A squirrels are least able to cope with cold conditions.
B rabbits and dogs could survive in similar regions to polar bears.
C wolves can survive lower temperatures than the other animals.
D no definite statement about the animals' tolerance to cold conditions is possible.

3c-12 The results show that the seal has thick fur but its insulation is not very effective.

Co 2 (c) A

Which one of the following is the **best** explanation for the seal's ability to survive in its usual environment?

A The seal is aquatic and a layer of fat provides better insulation than fur.
B The seal does not need insulation since its body temperature is the same as that of the surrounding water.
C The seal's fur insulates the animal on land but not in water.
D The seal is a very large animal and so it loses relatively little body heat.

3c-13 The following table compares some properties of air and water.

Co 5 (c) A

Property	Air	Water
Relative oxygen content	210	8
Relative diffusion rates of oxygen	100 000	1
Relative density	1	1000
Relative viscosity	1	100

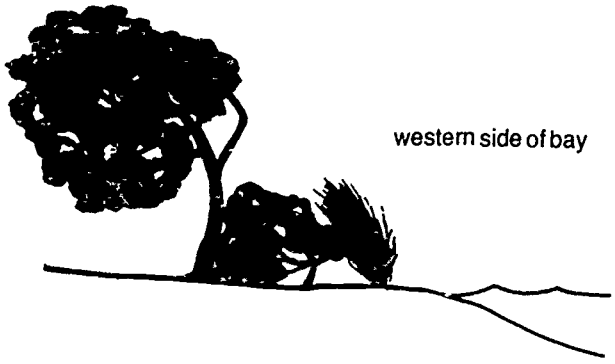
Consider a respiratory system in which the water flows continuously in one direction past the respiratory surface.

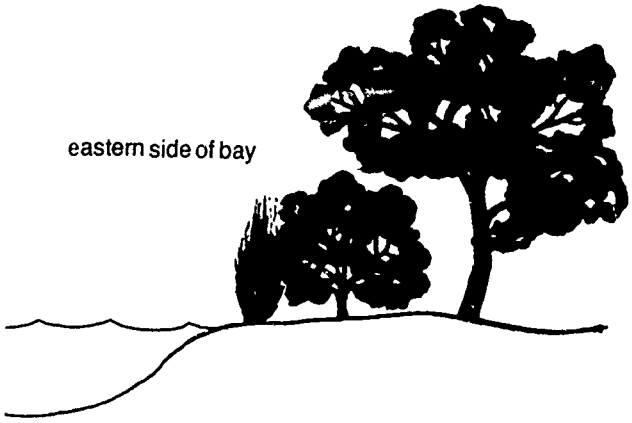
Which properties of water are most relevant to the system's design?

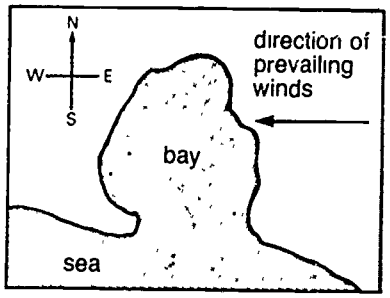
A low oxygen content and high viscosity
B high density and high viscosity
C low density and low oxygen diffusion rate
D low oxygen content and high density

3c-14 – Co 5 (c) C

Below are diagrams of the vegetation found on the western and eastern sides of the bay shown in the map. The land shown in the map is part of a large coastal plain.







The major factor responsible for the variation in vegetation shape between the eastern and western sides of the bay was probably the action of the

A prevailing winds.
B waves.
C salt water spray.
D tide variations.

3c-15 – Ap 2 (c) D *

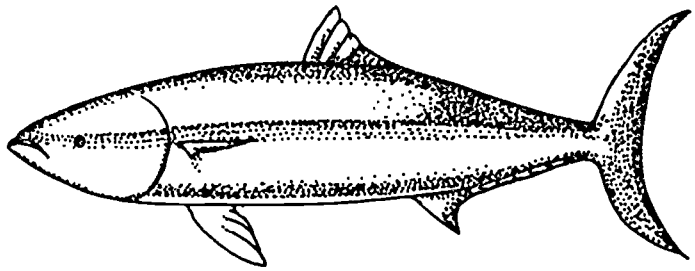
The Weddell seal is the only mammal naturally wintering along the shores of Antarctica, and has to undertake the task of maintaining a breathing hole through the ice. This is done by regularly surfacing and systematically gnawing at the ice, to prevent the hole from icing over.

The seal remains in the ocean throughout the severe winter because

A it needs to remain close to his breathing hole.
B there is sufficient oxygen dissolved in the water.
C evaporation in the air would cause too much cooling.
D ice is a good insulator and the water remains warmer than air.

3c-16 – Co 3 (c) B

Consider the following diagram of a marine Kingfish.



The overall shape of the fish is an adaptation to assist in overcoming problems associated with

A buoyancy.
B high viscosity.
C upthrust.
D high pressure.

3c-17 – Ap 3 (c) C

The following table shows the concentration of ions in a freshwater pond and in a freshwater alga (*Nitella*) found in the pond.

	Ion concentration (Millimoles/Litre)	
Ions in solution	Pond water	*Nitella*
Potassium (K^+)	1.9	57.2
Sodium (Na^+)	1.4	26.4
Calcium (Ca^{2+})	0.8	7.9
Magnesium (Mg^{2+})	1.0	4.0
Chloride (Cl^-)	1.1	79.3

From these data it may be inferred that

A *Nitella* cells have accumulated water.
B *Nitella* cells have a slight positive charge.
C ions enter *Nitella* cells by a process other than diffusion.
D chloride ions would tend to move out of *Nitella* much faster than the other ions listed.

3c-18 12a Ap 3 (c) A

In the cold desert night a camel's temperature may drop to 32 °C and in the heat of the day it may rise to 42 °C. The body temperature of a human under similar environmental conditions remains between 36 °C and 39 °C.

This information suggests that

A humans sweat more readily than camels.
B camels shiver more readily than humans.
C camels generally have a thicker layer of fat than humans.
D humans absorb less heat from the environment than camels.

3c-19 The environment of organisms living in a body of water varies in the amount of water, oxygen and carbon dioxide present. These substances enter and leave the body of water *via* the surface of the water which is exposed to the air. They do so by means of diffusion.

Ap
3
(c)
A

The rate of diffusion from the surface of a pond will decrease if

A part of the pond becomes covered by floating plants.
B the temperature of the pond water rises.
C the concentration of mineral ions decreases.
D the velocity of the wind increases over the surface of the water.

3c-20 The following is a quotation from a scientific paper describing a recently discovered organism.

Ap
3
(c)
B
*

> The extended intestine, together with the prominent kidneys, indicate that the animal regularly takes in a much larger quantity of water than is normally expected for an animal of its size. An unusual feature is a large gland, attached near the posterior opening of the intestine, which apparently eliminates considerable quantities of excess salts from the body.

Such an organism would most likely inhabit

A a desert.
B an ocean.
C a freshwater lake.
D a rain forest.

The next 2 items refer to the following information:

An experiment was carried out to measure the rate of water loss from slaters (wood-lice) at temperatures of 15 °C, 20 °C, and 30 °C . Three different genera were used: *Ligia*, *Armadillidium* and *Porcellio*. Slaters of equal size were selected for the experiment. Groups of five slaters from each genus were weighed and put into test tubes. One tube for each genus was placed in a sealed glass container kept at constant temperature.

After two hours the slaters were weighed again and the per cent weight lost calculated. A record was kept of the number of dead slaters.

Genus	% weight lost at 15 °C	% weight lost at 20 °C	% weight lost at 30 °C
Ligia	4.7	6.1	13.9 (all dead)
Armadillidium	3.3	5.1	9.2
Porcellio	2.5	4.9	11.4 (1 dead)

3c-21 An important assumption made in this experiment is that

17e
An
2
(c)
B

A the three genera of slaters have the same body weight.
B any loss of weight is due to water loss.
C in this case, no control can be used.
D the three genera of slaters can tolerate high temperatures.

3c-22 Which one of the following explains why the slaters were matched for size?

17e
Co
1
(c)
A

A Water loss will be approximately equal for slaters of the same size in any one genus.
B Weighing is easier since only one slater of each genus needs to be weighed.
C Slaters of equivalent size would more likely reflect the natural population.
D All the slaters of one genus should die at about the same time.

The next 2 items refer to the following information:

In a certain grape-growing district there had been poor fruit yields. It was suspected that the ungrafted sultana vines were highly susceptible to infestation by root knot nematodes (small round worms which live in the soil and attack the roots of grape vines, restricting growth and fruit yield).

During the investigation of this problem an agricultural scientist cleared an area completely and fumigated the soil to destroy the nematodes present.

The next year (1959) he planted ungrafted sultana vines. In 1960 he planted grafted sultana vines of types X and Y between the ungrafted ones.

Below is a diagram of part of the vineyard.

O	X	O	Y	O	X	O
Y	O	X	O	Y	O	X
O	Y	O	X	O	Y	O

O = ungrafted vine
X = grafted vine on root-stock X
Y = grafted vine on root-stock Y

For the first few seasons there was little difference in the yields of the vines, but in 1965 and 1967 the yields were as shown below.

	Average yield of fresh fruit (kg per vine)	
Rootstock	1965	1967
Grafted (X)	57.8	87.2
Grafted (Y)	45.1	92.6
Ungrafted (O)	24.0	49.0

3c-23 The data in the table indicate that
17e
An
1
(c)
D

A the grafted vines were slower to produce fruit than the ungrafted vines.
B the grafted vines were not susceptible to attack by nematodes.
C sultana vines reach their maximum productivity after 7 or 8 years.
D the grafted vines produced a higher average yield of fruit than the ungrafted vines.

3c-24 The agricultural scientist's hypothesis was that the grafted vines would be less affected by nematodes than the ungrafted vines.
17e
An
3
(c)
C
*

The results of the experiment

A prove this hypothesis to be correct.
B show this hypothesis to be unsound.
C indirectly support the hypothesis.
D indicate that nematodes do not affect grafted vines at all.

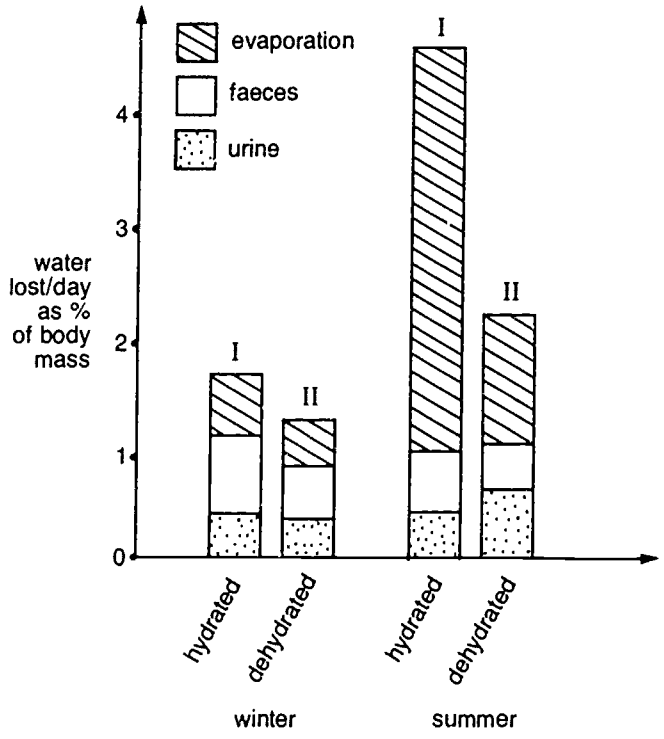
The next 2 items refer to the following information:

The camel has methods of reducing the amount of water lost in its urine and faeces, and by evaporation.

The graph shows the amounts of water lost by a camel when it was

I given water freely (i.e. hydrated)
II given no water (i.e. dehydrated).

Results are shown for winter (air temperature 20 °C) and for summer (air temperature 40 °C).



3c-25 The graph shows that
17f
An
2
(c)
A

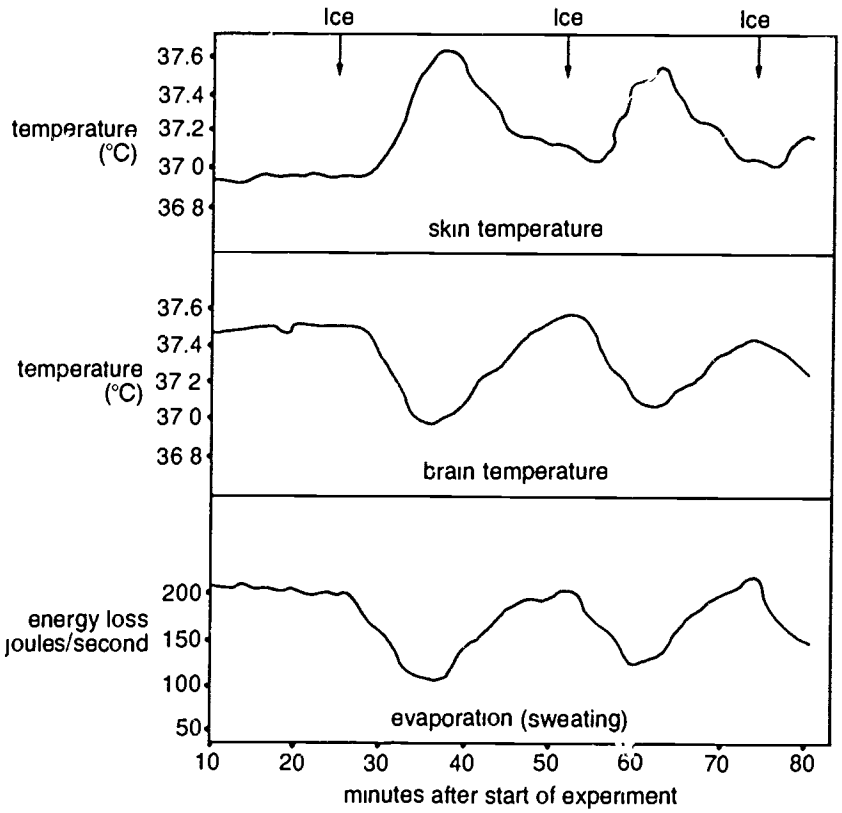
A more water is lost per day from the camel's body in summer than in winter.
B in winter and summer most water is lost by evaporation.
C in summer almost all of the body mass of the hydrated camel is water.
D the camel has less water in its body in winter than in summer.

3c-26 The graph also shows that
17f
An
4
(c)
A

A when given water frequently in the summer, 3.5 per cent of the camel's body mass is lost per day by evaporation.
B at any time of the year, a dehydrated camel will usually lose less water than a hydrated camel.
C in the summer, a dehydrated camel loses less water from each of the three sources (urine, faeces and evaporation) than when it is given water freely.
D in the winter the dehydrated camel loses more water in its faeces than does the freely watered camel.

3c-27 17f An 3 (c) C

While investigating the role of internal and surface temperature receptors, Benzinger measured the brain and skin temperatures of human subjects before and after they ate large quantities of ice. The subjects' heat loss due to sweating was also measured. The data are presented in the graphs below.



A valid conclusion that could be drawn from the data is that

A the activity of sweat glands is dependent upon the temperature of the skin.

B sweating is the most effective way to lose heat in a hot environment.

C there is a relationship between the temperature of the brain and the activity of sweat glands in the skin.

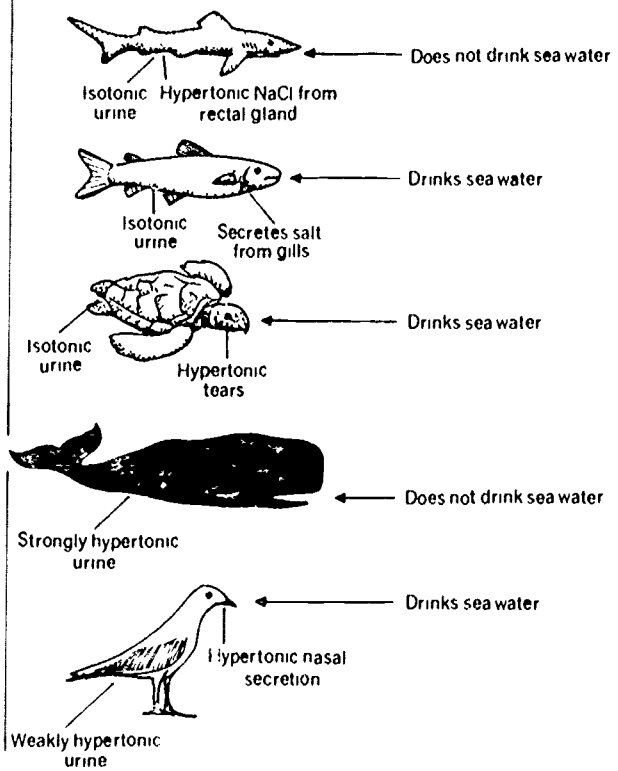
D a fall in skin temperature initiates an increase in heat loss by sweating.

3c-28 The following figure illustrates the salt and water balance regulating mechanisms of marine vertebrates.

An
4
(c)
D

Class of organisms	Susceptibility to Osmotic Water Loss	Susceptibility to Evaporative Water Loss	Blood Conc Relative to Medium Conc	Urine Conc Relative to Blood Conc
Chondrichthyes	○	○	Isotonic	Isotonic
Osteichthyes	◎	○	Hypotonic	Isotonic
Reptilia	○	◎	Hypotonic	Isotonic
Mammalia	○	◎	Hypotonic	Hypertonic
Aves	○	◎◎◎	Hypotonic	Hypertonic

○ = No liability
◎ = Liability



N.B. hypertonic = higher concentration
isotonic = same concentration
hypotonic = lower concentration

Which of the following statements is consistent with the above information?

A The skin of marine mammals is permeable to water but not permeable to salt.

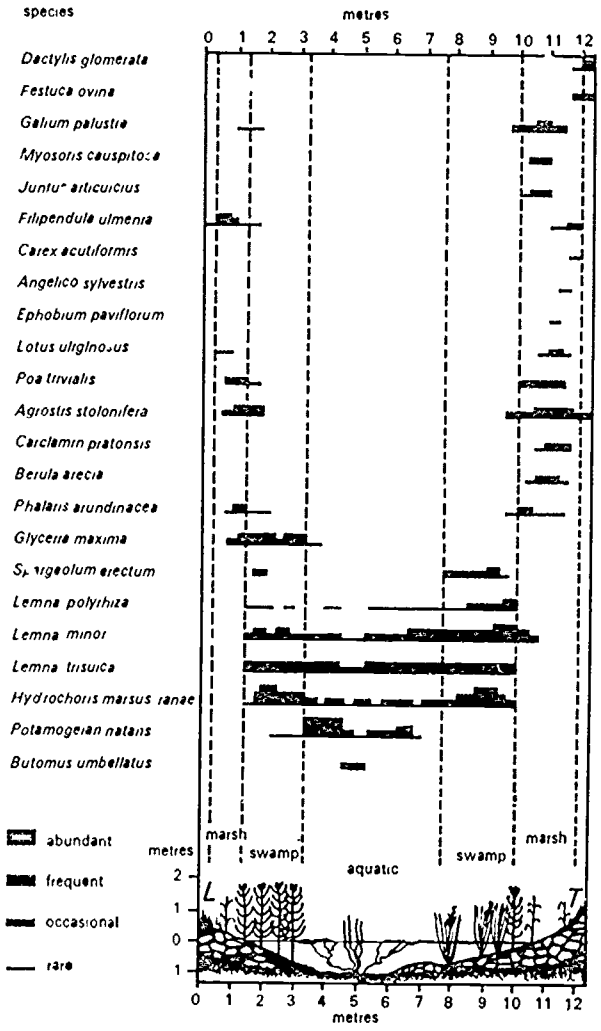
B Organisms which drink sea water have an internal salt concentration which is the same as sea water and thus do not excrete salt.

C Marine reptiles are well adapted to life in salt water because there is no net diffusion of either water or salts into or out of these organisms.

D The survival of vertebrates in a marine environment is aided by their ability to transport salt against a concentration gradient.

The next 4 items refer to the following information:

Pictured below is a transect made by a number of students who waded through a pond from point L to point T, noting the vegetation changes as they went.



3c-29 Which species is best adapted to an entirely aquatic environment?

An 2 (c) A

A *Potamogeian natans*
B *Glyceria maxima*
C *Spargeolum erectum*
D *Lemna minor*

3c-30 The swamp was partly drained, reducing the permanent water level to a point where the water was 14 cm deep. This resulted in the marsh-swamp boundary coming to lie close to the 3 and 7 metre marks.

An 3 (c) B

After a number of years, the students would expect to find

A *Lemna minor* at 2 metres.
B *Agrostis stolonifera* at about 3 and 7 metres.
C *Hydrochoris marsus-ranae* at 9 to 10 metres.
D *Poa trivialis* at 10 to 11 metres.

3c-31 – An 3 (c) D The students would expect to find, eventually, under the conditions described in the previous question, *Phalaris arundinacea*

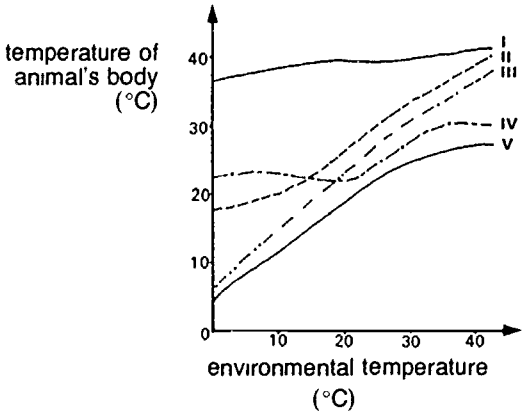
A in two zones around 1 and 10 metres.
B wiped out by the drier conditions.
C in two zones around 0.5 and 11 metres.
D in two zones around 3 and 7 metres.

3c-32 – An 4 (c) C * Species in the surrounding dry area, but not found on the original transect, would most likely be found on the 'drained' transect

A in two zones around 4 and 6 metres.
B in two zones around 2 and 10 metres.
C in two zones around 0 and 12 metres.
D in one zone around 5 and 6 metres.

The next 2 items refer to the following information:

Thermistors for measuring temperature were attached to the bodies of five different animals. The animals, which came from different habitats (e.g. water, air, moist soil), were kept in the laboratory, each animal being kept in a habitat as close as possible to its natural one except that the temperature was varied. The temperature of each animal was recorded for a wide range of environmental temperatures.



3c-33 17e An 4 (c) C Which one of the following conclusions concerning animal I is best supported by the data?

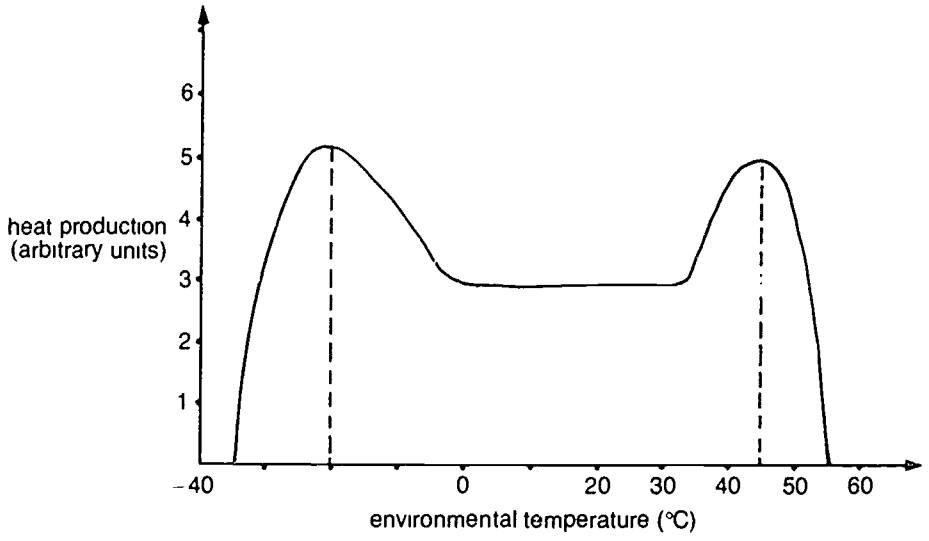
A Animal I probably comes from a terrestrial environment.
B Animal I maintains its temperature at a relatively constant level by shivering when the environmental temperature is below its normal body temperature of 37 °C.
C Animal I is homoiothermic over the environmental temperature range 0 – 40 °C.
D Animal I is probably a mammal.

3c-34 17e An 3 (c) B Which one of the animals probably does not possess any temperature-regulating mechanisms?

A animal II
B animal III
C animal IV
D animal V

The next 3 items refer to the following information:

The graph below shows the relationship between the metabolic heat production of a homoiothermic mammal at rest and the environmental temperature.



3c-35 9b An 5 (c) C

The range of environmental temperatures over which the mammal's body temperature was relatively stable is

A -35 °C to 50 °C.
B 0 °C to 30 °C.
C -20 °C to 35 °C.
D -25 °C to 40 °C.

3c-36 9b An 4 (c) B

If the environmental temperature gradually decreases from 45 ° to -40°C, the temperature at which shivering would probably begin is

A 35 °C.
B 0 °C.
C -20 °C.
D -35 °C.

3c-37 9b An 4 (c) A

The increase in metabolic heat production between environmental temperatures 35 °C and 45 °C is due to

A the response of the body's metabolism to an increase in body temperature.
B an increase in the activity of sweat glands.
C an increase in blood flow through the skin.
D a sudden increase in environmental temperature.

INCORRECT response items

3c-38 – Co 2 (i) D *
Plant adaptation to living on land made several new requirements necessary, including

A a means of absorbing water and minerals from the soil.
B structures to support the plants.
C a process for linking the gametes.
D the ability to manufacture their own food.

3c-39 – Kn 3 (i) B
The water-holding frog, *Cyclorana*, possesses a number of adaptations to its natural environment in inland Australia.

Adaptations which increase the frog's chances of survival include

A burrowing behaviour which reduces water loss as the animal is surrounded by soil.
B a body shape which has more surface area than any other shape of the same volume, thus reducing water loss.
C the ability to absorb water both through the body surface and from the contents of the urinary bladder.
D the reproductive cycle from egg to frog being completed in only a few weeks, before the pools dry up.

3c-40 – Kn 4 (i) D
The following adaptations enable desert plants to survive in their environment.

A drought resistant seeds which germinate after heavy rains
B long spike-shaped leaves which reduce the surface area exposed to the sun
C a root system situated close to the surface to absorb water after brief showers
D leaves with many small pores called stomata which absorb water from the atmosphere

3c-41 – Kn 4 (i) C
Each of the following is a mammalian adaptation which helps survival in areas of low temperature

A The extremities of the body can tolerate a temperature below that of the core temperature.
B Land mammals trap a stationary layer of air in their fur.
C The blood flow to the skin increases in the cold, thereby warming the skin.
D The layer of fat under the skin helps maintain the body temperature at a constant level.

3c-42 – Co 3 (i) D
Growth of a unicellular organism is limited by its ability to

A absorb sufficient food materials for its volume.
B regulate water absorption through its surface.
C excrete sufficient waste material through its surface.
D divide when conditions are favourable.

3c-43 – Co 4 (i) C
The dominant features in the environment of a red kangaroo are the high summer temperatures and the shortage of water. Other factors affecting the red kangaroo are the absence of shade trees, and the low nutritional value and high salt content of some herbage.

A behavioural adaptation of the red kangaroo in this environment is

A travelling long distances for water.
B licking the forelimbs to assist with cooling.
C producing more concentrated urine.
D seeking partial shade under low bushes.

3c-44 – Co 3 (i) D *
Desert frogs dig themselves into underground chambers during dry periods.

Each of the following is a likely explanation for this behaviour.

A The temperature of the soil in the chamber is lower than the soil temperature at the surface.
B The chamber is saturated with water vapour, thus reducing the frog's water loss.
C As the frog is shielded from the sun, water loss by evaporation is reduced.
D Water evaporates rapidly from the chamber, thus keeping it cool.

3d—Survival by response to the environment

CORRECT response items

The next 2 items refer to the following information:

The behaviour of animals is often described in terms of human emotions, understanding, and purposeful actions. This may be inaccurate as well as inappropriate since there is no evidence that all animals are capable of such feelings and action.

3d-1
17f
Co
4
(c)
C

Which one of the following statements is expressed in scientifically acceptable terms?

A The St Andrew's Cross spider began to spin a web in order to trap its food.

B After completing the main structure of the web, the female added extra strands at the centre so that the web would be strong enough to restrain the larger insects.

C Later the female moved to a position near the centre of the web and laid its eggs in pairs along three or four of the strands.

D During this time, so as not to be eaten by the female, the male spider lived mainly on the outer strands of the web.

3d-2
17f
Co
4
(c)
C

Tree frogs usually have certain structural characteristics which differ from those of frogs living in other environments.

With respect to these characteristics, and the information supplied above, which one of the following statements is correct?

A In order to live amongst trees, tree frogs have developed means of climbing.

B On each finger and toe, tree frogs have developed a disc so that they can take a firm grip of branches.

C Tree frogs have well-developed front legs which appear to suit them to climbing in trees.

D The hind legs have remained large and strong as it is necessary for tree frogs to be able to jump from branch to branch.

3d-3
–
Ap
2
(c)
D

Well-developed hearing organs are found at the base of the antennae of some insects.

This indicates that these insects probably

A feed at night.

B have well-developed sound-producing organs.

C would communicate only during the night with insects of the same species.

D depend for their survival on the detection of certain sounds.

3d-4
–
Ap
3
(c)
A

Arctic mammals become less active or hibernate during winter, whereas birds from the same region migrate south to the tropics for the winter season.

In which one of the following respects are these two types of behaviour similar?

A an adaptation to the problem of food availability in the Arctic winter

B an effective means of maintaining normal body temperature

C the seeking of a warm place to live

D a means of escaping predation during winter

4 REPRODUCTION

Reproductive Processes

4a—Sexual and asexual reproduction

CORRECT response items

4a-1 Which of the following is the **best** definition of sexual reproduction?

– Kn 2 (c) C

A the production of offspring genetically identical to the parents
B the result of two individuals mating
C the production of offspring after fusion of gametes
D the production of large numbers of offspring through mitosis

4a-2 Budding and regeneration can involve the formation of

– Kn 3 (c) A

A individuals or parts of individuals by mitosis.
B gametes which can fuse together to form a zygote.
C fruits and flowers in angiosperms.
D new organisms by meiosis of parent cells.

4a-3 14c Kn 3 (c) C

A biology student wished to examine prepared slides of animal tissue showing gamete formation. A number of prepared slides were found in the laboratory.

Which of the following would be suitable?

A human red blood cells
B section of early developing embryo
C section of rat testis
D section of human bone marrow

4a-4 14c Kn 4 (c) B

Which of the following classifications of cells is correct?

	cell	*classification*
A	fertilized egg	haploid
B	body cell of mother	diploid
C	body cell of embryo	haploid
D	spermatazoan	diploid

4a-5 – Co 1 (c) B

Which one of the following is an example of sexual reproduction?

A budding in yeasts
B fusion between gametes of red algae
C fission of nuclear material and cytoplasm in bacteria
D growth of a new plant from a piece of potato

4a-6 – Co 2 (c) B

Liverworts and mosses are classes of the Phylum Bryophyta. In the liverwort *Marchantia* small, multicellular buds develop by cell division in shallow cups on the upper surface of the plant. If a bud falls to the ground and forms root-like structures, a new generation results.

This process is an example of

A gamete formation.
B asexual reproduction.
C spore formation.
D sexual reproduction.

4a-7 – Ap 4 (c) B What is one disadvantage of natural vegetative reproduction by corms (e.g. gladiolus) and tubers (e.g. potato)?

A Special mechanisms are necessary for seed dispersal.

B The plants may not obtain enough light because of overcrowding.

C The climate in which the parent is growing is most likely unsuitable for the young plant to grow.

D There is less food stored in the reproductive structures than in seeds, so they have a poorer chance of surviving unfavourable conditions.

INCORRECT response items

4a-8 – Kn 2 (i) D * Each of the following statements concerning a seed and a reproductive spore is correct.

A Seeds contain an embryo plant, spores do not.

B Both seeds and spores are important in the dispersal of the species.

C Seeds and spores are often able to survive adverse conditions.

D Seeds and spores contain large stores of food for the developing plant.

4a-9 4e Kn 3 (i) B * In one type of asexual reproduction, many single cells are formed in special reproductive structures.

This occurs in

A fungi.

B bacteria.

C ferns.

D mosses.

4a-10 – Co 3 (i) B Each of the following is an example of asexual reproduction.

A budding in the freshwater animal, *Hydra*

B conjugation in the filamentous alga, *Spirogyra*

C binary fission in the bacterium, *Escherichia coli.*

D spore formation in the fern, *Pteridium*

4b—Sexual reproduction and variability

CORRECT response items

4b-1 – Kn 2 (c) B

If large numbers of similar offspring are produced, it is reasonable to conclude that this reproduction

A involves fusion of gametes.
B is asexual.
C results in all-female offspring.
D involves zygospores from which the offspring have developed.

4b-2 – Kn 3 (c) D *

Cross-pollination is more common than self-pollination.

The most likely reason for this is that

A cross-pollination is a more reliable method of gamete transfer.
B cross-pollination provides food for insects.
C most plants have mechanisms for preventing self-pollination.
D cross-pollination produces a greater variety of plants.

4b-3 4d Co 4 (c) A

Consider the following table.

Method of reproduction	Example from animal kingdom	Example from plant kingdom
Sex cells released into the water in which the organism lives permanently	codfish	seaweed
Sex cells released into water near which the organism lives	frog	fern
Sex cells unite within the body of one of the parents	dog	gumtree

This table can be used to support the proposition that

A the more highly evolved forms of life have abandoned external fertilization.
B each step is an advance in the survival rate.
C the highly evolved forms of life must produce a greater abundance of offspring than the less highly evolved forms.
D there is more variation in the highly evolved forms of life.

4b-4 14d Ap 2 (c) A

Animals that are hermaphroditic rarely fertilize themselves.

The most important reason for this is that

A the range of difference between the offspring is increased.
B many hermaphrodites are parasitic.
C many more sperm than eggs are produced.
D they are attracted to the opposite sex by chemicals.

4c—Reproductive systems

CORRECT response items

4c-1 – Kn 2 (c) C

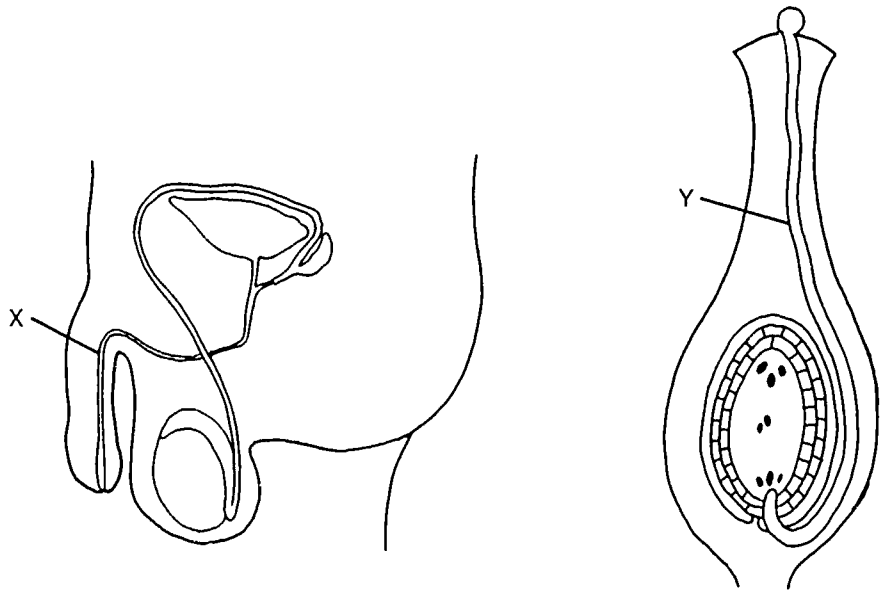
A method of contraception currently available is an operation known as a vasectomy. This involves cutting and/or tying the vas deferens (sperm duct).

The result of this operation is that

A no semen is produced.
B no sperm are produced.
C semen would contain no sperm.
D semen would contain no nutrients for the sperm.

4c-2 – Kn 2 (c) D

The following diagrams represent the reproductive systems of a human and a flowering plant.



How are the functions of the two tubes marked X and Y related?

	X	*Y*
A	carries out fertilization	carries out pollination
B	transfers gametes	nourishes developing embryo
C	transfers embryo to female	carries male gamete to female gamete
D	transfers gametes	carries male gamete to female gamete

4c-3 – Kn 2 (c) C

Identical twins are formed when

A two sperm fertilize two ova, forming two zygotes.
B two sperm fertilize one ovum, which divides to form two zygotes.
C one sperm fertilizes one ovum, which divides to form two zygotes.
D one sperm divides to fertilize two ova, forming two zygotes.

4c-4 – Kn 2 (c) B

When studying reproduction in placental mammals, four students were given a list of organs and a list of the processes occurring in each organ. The students matched them in the following manner.

	Organs and processes				
Student	oviduct	penis	uterus	testis	ovary
I	egg production	sperm transfer	development of embryo	sperm production	fertilization
II	fertilization	sperm transfer	development of embryo	sperm production	egg production
III	development of embryo	sperm production	fertilization	sperm transfer	egg production
IV	fertilization	sperm production	development of embyro	semen production	egg production

Which student matched them correctly?

A I
B II
C III
D IV

4c-5 – Kn 2 (c) C

Marsupials are non-placental mammals.

This implies that

A the female marsupial has no uterus.
B fertilization is external.
C the young are born at an early stage of development.
D the mammary glands produce milk immediately after fertilization.

4c-6 – Kn 3 (c) A *

The following table lists some structural characteristics of flowers.

Number	Characteristic
I	Flowers brightly coloured and scented
II	Flowers small and inconspicuous
III	Pollen heavy and sticky
IV	Pollen light and smooth
V	Nectar present at the base of each petal
VI	Stamens big and protude outside the petals
VII	Stigma compact
VIII	Stigma large and feathery

Which characteristics best refer to insect pollinated flowers?

A I, V, VII
B I, IV, VI
C II, IV, VIII
D IV, V, VIII

4c-7 – Co 3 (c) D

During studies made of the tammar wallaby it was found that a hormone called prolactin maintained milk secretion and inhibited ovarian function.

Factors which increase the production of prolactin in female humans are the suckling of infants and a low level of nutrition of the mother.

In hunter-gatherer societies today, women suckle their young for up to four years and during this time they do not become pregnant.

This failure to become pregnant may occur if prolactin

A production is increased by suckling of infants
B production is increased by a low level of nutrition.
C maintains the production of milk.
D inhibits the production of ova.

4c-8 How does the embryo of a placental mammal obtain its food?

– Kn 3 (c) D

A The mother's blood flows into the embryo, carrying food with it.

B Stored food in the yolk sac is sufficient to provide nutrition for the developing embryo.

C The embryo's digestive system is linked to the mother's digestive system through the umbilical cord.

D Substances diffuse from the mother's bloodstream to the embryo's bloodstream in the placenta.

4c-9 Which process in mammals is most similar to pollination in flowers?

– Kn 4 (c) A

A depositing sperm near the cervix

B fertilization of the ovum by sperm

C the testes producing sperm

D growth of the umbilical cord

4c-10 4d Co 3 (c) A

Human semen consists of sperm cells and secretions from various glands. One of these secretions contains a high concentration of the simple sugar fructose.

The function of this sugar in the semen would be to

A provide a readily usable energy source for the sperm.

B prevent the sperm dessicating (drying out) and thus dying.

C provide a medium through which the sperm can swim to the ova.

D maintain an ideal level of acidity.

4c-11 11e Co 3 (c) B

The following data show the difference in oxygen saturation between the blood of a pregnant woman and that of the fetus developing in her uterus, when each type of blood is exposed to air with the oxygen concentrations shown.

Partial pressure of oxygen in air (kN/m^2)	Percentage saturation of blood with oxygen	
	Mother	Fetus
1.3	8	10
2.7	20	30
3.9	40	60
5.3	65	77
6.6	77	85
8.0	84	90
9.3	90	92

Which of the following statements is supported by the data in the table?

A Equal volumes of maternal and fetal blood will contain the same amount of oxygen in the same environment.

B Fetal blood has a greater tendency to bind with oxygen than maternal blood under the same conditions.

C Oxygen passes from maternal blood to fetal blood through the placenta by simple diffusion.

D The blood of the mother contains less haemoglobin than the blood of the fetus.

4c-12 2d Ap 2 (c) B

Considering the reproductive mechanisms of the following organisms, in which one would the developing embryo normally spend the longest time within the mother's reproductive tract?

A emu

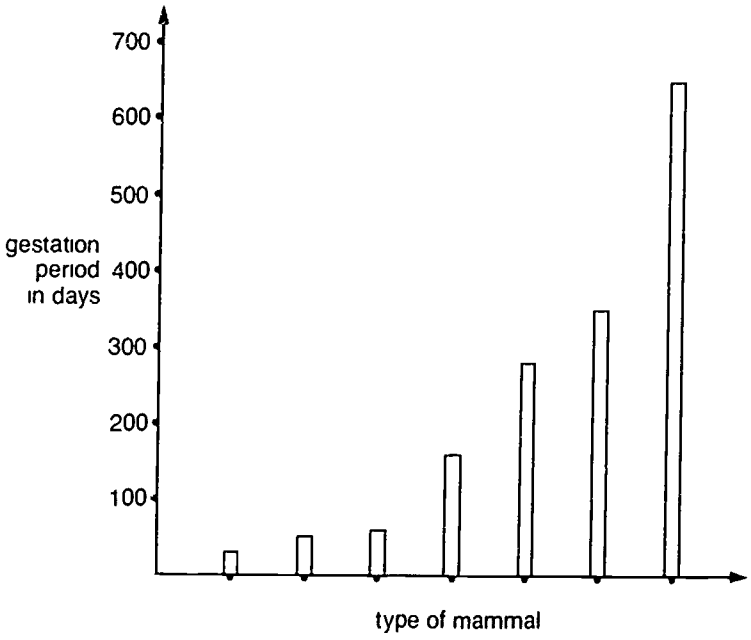
B dingo

C kangaroo

D echidna

4c-13 The gestation periods of some mammals are graphed as follows.

–
Co
4
(c)
D



A group of biology students was asked to propose an explanation for the above data.

Which of the following best explains the relative gestation periods?

A the life expectancy of the individuals of the species
B the size of the cells of which the individuals are composed
C the degree of development of the nervous system
D the mass of the new born

4c-14 Tammar wallabies are adapted for strict seasonal breeding.

–
Co
5
(c)
D

Scientists investigating tammar wallabies took them from Kangaroo Island, South Australia (35 °S), to Louisiana, USA (30 °N), which has a humid, subtropical climate.

On Kangaroo Island, females give birth at the hottest, driest time of the year when their general condition is approaching its lowest ebb, but by the time the pouch young make a heavy demand for milk, the winter rains have fallen and feed is available.

In Louisiana, the females give birth in July after the northern hemisphere's summer solstice (mid-summer day).

This suggests that the onset of breeding is influenced by

A the abundance of food and water.
B the condition of the wallabies.
C the month of the year.
D the changing day length.

4c-15 Mammalian ova are smaller than ova of other organisms such as birds because

–
Ap
2
(c)
C

A mammalian ova contain special nutrients.
B many mammalian ova have to be stored in the uterus.
C nutrients for the mammalian embryo are supplied via the placenta.
D mammals such as mice are smaller than birds such as kookaburras.

4c-16 – Ap 3 (c) B A couple who had been unsuccessful in having a baby wished to take advantage of the new technique of in-vitro fertilization (commonly called 'test-tube baby'), using the woman's own egg and the man's sperm. In this technique, the fertilized egg is placed in the woman's uterus to develop in the normal way.

Which of the following infertility problems could most easily be overcome by this method?

A failure of the follicle to mature
B blocked oviducts from severe infection
C unstable uterine wall which greatly reduces the probability of implantation
D pelvis too small to allow normal development of the fetus

The next 2 items refer to the following information:

Although a cow's ovary normally releases only one egg at a time, by using certain techniques it is possible to induce the release of a large quantity of eggs. The method of artificial insemination can then be used to have as many as 100 fertilized eggs produced in a particular animal. Several days after this mass conception, the embryos can be flushed out and implanted directly into the uteri of other cows. Provided these have been properly prepared with hormones, the implanted cow embryo will go through a normal gestation period and be born.

If transplanted into smaller animals such as rabbits that have been prepared to receive them, it has been shown that the embryos will develop normally for up to 14 days. If after 10 days these cow embryos are removed from the rabbits and put into prepared cows, they develop normally.

4c-17 – Ap 2 (c) C The chief advantage of such a process of mass fertilization is that

A a few closely related offspring can be produced.
B a single cow can give birth to more offspring with special characteristics.
C more offspring of a specified type can be produced at one time.
D the offspring will have more varied genetic qualities because of gestation in a foster mother.

4c-18 – Ap 3 (c) D * Since development of the embryos can continue in a rabbit, it can be assumed that

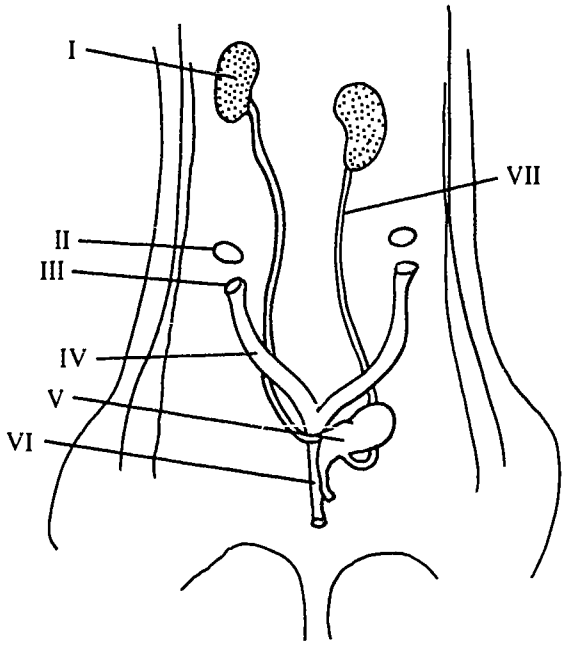
A cows and rabbits belong to the same order.
B because of this early gestation period in the rabbit the offspring so fostered will be infertile.
C vertebrate embryos have similar growth requirements at some stages of development.
D development of the fertilized cow ova can take place anywhere provided the environmental conditions are suitable.

4c-19 5a Ap 3 (c) D A woman who gave birth to three babies was uncertain as to the reason for the multiple birth. Her doctor said that even though she had given birth to three babies, he was reasonably sure that in her case, only one egg was released from each ovary, and these were fertilized independently.

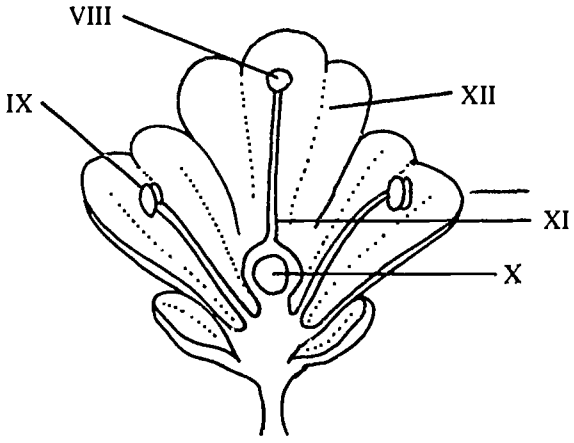
The doctor's reason for stating this would be because the woman had given birth to

A a girl and two boys, all of whom were non-identical.
B three girls, all of whom were identical.
C two boys and a girl, the girl and one of the boys being identical.
D three boys, two of whom were identical.

The next 3 items refer to the following diagrams:



The Reproductive System of a Rat



Section through a Flower

4c-20 Which structure in the flower has the same function as structure II in the rat?

–
Ap
3
(c)
C

A structure VIII
B structure IX
C structure X
D structure XI

4c-21 The sites of fertilization in the rat and the flowering plant respectively are

4e
Ap
3
(c)
C

A II and X .
B III and VIII .
C IV and X .
D IV and VIII .

4c-22 The main function of structure XII in the flowering plant is to

–
Kn
2
(c)
D

A protect all parts of the flower from the wind.
B aid in the dispersal of seeds.
C protect the ova from predators.
D attract insects for pollination.

4c-23 – An 2 (c) A

In a study of male tammar wallabies in Australia, scientists found that the prostate glands involved in the production of seminal fluid are much enlarged from December to March. This enlargement is stimulated by an increase in the concentration of hormones, from testes and pituitary gland, in the blood of a tammar.

Two groups of males were investigated. The scientists tested the levels of the hormones in the blood of the male tammars which were isolated from female tammars, as well as those in company with females.

Isolated males and males with non-breeding females showed no increase in the appropriate hormones from December to March, while the males with females in breeding condition showed marked increases in these hormones in the same months.

The conclusion best drawn from this study is that the males' breeding condition is most influenced by

A the breeding condition of the females.
B the presence of the females.
C the enlargement of the prostate glands.
D the day lengths from December to March.

INCORRECT response items

4c-24 – Kn 2 (i) B *

Normal sperm cell production in man

A takes several weeks.
B occurs at body temperature.
C takes place in the seminiferous tubules.
D yields millions of sperm.

4c-25 – Kn 3 (i) B

Flowering plants carry out sexual reproduction despite the fact that most are anchored to the one position.

In order to reproduce

A some plants have pollen adapted to transport by wind or animals.
B bi-sexual flowers usually self-pollinate, an adaptation to the sessile (non-mobile) existence.
C the pollen grain produces a pollen tube containing the two male gametes, which grows down to the ovule.
D the ovule contains a number of female sex cells, one of which combines with a male gamete to form an embryo.

4c-26 In the human female reproductive system,

–
Kn
3
(i)
D

A many developing ova are already in a resting stage in the ovaries at the time of birth.
B usually only one ovum completes development in each menstrual cycle.
C ovulation occurs when the follicle bursts, releasing an ovum.
D the ovum enters the oviduct which is attached to the ovary at one end and the uterus at the other end.

4c-27 In angiosperms and gymnosperms seeds are produced as a result of sexual reproduction.

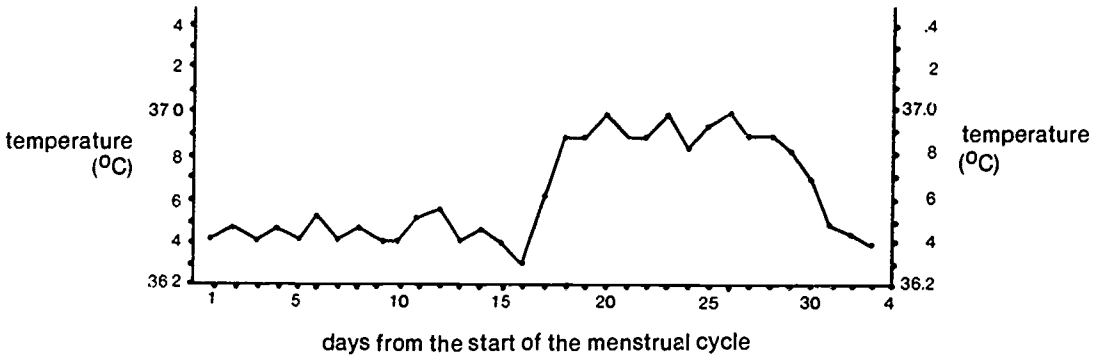
–
Kn
4
(i)
A
*

These seeds

A are the first complete cell of the new individual of that species.
B contain a food supply called an endosperm which consists largely of starch.
C are surrounded by a seed coat or testa which protects the contents.
D contain an embryo which will become the roots and shoots of the new plant.

4c-28 The graph shows the core temperature changes of a particular human female during a menstrual cycle.

–
Ap
3
(i)
B



Core temperature changes of a human female during her menstrual cycle

For this particular person it is probable that

A menstruation occurred during days 1 to 4.
B ovulation occurred about day 14.
C the probability of pregnancy occurring was greatest if intercourse took place during days 15 to 20.
D if fertilization had occurred, implantation would have occurred around day 23.

Reproduction and Survival

4d—Characteristics enabling reproduction, survival and dispersal

CORRECT response items

4d-1 – Co 1 (c) B

Violets produce two kinds of flowers, both of which produce seeds. Type I are bright purple, sweetly scented and open fully. Type II are inconspicuous and do not open.

Which of the following is **most likely true** for the two types of flowers?

	Type I	*Type II*
A	wind pollinated	insect pollinated
B	insect pollinated	self pollinated
C	insect pollinated	sterile
D	wind pollinated	self pollinated

4d-2 – Co 2 (c) B

As the flowers of grasses are generally small and green, one is seldom aware of them.

This observation suggests that grasses are usually

A not pollinated.
B wind-pollinated.
C pollinated by crawling insects.
D pollinated by flying insects.

4d-3 – Co 2 (c) D

The following table describes characteristics of four different plant species.

Species	Flower scent	Flower colour	Nectar	Flower position—height above ground (cm)
sweet pea	sweet	bright pink	produced	20—200
Banksia marginata	musky	yellow–green	produced	50—300
Aspidistra lurida	nil	brown	not obvious	0—1
maize	nil	white–green	absent	50—150

Which species is most probably pollinated by wind?

A sweet pea
B *Banksia marginata*
C *Aspidistra lurida*
D maize

4d-4 – Ap 1 (c) D

The following table gives gestation times and average number of offspring for some mammals.

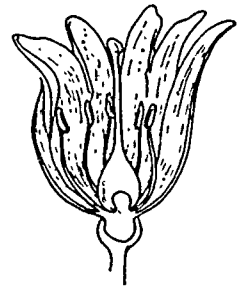
Species	Common name	Average gestation (days)	Average number of offspring (approx.)
Rattus norvegicus	black rat	21	12
Felis catus	cat	63	6
Canis familiaris	dog	63	6
Homo sapiens	man	278	1
Equus caballus	horse	336	1
Elephas maximus	Indian elephant	624	1

A reasonable conclusion from this table is that the larger the mammal

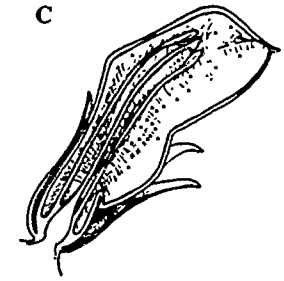
A the shorter the gestation and the larger the number of offspring.
B the shorter the gestation and the smaller the number of offspring.
C the longer the gestation and the larger the number of offspring.
D the longer the gestation and the smaller the number of offspring.

4d-5 The following diagrams show the cut-away views of four different flowers.
–
Co Which flower is most likely to be self-pollinating?
3
(c)
C

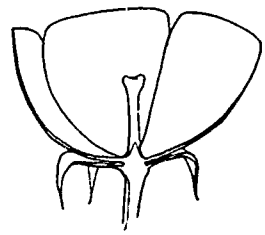
A



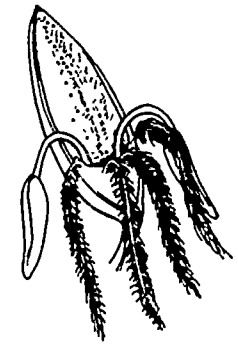
C



B



D



4d-6 Which of the following statements applies to an animal species that reproduces sexually?
–
Co A It must have two separate sexes.
4 B Male gametes must be transferred to the female's body.
(c) C The embryo must develop inside the female.
D D Fertilization must occur in a watery medium.

4d-7 Australian horticulturalists have found that it is necessary to place the bulbs of certain tulips in a refrigerator for a few weeks before planting if they wish to get flowers from these plants.
–
Ap The reason for this procedure is probably to
3
(c) A inhibit bulb rot.
C B destroy tulip parasites.
C provide the period of cold necessary in the life cycle.
D ensure controlled germination and a subsequent active growing period with a maximum of foliage.

4d-8 During studies made of the tammar wallaby it was found that a hormone called prolactin maintained
17k milk secretion and inhibited the development of an embryo by directly inhibiting ovarian
An function.
3
(c) In female humans, the suckling of infants and a low level of nutrition are two factors which increase the
C production of prolactin. Both factors are thought to be significant in maintaining a long interval between births.

If prolactin directly inhibits the function of the ovaries in humans, it may be of use to humans

A in the nutrition of females while breast-feeding infants.
B for regulating the gestation period.
C as a new type of contraceptive.
D in aiding fertilization of an ovum.

The next 2 items refer to the following information:

The following table contains information about the life cycles of a brown snake, dog, trout, frog and magpie.

Organism	Type of fertilization	Egg or live-born	At birth: Body covering	At birth: Overall appearance compared with adult
I	inside female	egg in calcarous shell	feathers	adult-like
II	outside female	eggs in jelly-like mass	moist skin	very different from adult
III	inside female	live	dry skin	adult-like
IV	outside female	eggs in jelly-like mass	X	adult-like
V	inside female	live	scales	adult-like

4d-9 5c Ap 2 (c) A

Organism III is probably a

A dog.
B trout.
C brown snake.
D frog.

4d-10 5c Co 4 (c) B

The missing characteristic labelled X in the table is

A feathers.
B scales.
C moist skin.
D hair.

4d-11 17f Ap 2 (c) B

The next item refers to the following table:

Organism	Number of offspring capable of being produced	Number of offspring that survive as adults
Field mushroom	16 000 000 000 spores per mushroom	1–2 next year
Western rock lobster	2 100 000 over 7 years	7 over 7 years
Pink cockatoo	40 eggs laid over 15 years	2–3 after 5 years
Banksia tree	120 000 seeds per 15 years	1–5 trees

Use the data in the table and your knowledge about the conditions under which the organisms reproduce to select the statement which is true.

A The more offspring produced by a species, the more offspring reach maturity.
B The more difficult that survival is for the young of a species, the more offspring that species seems to produce.
C The more easily offspring are dispersed, the more likely an individual is to survive.
D The more parental care supplied by organisms, the more offspring that species seems to produce.

4d-12 4e Ap 4 (c) B

Moss spores are produced in a capsule. They are released when the lid of the capsule falls off, and teeth closing the capsule open. In wet weather the teeth close the capsule and prevent the escape of spores. In dry weather the teeth open or even shrivel, allowing the release of the spores.

The best explanation of this process is that

A spores need dry conditions for germination.

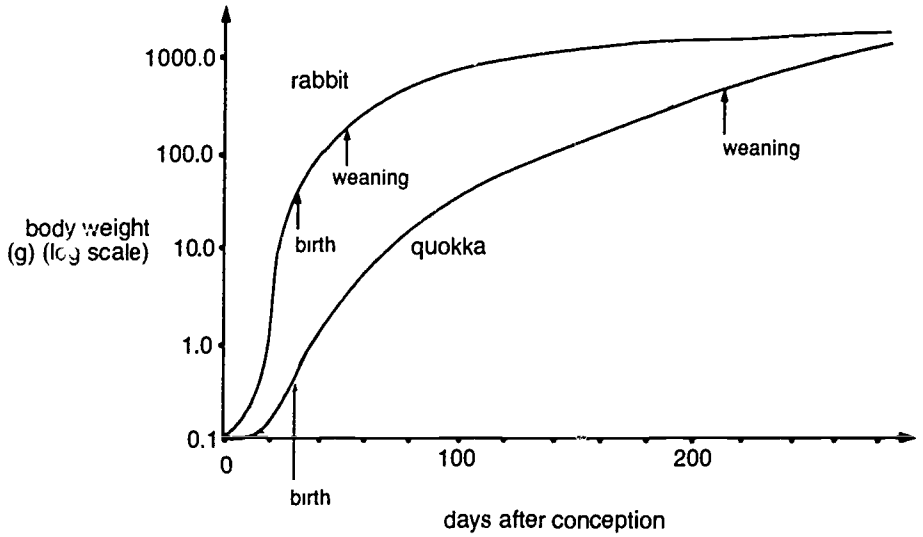
B spores are scattered more widely in dry weather.

C moss plants grow more rapidly in wet weather.

D male gametes in mosses require water to swim to a female gamete.

4d-13 – An 5 (c) A *

Reproduction in an arid climate poses particular problems for female mammals. The following graph shows a comparison of the growth of a placental mammal (the rabbit) and a marsupial (the quokka) from conception to adult size.



Which of the following is supported by the information in the graph?

A The marsupial mother has the advantage that, by providing less food during the early development of the offspring, she can discard the offspring during drought with little loss to herself.

B In a dry climate, the mammary gland is a more efficient organ than a placenta for nourishing the offspring.

C Although the rabbit and the quokka both weigh the same at birth, in drier areas it takes the quokka longer to reach adult size.

D The time spent during gestation and lactation is not significantly different in the two species, considering the time taken to reach adult size.

INCORRECT response items

4d-14 – Kn 1 (i) B

In some animals, under certain conditions, egg cells often develop into new individuals without fertilization by a sperm cell.

This type of reproduction

A is known as parthenogenesis.

B usually produces equal numbers of male and female offspring.

C may be the only type of reproduction of same species.

D may be combined in a life cycle with sexual reproduction.

4d-15 Angiosperms have adaptations that ensure pollination.
–
Kn
2
(i)
B

These include

A bright colours that seem to attract bees.
B an offensive odour and pale colour which indicate that the flower is self-pollinating.
C sugary nectar which may be sought after by various insects and birds.
D landing stages which seem specifically adapted to insect pollination.

4d-16 Bats, being nocturnal mammals, sometimes act as pollinators.
–
Co
1
(i)
A

Bat-pollinated flowers would need to have the following characteristics.

A bright colour
B opening at night
C strong scent
D sturdy structure

4d-17 In birds it is often the male that is more brightly coloured than the female.
–
Co
2
(i)
C

Each of the following is a reproductive explanation of this colour difference.

A attraction of a female
B marking of territory
C providing camouflage
D identification of sex

4d-18 Most mammals go through a number of stages of development during their lifetime. These stages are generally associated with the attainment of various functions and abilities which enable the animal to live independently and reproduce.
5c
Co
3
(i)
B

Placental mammals show the following features during their development.

A The embryo develops rapidly inside the uterus.
B There is a continuous decline in the rate of growth after the animal is born.
C The behavioural skills of the animal increase in number and complexity.
D The functioning of various parts of the body changes with time.

4d-19 Dispersal of offspring, as soon as they are produced, is usually thought of as an aid to their survival.
–
Ap
2
(i)
C

This would be true for the

A field mushroom
B western rock lobster
C pink cockatoo
D Banksia tree

4d-20 Mangroves are shrubby plants which grow on mud flats in river estuaries subject to tides. In some species of mangroves, germination of seeds occurs while they are still inside the fruit attached to the plant. The fruit releases a young seedling which may embed in the mud and develop into a new plant.
–
Ap
3
(i)
D

A reasonable explanation of this process is that

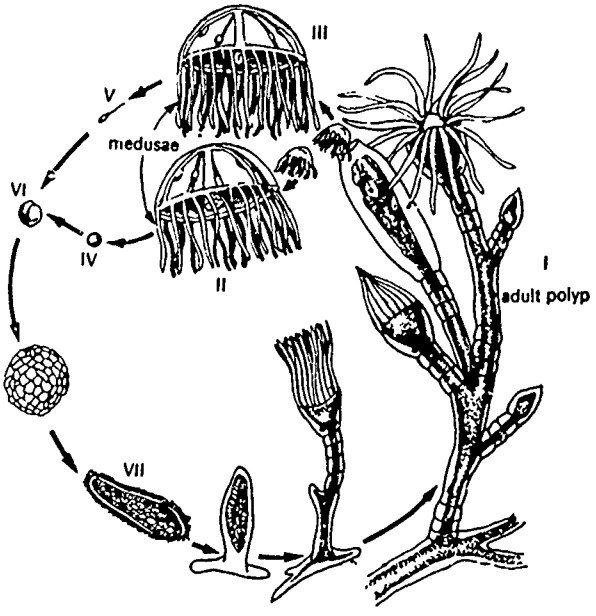
A waterlogged mud lacks oxygen and is not a favourable environment for germination.
B mangrove seeds require light for germination.
C mangrove seedlings are better adapted for anchorage against the tides than seeds are.
D mangrove seedlings quickly establish themselves enabling photosynthesis before high tide floods the young plants.

4e—Life cycles and their reproductive stages

CORRECT response items

The next 3 items refer to the following information:

The diagram below shows the life cycle of a particular coelenterate. (Coelenterates have structures known as polyps which generally have three functions—feeding, reproduction, and protection.)



4e-1 Fertilization occurs immediately before stage/s

Co 3 (c) B

A I.
B VI.
C VII.
D II and III.

4e-2 Asexual reproduction occurs in stage/s

Co 3 (c) A

A I.
B II and III.
C IV and V.
D VII.

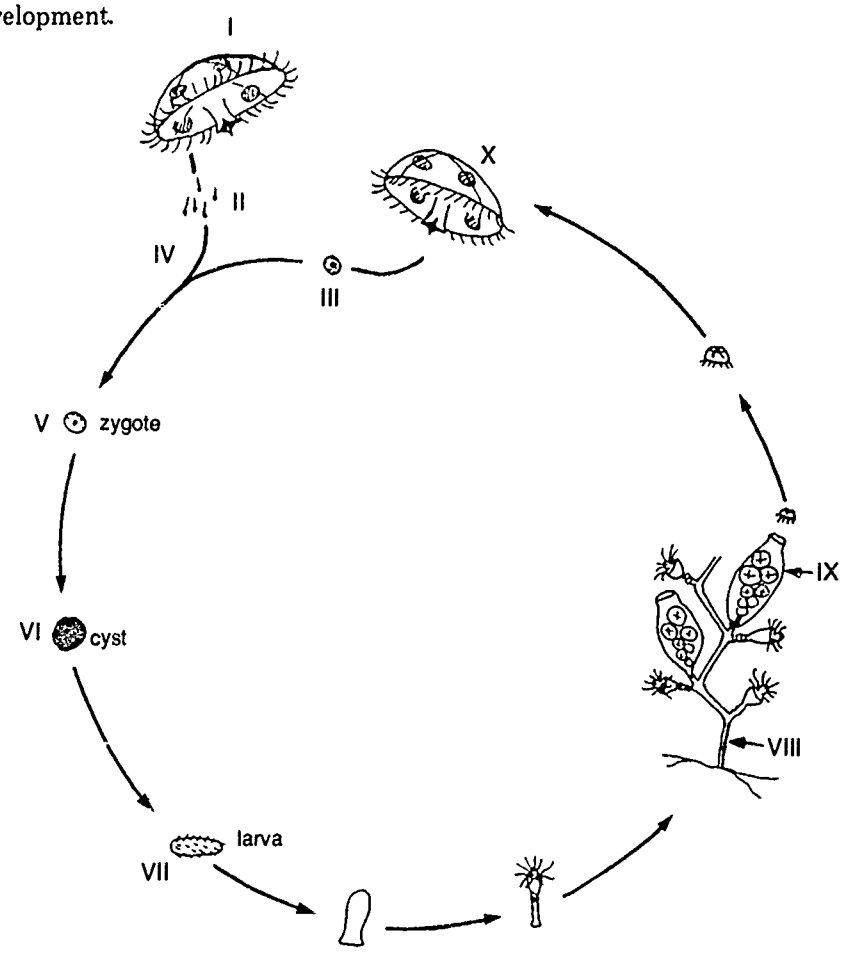
4e-3 Which stage could be considered female?

Co 3 (c) B

A I
B II
C III
D IV

The next 4 items refer to the following information:

The diagram shows the life-cycle of *Obelia*, a marine coelenterate, and the letters refer to various stages in its development.



4e-4 Which stage represents sexual reproduction?

– Co 2 (c) A

A U
B V
C W
D Y

4e-5 Which stages disperse the species?

– Co 4 (c) C

A U and Y
B R and Y
C W and Z
D U and W

4e-6 Which is/are the adult stage (or stages)?

– Co 1 (c) C

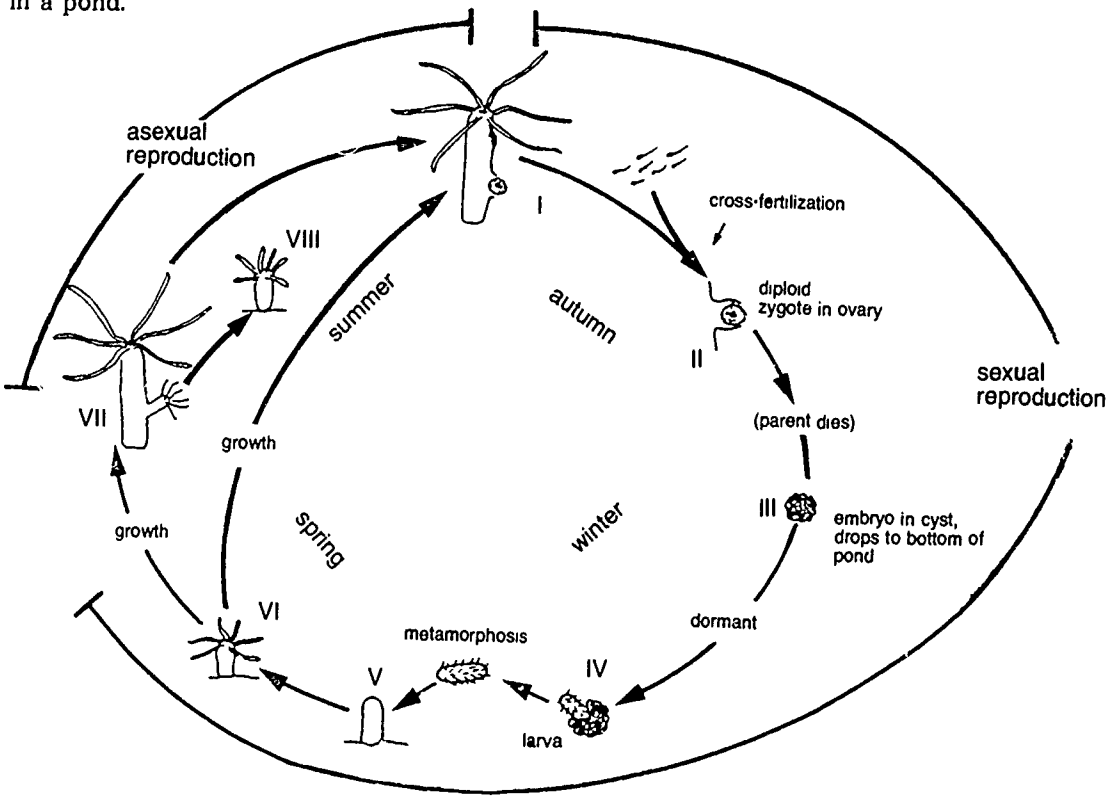
A V
B W
C X and Z
D V and W

4e-7 Which stage produces most individuals?

– Co 4 (c) D

A T
B V
C Y
D Not enough information given.

The next 4 items refer to the following diagram of the life cycle of the coelenterate *Hydra* in a pond.



4e-8 From the above diagram and your own knowledge, it can be concluded that

–
Co
3
(c)
D

A asexual reproduction always occurs before sexual reproduction.
B sexually reproducing *Hydra* are hermaphrodites.
C sexual reproduction involves budding of new individuals.
D new individuals undergo growth before sexual or asexual reproduction.

4e-9 The individuals showing most variation from each other are

4b
Co
3
(c)
C

A VI and VII
B VI and VIII
C VI and I
D VII and VIII

4e-10 The changes in the organism from stage VI to VII involve

5b
Ap
4
(c)
C
*

A cell division only.
B cell division and cell enlargement only.
C cell division, enlargement and specialization only.
D cell division, enlargement and specialization, and reproduction.

4e-11 What is the significance of stage III in this life cycle?

4d
Ap
2
(c)
B

A to feed on detritis at the bottom of the pond
B to survive the adverse conditions of winter
C to await fertilization by male gametes
D to produce many new organisms from the one cyst

4e-12 Which of the following is a part of the sporophyte generation in the lifespan of a moss?

–
Kn
4
(c)
A

A the stalked capsule
B the formation of sperms and eggs
C the germination of a spore
D the leafy plant

4e-13 In angiosperms and gymnosperms, the female gamete is usually retained within the tissues of the parent.

–
Co
3
(c)
D
*

This is an advantage because

A cross fertilization is more likely to occur.
B dispersal of the seed is made more successful.
C sexual reproduction is made possible.
D a moist environment is provided for the gametophyte.

4e-14 Even though adult ferns lack the power of locomotion, the male gametes may reach the female gametes of different individuals (so achieving cross-fertilization) by

2f
Co
5
(c)
A
*

A swimming from one individual to another.
B the transfer of pollen grains during pollination.
C being produced in the same spore case as the female gametes.
D vegetative propagation.

The next 2 items consist of statements. Consider each statement, then for each one write

A if it indicates that sexual reproduction has taken place.
B if it indicates that asexual reproduction has taken place.
C if it indicates that *both* sexual and asexual reproduction have taken place.
D if it is not possible to determine from the statement whether sexual or asexual reproduction (or neither) has taken place.

4e-15 In successive generations of onions the offspring have varying sizes, flowering periods, and flower colours.

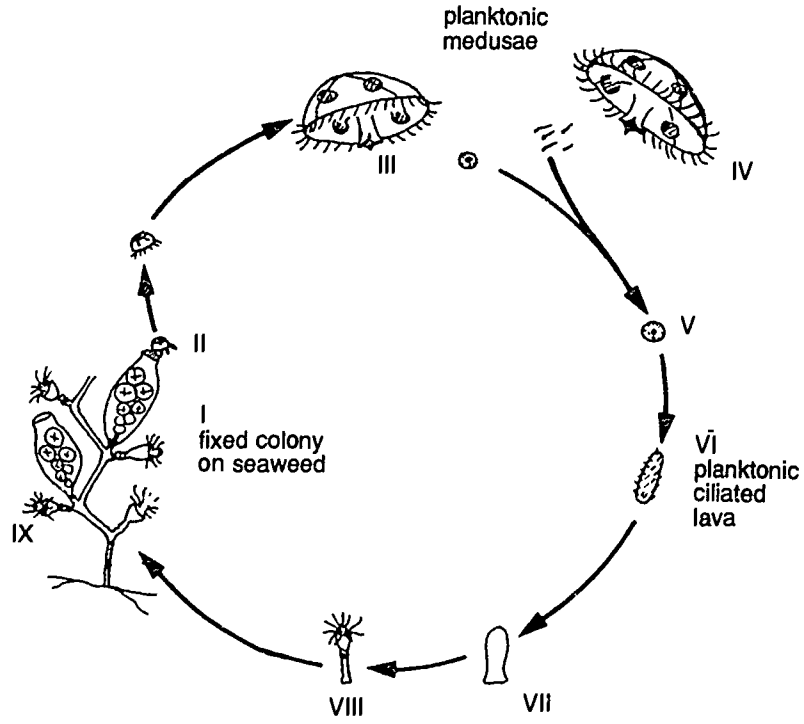
4b
Ap
3
(c)
A

4e-16 *Volvox*, a spherical colonial green alga, is observed to have smaller *Volvox* growing within it.

4b
Ar
4
(c)
D

INCORRECT response items

The next 3 items refer to the following diagram of the life cycle of *Obelia*, an aquatic coelenterate.



4e-17 Each of the following would have identical inheritable characteristics.

Co 3 (i) A

A III and IV
B V and VII
C VI and IX
D VIII and II

4e-18 The functions of the medusae include

An 4 (i) B

A dispersal of the offspring of the species.
B maintenance of the characteristics of the colony.
C increasing the species' range of characteristics.
D producing gametes for zygote formation.

4e-19 Asexual reproduction in *Obelia* is important to

An 4 (i) C

A minimize the wastage of gametes.
B preserve characteristics favourable to the immediate environment.
C minimize competition from other colonies of *Obelia*.
D hasten the initial colonization of a habitat.

4e-20 Before reaching maturity, an insect with a larval stage in its life cycle

Kn 2 (i) C *

A must have hatched from an egg.
B must have undergone metamorphosis.
C must have experienced a nymphal stage.
D could have experienced diapause.

5 NUTRITION, DEVELOPMENT AND GROWTH

Development and Growth

5a—Changes in a lifetime

CORRECT response items

5a-1 – Kn 3 (c) A *

Organisms come into being, live for a period, and then die. For multicellular organisms life begins as a single cell and follows a sequence which ends in death.

This sequence is best summarized as

A zygote formation, cell reproduction, differentiation, maturation, senescence.
B zygote formation, differentiation, cell reproduction, maturation, senescence.
C cell reproduction, zygote formation, maturation, differentiation, senescence.
D cell reproduction, differentiation, zygote formation, senescence, maturation.

5a-2 – Co 2 (c) C

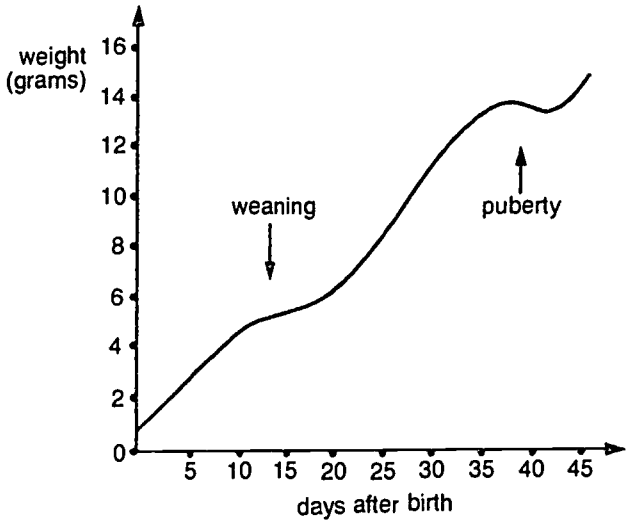
A severe blow to the head may fracture the skull and damage brain tissue. With good care the fractured skull will mend, but damage to brain tissue is often permanent.

This suggests that bone cells and nerve cells differ in their

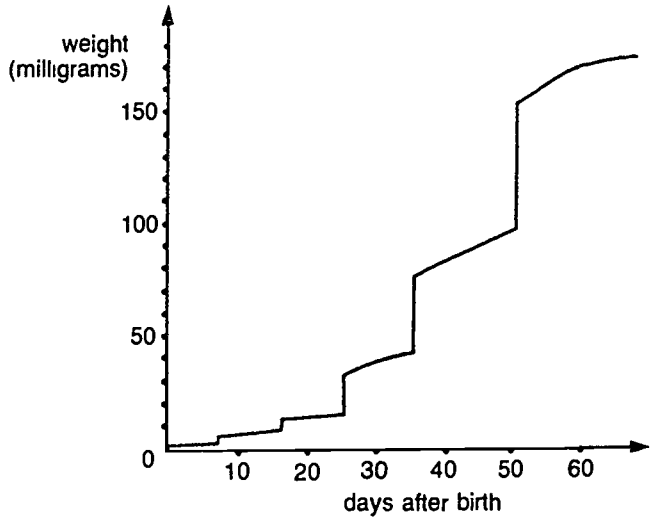
A capacities for respiration.
B methods of obtaining oxygen.
C capacities for reproduction.
D methods of removing waste substances.

The next 3 items refer to the following information:

The graphs illustrate the weight changes of a mouse and an insect during the first month or two after birth.



Growth in weight of a laboratory mouse



Growth in weight of an insect

5a-3 – Co 3 (c) B *

Which of the following would account for some of the differences between these graphs?

A Pregnancy in mice lasts for 21 days.
B Mice have a greater rate of growth than insects.
C There is a constant weight increase in mice.
D Mice reach their maximum size by day 40 whereas insects keep growing after this time.

5a-4 – Co 2 (c) B *

Consider the growth curve for the mouse.

The greatest growth rate occurs

A between days 5 and 10.
B between days 25 and 30.
C on day 38.
D on day 45.

5a-5 – Co 2 (c) B

Insects regularly shed their exoskeleton (moulting) to enable growth to occur. The time interval between successive moults is called a stadium.

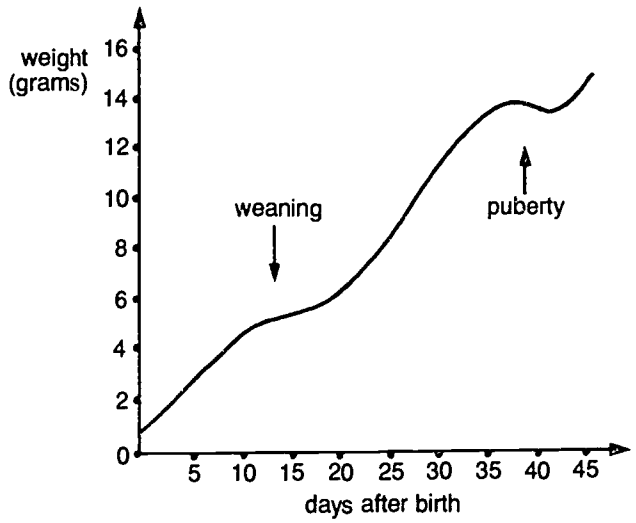
From the growth curve for the insect, which of the following is correct?

A The longest stadium occurs after the third moult.
B There is a smaller weight increase between moults two and three than between moults one and two.
C If the insect had not undergone its fifth moult, it would have reached a weight of about 104 grams by day 55.
D No further moults are required after day 65.

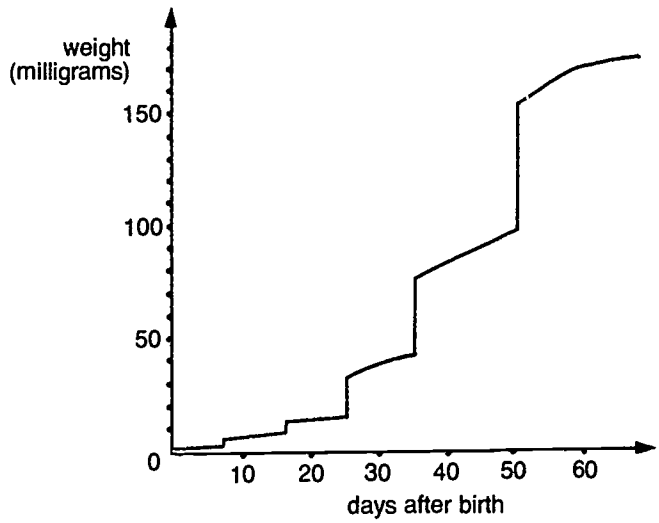
INCORRECT response items

5a-6 – Co 4 (i) D

The graphs illustrate the weight changes of a laboratory mouse and an insect during the first month or two after birth.



Growth in weight of a laboratory mouse



Growth in weight of an insect

Each of the following would account for differences between these graphs.

A Mice are weaned at 2 to 3 weeks of age, whereas insects have more gradual diet changes.
B The mouse has a greater rate of growth than the insect over the period shown.
C Insect growth is limited by a hard exoskeleton which is periodically shed and a new one formed.
D Insect growth rate slows during winter and is faster during summer.

5b—Development by cell growth, differentiation, death and replacement

CORRECT response items

5b-1 – Kn 1 (c) B *

Which sequence of development is the most likely in humans?

A grasps and shakes objects, eats unaided, walks, picks up objects between the thumb and forefinger
B grasps and shakes objects, picks up objects between thumb and forefinger; walks; eats unaided
C eats unaided, grasps and shakes objects, picks up objects between thumb and forefinger; walks
D eats unaided, grasps and shakes objects, walks, picks up objects between thumb and forefinger

The next 2 items refer to the following table:

This table shows average masses and heights for Australians (NSW) of ages 6 to 18 years.

Heights are in centimetres; masses in kilograms.

	Heights and masses of children 6 to 18 years													
	Age (years)	6	7	8	9	10	11	12	13	14	15	16	17	18
Males	Height mean (cm)	114.9	120.8	126.7	132.0	136.8	141.3	146.8	153.8	159.9	166.2	170.8	173.3	173.8
	Mass mean (kg)	21.5	23.9	26.6	29.4	32.2	35.5	39.3	43.8	49.4	55.3	60.0	63.4	65.7
Females	Height mean (cm)	113.4	119.8	125.7	130.9	136.2	142.3	148.6	153.7	157.2	159.5	160.9	161.7	161.8
	Mass mean (kg)	20.9	23.4	26.3	29.0	32.1	36.2	41.0	45.6	49.6	52.3	54.2	55.2	55.3

5b-2 17f Co 2 (c) D

From the above data, which of the following statements is true?

A The average 8-year-old male is 132.0 cm tall and 29.4 kg mass.

B 14-year-old boys are all taller but slightly lighter in mass than 14-year-old girls.

C A young person of 157.2 cm height and 49.6 kg mass would be a 14-year-old girl.

D On the average, 12-year-old girls are taller and heavier than 12-year-old boys.

5b-3 17f Co 1 (c) B

A girl 15-years-old is 162.0 cms high and has a mass of 35.1 kilograms.

The girl is

A relatively fat.

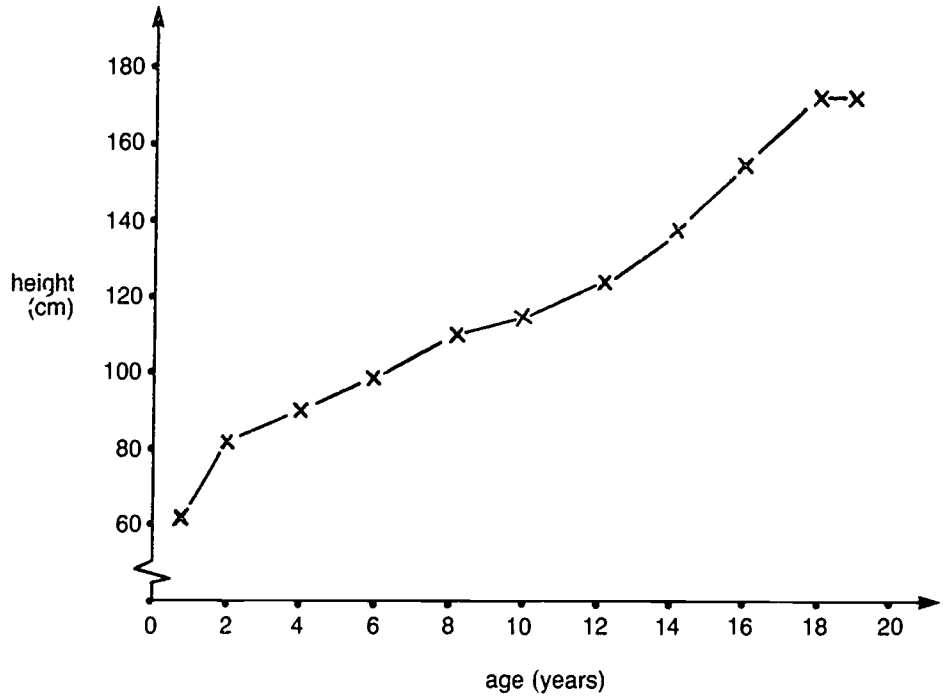
B relatively thin.

C below average height for her age.

D above average weight for her age.

The next 2 items refer to the following information:

The graph below indicates the height of a particular male named Keith, between the ages of 1 and 19 years.



5b-4 The graph shows that

An 3 (c) C *

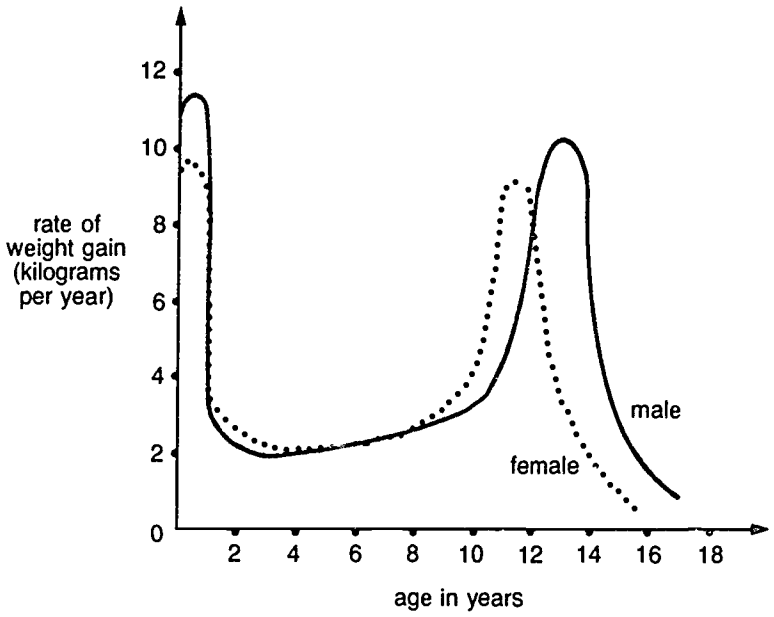
A a graph of Keith's growth rate against age will have a maximum at 19 years.
B Keith's birth length was about 60 cm.
C in Keith's first 16 years of life, his minimum growth rate occurred at 8 to 10 years of age.
D Keith will not grow further after the age of 20 years.

5b-5 A similar graph drawn of the height of a particular female between 1 and 19 years would be

Co ? (c) D

A to the left of the graph for Keith.
B to the right of the graph for Keith.
C below the graph for Keith.
D impossible to say with certainty.

The next 2 items refer to the following graph:



Relationship between Age and the Rate of Weight Gain for a Large Sample of Humans

5b-6 17f An 2 (c) C

From the data above, which of the following statements can be deduced?

A All boys have their greatest period of adolescent growth later than all girls.

B Some boys have their greatest period of adolescent growth earlier than all girls.

C The average boy achieves greatest weight gain later than the average girl during adolescence.

D From age 14 onwards, most boys and girls lose weight.

5b-7 17f An 3 (c) B *

In order to judge whether all girls have a smaller maximum weight gain during adolescent growth than all boys, it is necessary to know

A the average maximum weight gain for adolescent boys and girls separately.

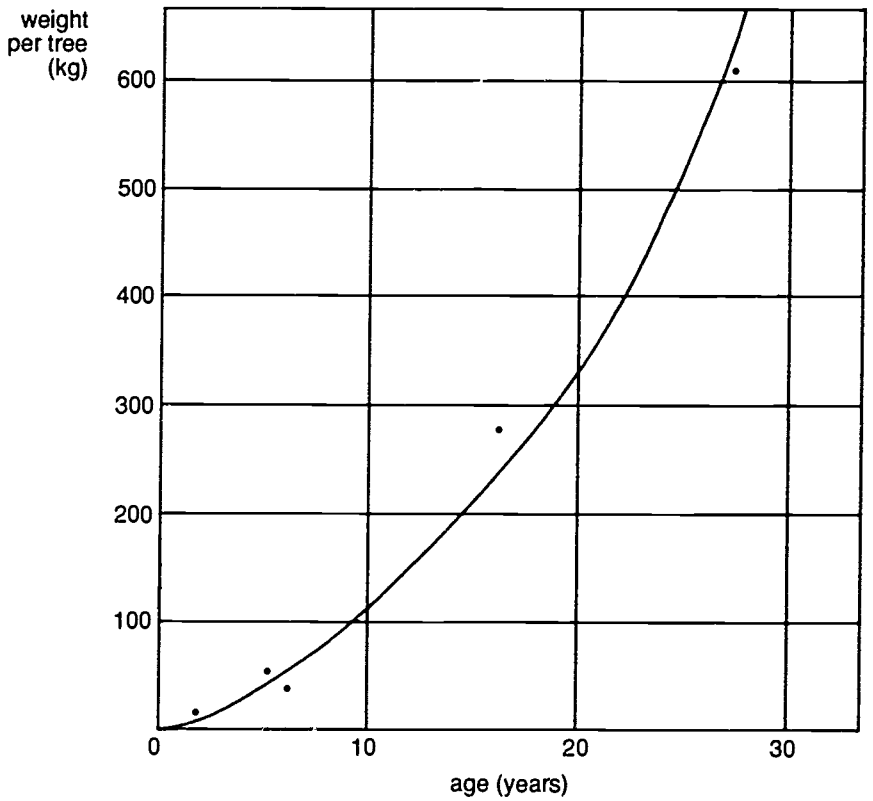
B the range of variations in maximum weight gain for adolescent boys and girls separately.

C the greatest weight gain achieved in any one year by an individual boy and an individual girl.

D the smallest weight gain achieved in any one year by an individual boy and the greatest weight gain achieved by an individual girl.

5b-8 – Co 2 (i) A

The graph gives information about five rose gums in a New South Wales plantation. Each tree is indicated by a point on the graph.



From the data above, the following conclusions can be made.

A When a rose gum tree is small it grows faster than when it is large.
B A 27-year-old rose gum tree weighed about 610 kg.
C At 25-years-old, rose gums add about 30 kg of new growth per year.
D A 150 kg rose gum would be approximately 12-years-old.

5b-9 – Co 1 (i) C

The following table shows average masses and heights for Australians (NSW) of ages 6 to 18 years.

Heights are in centimetres; masses in kilograms.

	Heights and masses of children 6 to 18 years													
	Age (years)	6	7	8	9	10	11	12	13	14	15	16	17	18
Males	Height mean (cm)	114.9	120.8	126.7	132.0	136.8	141.3	146.8	153.8	159.9	166.2	170.8	173.3	173.8
	Mass mean (kg)	21.5	23.9	26.6	29.4	32.2	35.5	39.3	43.8	49.4	55.3	60.0	63.4	65.7
Females	Height mean (cm)	113.4	119.8	125.7	130.9	136.2	142.3	148.6	153.7	157.2	159.5	160.9	161.7	161.8
	Mass mean (kg)	20.9	23.4	26.3	29.0	32.1	36.2	41.0	45.6	49.6	52.3	54.2	55.2	55.3

Adapted from National Health and Medical Research Council *Charts and Tables of Heights, Masses and Head Circumferences of Infants and Children* (Australian Government Publishing Service, Canberra, 1975).

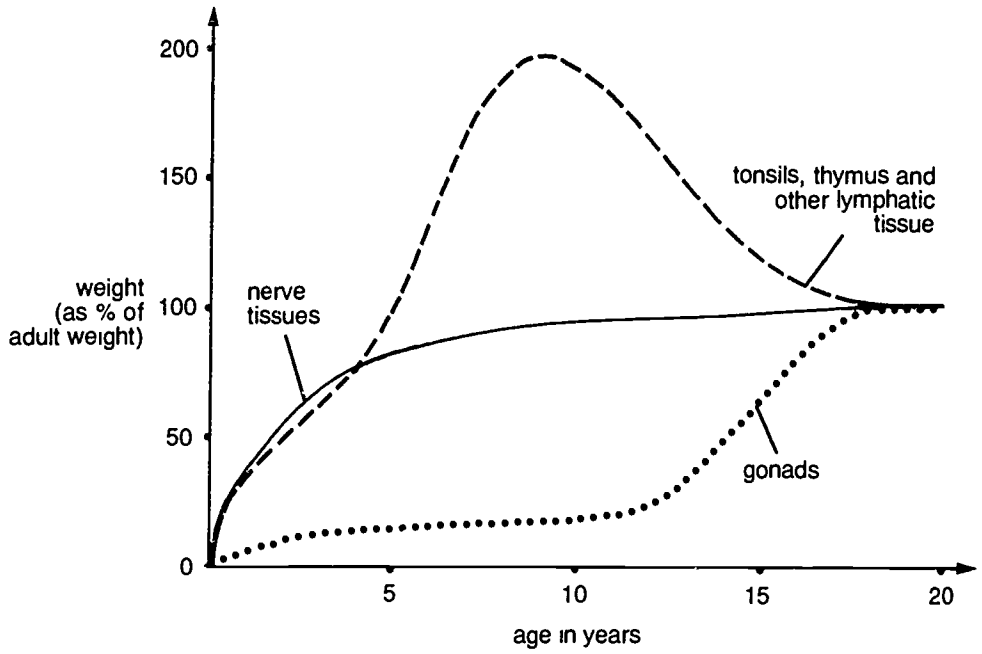
A girl of 15 years is 162.0 cms high and has a mass of 35.5 kilograms.

From the information in the table she is

A above average height for her age.
B below average mass for her age.
C taller than the average 15-year-old male.
D the same mass as the average 11-year-old male.

5b-10 – An 5 (i) C

The graph below shows the weight of various tissues of the human body (as a percentage of the final weight of the organ in the adult) as an individual develops from birth to maturity (age 20).



From this information it would be reasonable to conclude that

A soon after birth the nervous system grows most rapidly.

B by about 10 years of age the tonsils and thymus gland reach maximum size, and then grow smaller again.

C at about 20 years of age all the above tissues are approximately the same weight.

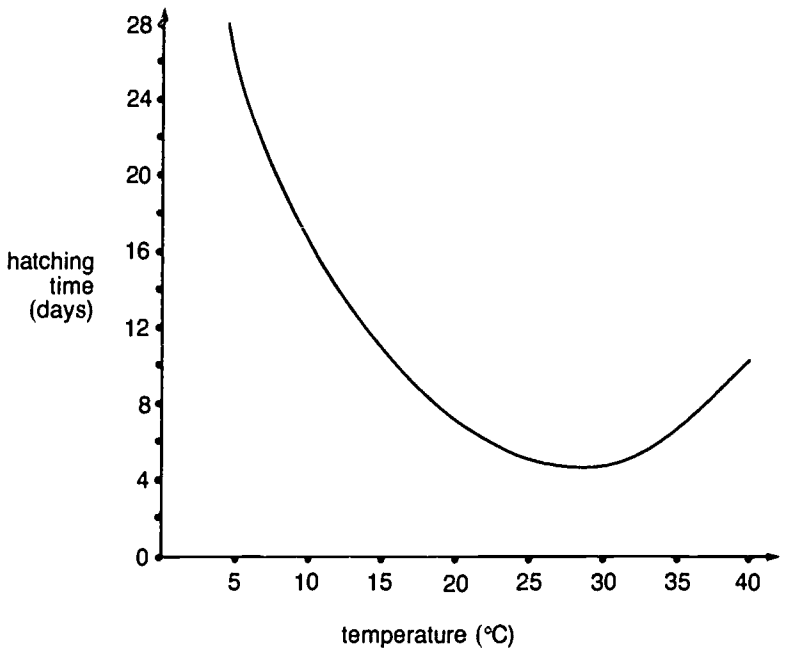
D the gonads start to develop rapidly at a later stage than the other organs shown.

5c—Patterns of development relating to habitat and structure

CORRECT response items

5c-1
17f
An
3
(c)
C

The graph below shows the results of an experiment to determine the effect of temperature on the time taken for locust eggs to hatch.



Which of the following statements is best supported by the data?

A Most locusts will hatch out in summer.
B Locust eggs do not hatch at temperatures below 5 °C.
C Hatching time of locusts will vary according to the seasonal temperatures.
D The reproductive rate of locusts would be highest in warm weather.

5d—Food materials

CORRECT response items

5d-1 11b Kn 1 (c) A

The products of protein digestion are

A amino acids.
B glucose and urea.
C fatty acids and glycerol.
D carbon dioxide, water and energy.

5d-2 5e Kn 2 (c) D

Many animals must eat a varied diet if they are to survive and reproduce successfully. The reason for this is that

A a variety of food is easier to digest.
B a decrease in one food has little effect on the individual.
C different foods contain various amounts of carbohydrates.
D no food contains all essential nutrients.

5d-3 – Kn 2 (c) A

The three most common elements in the human body are

A oxygen, carbon, hydrogen.
B carbon dioxide, water, salt.
C carbohydrates, fats, proteins.
D oxygen, hydrogen, nitrogen.

5d-4 – Kn 3 (c) C

The label of a certain brand of multivitamin capsules available in the USA boasts that one tablet supplies 62.5 times the daily adult vitamin D requirement.

This seems to be an unnecessarily high amount because vitamin D is

A synthesized by bacteria in the intestine.
B water soluble and excreted almost immediately.
C fat soluble and stored in the body.
D destroyed by sunlight.

5d-5 17g Kn 3 (c) B

A sample of food was subjected to a series of biochemical food tests, and the following results were obtained:

	Test				
	Benedict's solution	Iodine solution	Iodine 70% H_2SO_4	Sakaguchi	Brown paper
Colour reaction	Orange-brown colour	No noticeable change	Blue-black colour	Dark pink colour	Not translucent

From this data, which of the following chemical components does this food contain?

A cane sugar, starch and protein
B glucose, cellulose and protein
C glucose, fats and cellulose
D cane sugar, cellulose and protein

5d-6 Starch is too large a molecule to be absorbed into the bloodstream across membranes.
11b
Kn
3 It is therefore broken down into
(c)
B

A glycerol.
B simple sugars.
C fatty acids.
D amino acids.

5d-7 If the amount of chemical energy taken in by an organism exceeds its needs, the extra energy is usually
–
Kn
3
(c)
D

A lost to the environment as heat.
B metabolised to waste materials and excreted.
C used to allow movement to obtain resources.
D stored in organic compounds of large molecular size.

5d-8 Essential amino acids are those
–
Kn
4
(c)
C
*

A that animals cannot obtain by digestion of proteins and so must be provided separately in the diet.
B without which no proteins can be made by an animal or a plant.
C that cannot be made by an animal but are necessary in the diet in order for it to function properly.
D that have to be made by a plant before it can make a protein.

The next 2 items refer to the following information:

A small section of a healthy plant was enclosed in a transparent box, and a small amount of radioactive carbon dioxide ($^{14}CO_2$) was added. The plant was placed in constant light, and the path of the radioactive carbon was followed. After several hours, most of the radioactivity was found to have moved from the leaves to the actively growing tips and shoots of the plant.

5d-9 Which of the following is the best reason for these observations?
10d
Co
4
(c)
A

A The actively growing parts of the plant were using chemical compounds for energy and building up structural components.
B All of the $^{14}CO_2$ had been made into starch in the leaves, and was then sent to the actively growing sections of the plant as a source of energy.
C The movement of all radioactive compounds formed by the plant is towards actively growing parts of the plant.
D $^{14}CO_2$ was transported from the leaves to the actively growing parts of the plant, where it was synthesized into starch.

5d-10 In order to investigate the formation of proteins in the plant, a small amount of radioactive Nitrogen gas ($^{15}N_2$) was introduced into the transparent box. After several hours, insignificant amounts of ^{15}N were found in the plant's proteins.
–
Co
3 The best reason for this is that
(c)
D

A the plant was using nitrogen to synthesize another compound.
B there was sufficient non-radioactive nitrogen in the air, so that $^{15}N_2$ was not used.
C plants do not use nitrogen to produce proteins.
D nitrogen must be taken up from the soil, not the air.

5d-11 Carbohydrates and lipids differ in that

–
Kn
4
(c)
B

A carbohydrates are used as an energy source, whereas lipids are not.
B they contain different proportions of hydrogen and oxygen.
C lipids, but not carbohydrates, are a product of fat breakdown.
D carbohydrates contain nitrogen, whereas lipids do not.

5d-12 A stained microscope preparation of some unidentified material contains starch grains.

–
Kn
4
(c)
A

It is therefore most likely that the material

A came from a producer.
B came from a first-order consumer.
C came from a second-order consumer.
D could have come from a plant or an animal.

5d-13
13a
Kn
5
(c)
D

A biologist tested separate samples of an unknown substance with Benedict's solution and iodine solution.

To fresh samples of the substance he then added sulfuric acid, heated gently and repeated the tests. His results are summarized in the table below.

	Test	
Sample and treatment	Benedict's solution	Iodine solution
Unknown substance	No change	No change
Unknown substance after heating with sulfuric acid	No change	Blue-Black

From the data, the unknown substance is most likely to be

A starch.
B sucrose.
C glucose.
D cellulose.

The next 2 items refer to the following information:

Paper is made of cellulose fibres extracted from wood. The CSIRO has experimented with feeding sheep on pellets made from waste paper.

5d-14
11b
Ap
5
(c)
C

To be successful, the diet of paper pellets would have to be supplemented with

A minerals and trace elements.
B protein, minerals and trace elements.
C protein, fats, minerals and trace elements.
D protein, carbohydrate, fats, minerals and trace elements.

5d-15
11b
Co
4
(c)
A

Paper would not be used as a food source for humans because

A humans have no way of digesting cellulose.
B cellulose would not contain enough energy for humans.
C paper is unpalatable to humans.
D paper may contain chemicals harmful to humans.

The next 5 items refer to the following information:

Of the 22 or so different amino acids known, the rat requires 19 to manufacture its body protein. Ten of these, which must be included in the rat's diet, are called the essential amino acids. These must be produced by green plants, which manufacture all their own amino acids. The nine non-essential amino acids can be produced within the body of the rat. If a rat is deprived of the non-essential amino acids, its growth rate does not change if other conditions remain unchanged.

Rats have a large number of bacteria which live harmlessly in their intestines. To determine whether these bacteria produce the nine non-essential amino acids, or whether they were produced by the rat itself, the following experiment was performed.

One hundred and twenty (120) healthy young rats were selected. Sixty (60) were fed on an adequate diet which, however, contained only the ten essential amino acids, the other 60 were fed on a similar diet containing an adequate supply of all 19 amino acids. Half of each group were given sulfa drugs to reduce greatly the number of bacteria in their intestines. The rate of growth of the 120 experimental rats was carefully noted over several weeks.

5d-16 An essential amino acid is so called because it

17b Co 3 (c) D

A is required by the organism to make its own proteins.
B is essential to normal functioning of green plants.
C cannot be produced by the intestinal bacteria.
D must be included in the organism's food.

5d-17 How many amino acids are classified as 'essential' to green plants?

17b Co 4 (c) A

A 0
B 9
C 10
D 22

The treatments used in the experiment can be summarized in the following table.

	Sample W	Sample X	Sample Y	Sample Z
Drug treatment	sulfa drugs	no sulfa drugs	sulfa drugs	no sulfa drugs
Diet	10 essential amino acids		19 amino acids	

Four possible results of the experiment are listed below:

Result I — Sample W did not grow as quickly as the others.
Result II — Samples W and X did not grow as quickly as the others.
Result III — Samples W and Y did not grow as quickly as the others.
Result IV — There was no difference in the growth rates between the samples.

5d-18 Which result would suggest that the rat itself can manufacture the non-essential amino acids?

17f An 3 (c) D

A Result I
B Result II
C Result III
D Result IV

5d-19 17f An 4 (c) A

Which result would suggest that the intestinal bacteria provide the rat with the non-essential amino acids?

A Result I
B Result II
C Result III
D Result IV

5d-20 17f An 5 (c) B *

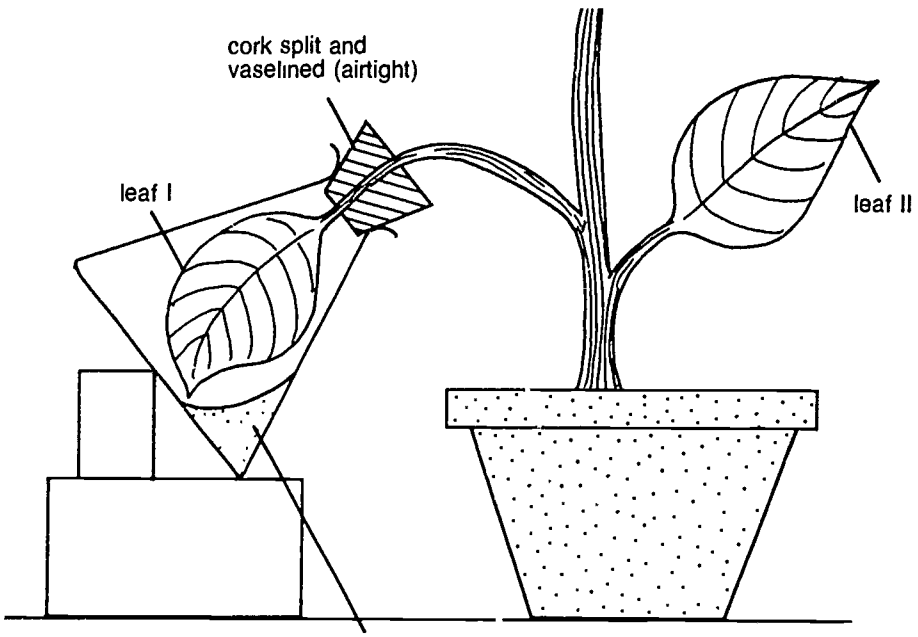
Consider the information in the opening paragraph, especially its last sentence.

If this information is correct, which result would you **least** expect?

A Result I
B Result II
C Result III
D Result IV

5d-21 – Ap 2 (c) C *

A plant was kept in the dark for several days to de-starch the leaves, after which the following experiment was set up:



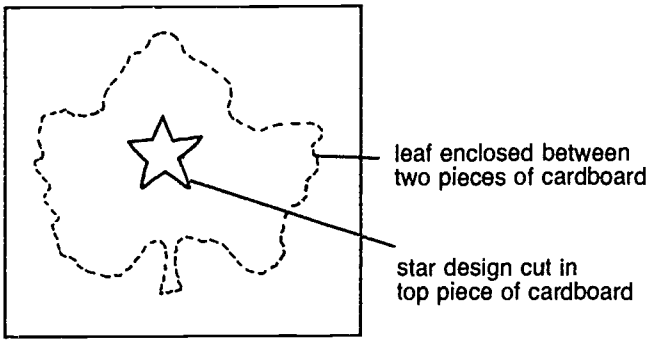
The plant was placed in sunlight for a day, and then each of the leaves was tested for starch (the iodine test) just after mid-day.

From a knowledge of plant processes, one would expect that

A both leaves I and II would stain blue-black, because starch is formed by photosynthesis.
B leaf I only would stain blue-black, because the caustic soda solution would provide enough CO_2 for photosynthesis.
C leaf II only would stain blue-black, as it would obtain enough CO_2 for starch production.
D neither leaf I nor II would exhibit staining, as leaving the plant in sunlight for one day would result in too little starch production.

The next 3 items refer to the following information:

A plant was kept in the dark for several days to de-starch the leaves. Then a leaf was taken and partially protected from light by being enclosed between two pieces of cardboard, in one of which a simple design had been cut, as shown.



The leaf was placed with its stem in water and was exposed to light for some hours. It was then decolourized by boiling, first in water and then in 95 per cent alcohol, and was finally placed in a solution of iodine.

5d-22 Which of the following staining reactions would be observed?

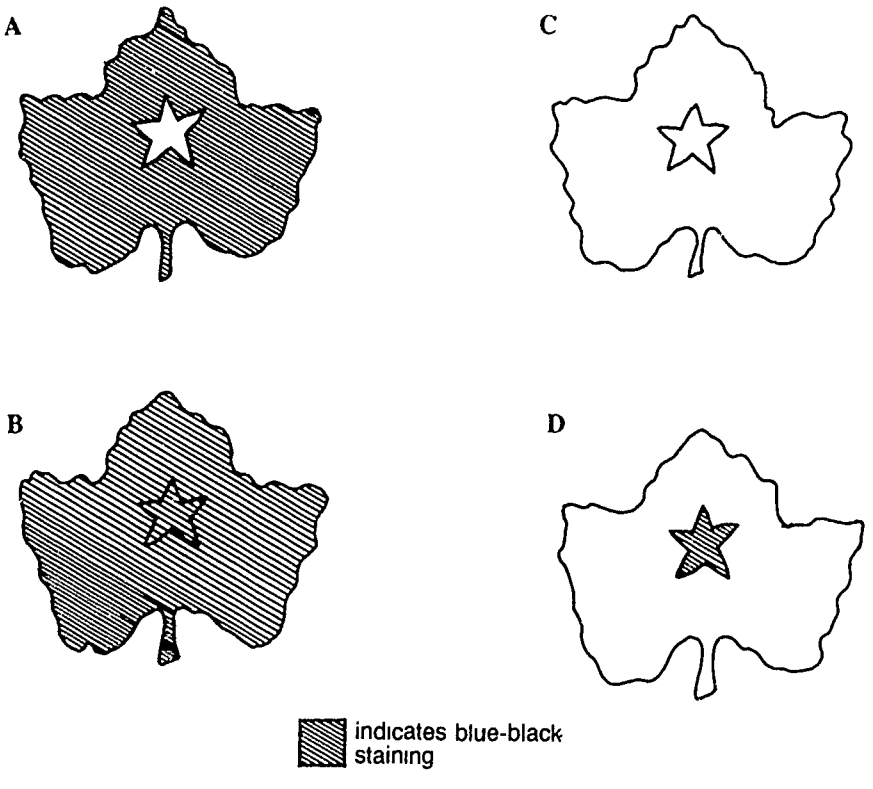
1b

Ap A C

3 B D

(c)

D



5d-23 Why did the selected pattern appear on the leaf?

1b
Ap
3
(c)
D

A The amount of starch present in all parts of the leaf does not alter over the period of the experiment.

B Photosynthesis does not result in starch being formed, and hence there is no reaction with iodine.

C When the leaf is exposed to light, all the starch in the star-section is used up.

D After destarching the leaf, active starch production will only occur in the star-section, which is exposed to light.

5d-24 What was the substance that was removed by boiling?

1b
Kn
2
(c)
B

A iodine

B chlorophyll

C cellulose

D starch

5d-25 Where particular reagents are to be used to test reactions in an experiment, they should be validated.

13a
Co
2
(c)
D

This means that the experimenter should

A check that the contents correspond with the label on the reagent bottle.

B carry out duplicate tests with the reagents to make sure that he has not made any error.

C make sure that the reagents give results in agreement with the ones he expects from the unknown substances.

D check that the reagents do give characteristic reactions when placed with known test samples.

5d-26 – Ap 2 (c) A

The Japanese art of Bonsai evolved when Japanese gardeners found that by trimming the root system of a plant, they could reduce its growth so that it remained a miniature tree.

This lack of growth was caused by

A a restricted intake of minerals and water.

B an increased susceptibility to plant diseases.

C the inability of the roots to hold up a full-sized plant.

D the cutting of the roots, making the plant weak and small.

5d-27 – Ap 3 (c) D

Forensic scientists are able to distinguish between the saliva of man and dog by a simple test. Human saliva is mixed with starch and incubated for 30 minutes at 37 °C. Then iodine solution is added and the resultant colour of the solution is yellow. If canine saliva is treated in the same way the resultant colour of the solution is black.

The most probable reason for this difference is that

A 37 °C is not a suitable temperature for incubating canine saliva.

B canine saliva lacks a hormone present in human saliva.

C the diets of dogs and humans are different.

D canine saliva lacks an enzyme present in human saliva.

5d-28 10d Ap 3 (c) C

A healthy plant was grown in a complete nutrient solution containing radioactive sulfur. After several hours, the radioactive sulfur was found to be concentrated around the outer part of the stem. A section of the stem was broken, and various important plant compounds were isolated. Most of the radioactivity was present in one compound, which also contained carbon, hydrogen, oxygen and small amounts of nitrogen.

Which of the following statements best explains the experimental data?

A Sulfur is absorbed through the plant roots, and later incorporated into an inorganic compound.

B Sulfur is an important nutrient for plant growth.

C Sulfur is absorbed through the plant roots, and later incorporated into a complex organic compound.

D Sulfur reacts with carbon, hydrogen, oxygen and nitrogen in the plant nutrient solution, and the resultant compound is absorbed through the root system.

5d-29 11b Ap 3 (c) B

A disease 'X' was diagnosed by a nutritional expert as being due to a deficiency of a compound 'Y' in the patient's food. As there was no natural 'Y' compound available in concentrated form, a synthetic derivative 'Y_s' was prescribed in tablet form. However, after two weeks on this prescription, no satisfactory changes had occurred. The faeces and the blood were examined for the presence of Y_s, and it was found to be present solely in the faeces. The nutritional expert suggested that the tablets of Y_s be taken during meals, with the result that the patient's condition improved.

The reason for the expert suggesting that Y_s should be taken with meals was that

A there might have been some Y present in the ingested food, and therefore Y_s would not be needed to alleviate the condition.

B Y_s alone was not being absorbed into the bloodstream, but ingesting Y_s with food might cause a chemical change in Y_s and hence allow its absorption.

C Y_s was being absorbed into the blood stream, but it was not acting, because there was no freshly digested food present to aid its action.

D the tablet needed to be coated with food in order to be absorbed into the bloodstream.

5d-30 – Ap 3 (c) B

An indoor plant has been growing well and appearing healthy for several years. However, it begins to display signs of stress, including loss of pigmentation in the leaves and thinning in the stems. Regular checks for soil moisture, pests and disease rule out these as causes of the problem.

Of the following alternatives, the best explanation that you could offer the owner would be that the plant is

A suffering from dehydration.

B requiring extra inorganic ions.

C lacking in sunlight.

D undersupplied with organic compounds.

The next 2 items refer to the following information:

A biology student set up an experiment to study the breakdown of starch by salivary amylase. This enzyme acts in a neutral environment. Test-tubes numbered I to VIII were treated as shown in the following table.

	pH 2 30 °C	pH 2 80 °C	pH 7 30 °C	pH 7 80 °C
Set X Starch solution and saliva	I	II	III	IV
Set Y controls	V	VI	VII	VIII

5d-31 11b Ap 3 (c) C

The test-tubes in Set Y should contain

A starch solution + saliva.

B starch solution + iodine solution.

C starch solution + distilled water.

D distilled water only.

5d-32 When she tested for sugar, in which of the test-tubes would sugar be found?

11b An 4 (c) A

A IIII
B III and VII
C I
D I and V

5d-33 Orchid seeds do not grow into mature plants unless they are infected by a mycorrhiza (a type of fungus within the roots).

17d Ev 4 (c) B *

A student advanced the hypothesis that the mycorrhiza helps provide orchids with sugars and mineral nutrients.

This hypothesis would best be tested by attempting to grow groups of mycorrhiza-free orchid seeds on

A (i) a culture mixture with mineral nutrients but no sugars, and
(ii) a culture mixture with sugars but no mineral nutrients.

B (i) a culture mixture with sugars and mineral nutrients, and
(ii) a water culture lacking sugars and mineral nutrients.

C (i) a water culture with mycorrhiza only, and
(ii) a culture mixture with sugars and mineral nutrients.

D (i) a culture mixture with mycorrhiza, sugars, and mineral nutrients, and
(ii) a water culture lacking sugars and mineral nutrients.

The next 2 items refer to the following information:

Table 1 gives the energy cost of a variety of activities. Table 2 gives the energy value of 100 g portions of a variety of foods.

Table 1

Activity	Energy cost (kJ/kg/hr)
sleeping	4
walking (5 km/hr)	21
swimming breast stroke	35

Table 2

Food	Energy content (kJ/100 g)
milk	280
ice cream	840
lamingtons	1490

5d-34 – Ap 4 (c) C *

The distance that a 60 kg man could walk on the energy supplied by 200 g of lamingtons is closest to

A 5 km.
B 8 km.
C 12 km.
D 20 km.

5d-35 – Ap 3 (c) C

From the above data, what mass of milk would a 60 kg man need to drink to enable him to swim breast stroke for one hour without losing body weight?

A 100 g
B 280 g
C 750 g
D 9800 g

5d-36 17e An 3 (c) B *

In the Seventeenth Century, van Helmont performed some experiments on plant growth to test the following hypotheses:

(I) Plant growth is not a result of 'soil eating' by roots;

(II) Water added to the plant must be the sole source of plant growth.

To test these hypotheses, he planted a small willow sapling in an earthen pot, made suitable arrangements so that extraneous dust would not mix with the soil, and regularly watered the tree for five years. His results are as follows:

	Masses	
	At start of experiment	Five years later
Willow sapling	5 lbs (2.26 kg)	169 lbs 3 oz (76.61 kg)
Soil	200 lbs (90.56 kg)	199 lbs 14 ozs (90.5 kg)

In the light of this evidence, which of the following alternatives is correct?

A Hypotheses I and II are supported.

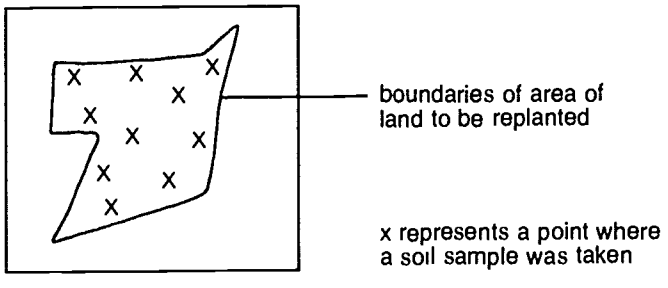
B Hypothesis I is supported, but further experimental design is required to support or disprove Hypothesis II.

C Both hypotheses I and II should be modified to include a small amount of 'soil eating' by plants.

D Hypothesis II is supported, but Hypothesis I needs modification.

The next 4 items refer to the following information:

The Department of Agriculture decided to replant an area of land with trees to prevent erosion. On the basis of water availability and climate, four types of trees were suitable for selection. To determine the chemical content of soil in the area, 10 representative soil samples were taken and analysed for content of inorganic ions.



Whilst all 10 samples showed close correlation for potassium (K^+), magnesium (Mg^{2+}), calcium (Ca^{2+}), ammonium (NH_4^+) and sulfate (SO_4^{2-}), the phosphate (PO_4^{3-}) results were considerably diverse.

5d-37 17f Ev 5 (c) D

Following the soil analysis, the Department of Agriculture should

A use another analysis procedure for PO_4^{3-}.

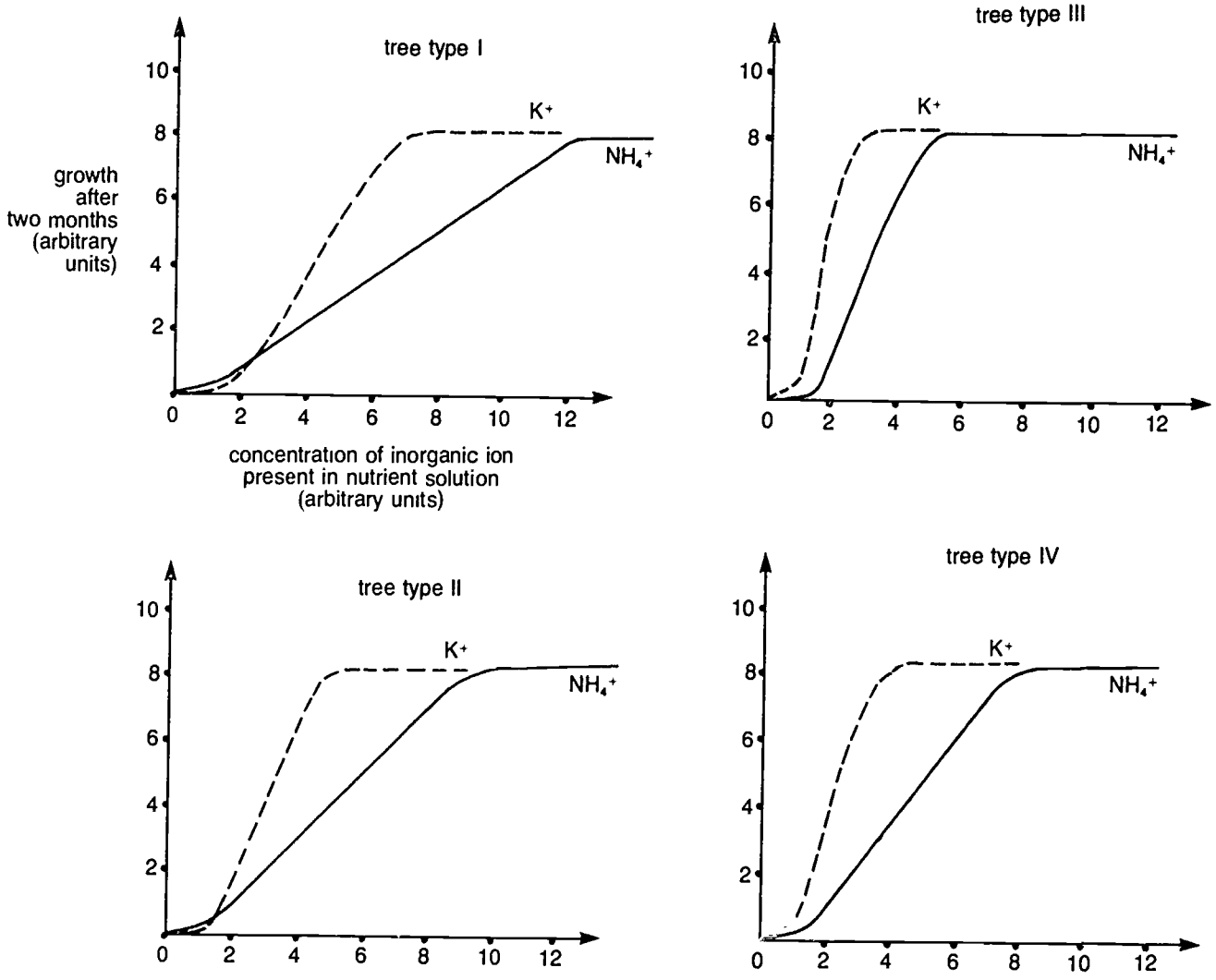
B take an average of all 10 results for PO_4^{3-}, and use the average as the correct value.

C repeat the experiment to see if similar results are obtained.

D assume that PO_4^{3-} soil contents are different in different spots, and plant trees accordingly.

The next 3 items refer to the following ADDITIONAL information:

It was then decided to test the inorganic ion requirements of the four types of trees. For each tree type, control seedlings were to be grown in a complete nutrient solution minus the inorganic ion to be tested. Similar seedlings were also grown in complete nutrient solutions with varying amounts of the ion to be tested. The results for NH_4^+ and K^+ are graphically represented below.



5d-38 17f An 4 (c) A — Which of the tree types has the highest requirement of NH_4^+ for *maximum growth* to occur?

A type I
B type II
C type III
D type IV

5d-39 17f An 3 (c) C — From the data, what is the order of requirement of K^+ for *maximum growth* to occur? (*Note:* The symbol < means 'is less than')

A tree type I < II < III < IV
B tree type I < II < IV < III
C tree type III < IV < II < I
D tree type IV < III < II < I

5d-40 17f Ap 3 (c) A

Eventually, it was decided to plant the area with type III trees, because the soil contained sufficient quantities of the inorganic nutrients K^+ and NH_4^+, for growth of type III trees. However, after several months, it was obvious that the trees were not growing very quickly, the leaves were small and pale, and the branch size small compared with their healthy counterparts.

What was the most probable reason?

A The scientists did not take into account the smaller quantities of other inorganic elements that the plant might need.

B The seedlings were not planted properly, and the root hairs were unable to obtain sufficient supplies of water and inorganic nutrients.

C The trees were not receiving adequate water.

D The plants were not obtaining sufficient carbon dioxide for photosynthesis and hence growth to occur.

5d-41 17f An 4 (c) C

At a research institute, guinea pigs were being fed a food nutrient mixture, but growth appeared to be retarded. It was suggested that this could be due to insufficient quantities of certain essential amino acids in the diet. The following experiment was then set up:

Group 1: fed original diet

Group 2: fed original diet and supplements of all essential amino acids

Group 3. fed original diet plus supplement of one essential amino acid (i.e. Isoleucine)

Group 4. fed original diet plus supplement of another essential amino acid (i.e. Leucine)

Groups 5–10. as for Groups 3 and 4, with supplement of different amino acids as in table

Each group contained four guinea pigs of approximately equal starting weight, and they were fed on these diets for four weeks.

Results

	Group									
	1 Original diet	2 Original diet plus full amino acid supplement	3 +Ile	4 +Leu	5 +Lys	6 +Met	7 +Phe	8 +Thr	9 +Tryp	10 +Val
Ave. mass before (g)	75	73	76	72	73	70	75	74	73	74
Ave. mass after (g)	83	124	85	81	82	94	82	85	92	83

Key

Ile	Isoleucine	Phe	Phenylalanine
Leu	Leucine	Thr	Threonine
Lys	Lysine	Tryp	Tryptophan
Met	Methionine	Val	Valine

From this data, the researchers should conclude that the original food nutrient mixture was deficient in

A all essential amino acids.

B methionine only.

C methionine and tryptophan.

D nothing, and that some other factor was causing the growth retardation.

INCORRECT response items

5d-42 – Kn 2 (i) D

Proteins have many characteristics which distinguish them from other dietary components.

Proteins are

A found in all living things.
B large molecules.
C organic compounds.
D composed of glucose units.

5d-43 17g Kn 3 (i) A *

The nutrient composition of foods may be tested for in the following ways:

	Test	*Compound tested for*
A	Benedict's	sucrose
B	iodine	starch
C	Sakaguchi	protein
D	brown paper	lipid

5d-44 17g Kn 3 (i) A

Chemical analysis of foods gives valuable information which can help people select a suitable diet. Simple tests can be made for a number of nutrients on a qualitative basis.

These tests include

A heating the food sample with Benedict's solution to test for the presence of sucrose.
B mixing the food sample with iodine solution to test for the presence of starch.
C rubbing the food on brown paper to test for the presence of fat or oil.
D testing the food sample with Millon's reagent or Sakaguchi reagents for the presence of protein.

5d-45 – Kn 3 (i) D

Carbohydrates and fats are compounds which are formed by most producer organisms and are found in most consumer organisms.

These compounds are similar in that they

A are stored within many organisms.
B possess carbon, hydrogen and oxygen atoms.
C release relatively high amounts of energy during respiration.
D include comparatively large numbers of oxygen atoms.

5d-46 11b Kn 4 (i) B

The following substances can be directly absorbed by the intestine.

A glucose
B proteins
C mineral ions
D vitamins

5d-47 – Ap 4 (i) C

The basal energy requirement of an organism depends on its

A size and shape.
B environment.
C body movement.
D age.

5e—Variations in nutritional requirements

CORRECT response items

5e-1 – Kn 3 (c) B

The basal energy requirement is best defined as

A the minimum energy needed for one day's normal activities.
B the energy needed for minimum activity.
C the energy needed for maximum activity.
D the average amount of energy released per minute.

5e-2 – Co 4 (c) B

One kilogram of carbohydrate provides 17 MJ of energy.
One kilogram of protein provides 17 MJ of energy.
One kilogram of fat provides 38 MJ of energy.
Carbohydrates include sugar, starch and cellulose.

Which of the following mixtures provides the **least** energy for a human?

A 1 part protein, 1 part fat
B 2 parts protein, 1 part starch, 1 part cellulose
C 1 part starch, 1 part cellulose, 1 part fat
D 2 parts sugar, 1 part fat

The next 3 items refer to the following information:

In an experiment, rats were maintained in a completely isolated, sterile environment. To ensure complete sterility the apparatus was constructed entirely from plastics and the air passing through was filtered to remove all particles. The rats were fed on a specially prepared diet from which all trace elements were removed.

After some weeks the rats showed detrimental effects such as the loss of hair and shaggy fur. Their condition returned to normal, however, when their diet was changed to include all essential nutrients.

5e-3 17d Co 2 (c) B

The scientist was most probably trying to investigate

A whether dust was a factor that affected growth.
B the trace element requirements of rats.
C the effect of sterile conditions on the growth of rats.
D why rats lose their hair and develop shaggy fur.

5e-4 17d Co 4 (c) C

The control in the above experiment was the

A use of the air filter.
B rats' diet.
C use of the same rats.
D removal of trace elements.

5e-5 17d Co 3 (c) B

The experimental variable was the

A use of the air filter.
B rats' diet.
C sterile environment.
D use of the same rats.

The next 2 items refer to the following information:

In a series of experiments with dairy cows, the effect of feeding conditions on butterfat production was tested.

The use of identical twins in such comparison experiments is of great value because identical twins have an identical inheritance in all respects and any differences between them must be due to the environment. If only the feeding conditions vary in the environment for a pair of twin cows, then differences in butterfat production must be due to differences in the feeding conditions.

Identical twins were used in these experiments: X1 and X2 are twins, so are Y1 and Y2, and so on.

The results are given in the table below.

4 hectares pasture per cow plus additional hand feeding		**4 hectares pasture per cow**		**2.5 hectares pasture per cow**	
twin no.	butterfat production (kg per year)	twin no.	butterfat production (kg per year)	twin no.	butterfat production (kg per year)
	Group I		Group II		
X1	191	X2	150		
K1	173	K2	121		
R1	185	R2	143		
average	183	average	138		
			Group III		Group IV
		Z1	120	Z2	102
		L1	123	L2	113
		Q1	138	Q2	130
		average	127	average	115
	Group V				Group VI
Y1	179			Y2	121
M1	182			M2	92
P1	165			P2	102
average	175			average	105

5e-6 17f An 3 (c) C

Which of the following probably accounts for the difference between the results for Groups I and V?

A Very small errors in measurement have combined to produce the difference.

B X1, K1, and R1, were allotted to Group I because they were known to be better producers of butterfat.

C By chance X1, K1, and R1 were allocated to Group I, and Y1, M1 and P1 to Group V, and the observed differences are themselves chance events.

D The Group I cows were in a different pasture from the Group V cows.

5e-7 17f An 2 (c) A

The suggestion was made that the natural pastures were not sufficiently good to ensure maximum production of butterfat.

This is supported by a comparison of the results from Groups

A I and II.

B II and III.

C IV and VI.

D V and VI.

The next 5 items refer to the following information:

A reptile breeder decided to breed a large number of a species of lizard. As the price he obtained for the lizards depended to some degree on their size, he decided to set up a series of experiments in an attempt to discover the best conditions for the lizards' growth. He was concerned with three factors:

(i) whether or not an additive should be added to the lizards' drinking water;
(ii) whether or not a supplement should be added to the lizards' food; and
(iii) at which of the three temperatures, 20 °C, 25 °C, or 30 °C, the lizards should be maintained.

He selected a batch of 120 newly hatched lizards and randomly divided them into 12 sets of 10 lizards. He placed one set of 10 lizards into each of 12 cages, and maintained certain conditions in the cages, as indicated in the table below, for a period of three months. There was no significant difference in the initial average weights of the lizards.

The table shows the average weight attained by the mature lizards (i.e. at three months) for each of the experimental groups, which are represented by Cages F–U.

	Average weight of mature lizards (gram)		
Treatment	cages kept at 20 °C	cages kept at 25 °C	cages kept at 30 °C
water additive and food supplement	Cage F 519	Cage G 560	Cage H 539
water additive only	Cage L 408	Cage M 429	Cage N 415
food supplement only	Cage P 530	Cage Q 598	Cage R 560
neither water additive nor food supplement	Cage S 465	Cage T 522	Cage U 501

5e-8 17f Co 1 (c) A

Which of the following conclusions about the food supplement, when all other treatments are considered, is consistent with the information given above?

The food supplement

A produces an increase in the weight of the lizards at three months.
B slows the rate at which the lizards grow in the first three months of life
C has no effect on the weight of the lizards at three months.
D has an effect on the growth rate of the lizards only if the water additive is present.

5e-9 17f An 1 (c) B

Which one of the following sets of conditions would be most likely to produce maximum growth of the lizards over the three-month period?

A 25 °C, water additive, no food supplement
B 25 °C, food supplement, no water additive
C 30 °C, water additive, food supplement
D 30 °C, food supplement, no water additive

5e-10 17f An 3 (c) B

Which of the following conclusions about the water additive, when all the treatments are considered, is consistent with the information given above?

The water additive

A produces an increase in the weight of the lizards at three months.
B slows the rate at which the lizards grow in the first three months of life.
C has no effect on the weight of the lizards at three months.
D has an effect on the growth rate of the lizards only if the food supplement is present.

5e-11 17f An 3 (c) D

Suppose that one lizard died in one of the cages three weeks after the start of the experiment, and that it was decided to replace that lizard by another.

Which one of the following would make the **least** satisfactory replacement?

A a newly hatched lizard of the same species

B any lizard of the same species which had the same body weight as the dead lizard

C a lizard of the same species which had the same body weight as the mean body weight of the nine surviving lizards in the cage

D a three-week-old lizard from a group which belonged to a different species of lizards

5e-12 17f An 4 (c) D

The reptile breeder calculated the following costs for maintaining the various conditions in the 12 cages for the three-month period:

cost per lizard of the water additive	20 cents
cost per lizard of the food supplement	40 cents
cost per lizard of maintaining a temperature of 20 °C	5 cents
cost per lizard of maintaining a temperature of 25 °C	10 cents
cost per lizard of maintaining a temperature of 30 °C	20 cents

If the breeder receives 1 cent per gram for the lizards, which one of the following conclusions can be drawn?

The cost of providing the ideal conditions for lizard growth

A is greater than the increased income from the sale of the lizards.

B is less than the increased income from the sale of the lizards.

C is exactly the same as the increased income from the sale of the lizards.

D cannot be compared with the increased income from the sale of the lizards unless the number of lizards is known.

The next 2 items refer to the following information:

The human body has a remarkable capacity for surviving without food for long periods. During weight-reduction programs, some obese individuals have gone without food for as long as eight months. Although they have limited their intake to water and vitamin and mineral supplements, they have emerged from the ordeal in good condition.

5e-13 – Kn 3 (c) B

The body's most immediate need under these conditions is

A continuous supply of protein to replace the loss by normal tissue breakdown.

B supply of energy for the maintenance of vital functions.

C building up of an energy source in the form of fats.

D storage of carbohydrates such as glucose.

5e-14 17j Ap 4 (c) D

A student was set the task of investigating fasting as a means of extensive weight reduction.

The student's first step should be to

A investigate the dietary habits of the community.

B carry out a controlled experiment to determine how excess food is converted to fat.

C select a number of obese subjects and divide them into a test group and a control group.

D study the results of research by other scientists.

5e-15 – Ap 3 (c) C

Fibre is believed to be a valuable part of the human diet. This fibre is often bran, the dry outer layer of wheat grains left after they are milled for flour.

Which of the following statements explains the importance of fibre in our diet?

A Vitamins are necessary to avoid certain deficiency diseases.
B Carbohydrates are important as an energy source.
C Cellulose is indigestible and stimulates the movement of faeces through the large intestine.
D Amino acids are the starting point in the synthesis of proteins.

5e – Ap 4 (c) C

The following table lists the composition of 100 gram samples of four common human foods.

Which food would be most suitable for selection by an athlete 30 minutes before a 10 000 metre race?

Food	*Energy* (MJ)	*Fat* (g)	*Water* (g)	*Protein* (g)	*Carbohydrate* (g)
A	1.02	1.4	38.3	7.8	52.9
B	1.77	34.5	37	34.5	Trace
C	1.14	40.4	49.9	9.4	0
D	0.04	Trace	95.7	1.3	1.1

5e-16 5d An 5 (c) C

The following table shows the percentage of thiamine (vitamin B_1) and ascorbic acid (vitamin C) remaining after the cooking of a variety of foods. This percentage is called the *retention factor.*

Foods	Retention factor for Thiamine %	Retention factor for Ascorbic acid %
Eggs—boiled, poached, fried	80	..
Milk	90	75
Meats, all kinds—		
oven roasted	60	..
braised, simmered	40	..
Fish—baked, grilled and fried	75	..
Foods from plant sources—		
pulses and legumes, boiled	90	..
potato—baked	75	80
boiled	90	80
fried	60	50
mashed	90	50
green vegetable—raw, boiled	75	55
frozen, boiled	80	60
other vegetable—raw, boiled	75	65
frozen, boiled	85	80
fruits, fresh and dried, stewed	80	70

From the table, it can be concluded that

A in water, thiamine is more soluble than ascorbic acid.
B most foods contain more thiamine than ascorbic acid.
C baked potatoes are a better source of ascorbic acid than fried potatoes.
D when meat is roasted, all the ascorbic acid is destroyed.

5e-17 The following table shows the relative compositions of 100 mL of human milk and cow's milk.

An
3
(c)
A

Nutrient	Human milk (100 mL)	Cow's milk (100 mL)
total energy	300 kJ	300 kJ
carbohydrate (lactose)	7 g	5 g
protein	1 g	3 g
ascorbic acid	4.0 mg	1.4 mg
calcium	33 mg	125 mg

Of the following, the **best** conclusion drawn from these data is that

A the nutritional needs of babies and calves differ.
B human babies and calves need the same amount of energy.
C cow's milk is ideal for feeding to human babies.
D human babies are less likely to get scurvy than are calves.

5e-18 Four sterile agar plates containing different types of nutrient substances were contaminated by exposing them to the air in a dark cupboard for 10 minutes. The plates were of uniform size and contained equal amounts of agar.
17f
An
4
(c)
B

Nutrient	Bacteria	Moulds	Viruses	Slime moulds
potato agar	5	12	0	0
malt agar	7	17	0	0
peptone agar	14	2	0	0
blood agar	12	0	0	0

Which one of the following hypotheses is **best** supported by the above data?

A Viruses and slime moulds cannot survive in dark conditions.
B Airborne moulds grow better on potato and malt agar than on peptone and blood agar.
C Airborne bacteria are easier to grow than airborne moulds.
D Slime moulds have more specific conditions for growth than common moulds.

INCORRECT response items

5e-19 The following table shows an association between diet, cholesterol in the blood, and the chance of heart attack in three groups of people of Japanese descent.
17b
Ap
5
(i)
A

	Japan	Hawaii	California
Percentage of dietary energy coming from saturated fats	7	23	26
Cholesterol in blood serum	181	218	228
Death rate from coronary heart disease per 1000 per year	1.3	2.2	3.7

From the information in the above table it can be concluded that, among people of Japanese descent,

A more die of coronary heart disease in Hawaii than in Japan.
B saturated fat intake is greater in California than in Japan.
C coronary heat disease seems to be linked to saturated fat intake.
D the higher the saturated fat intake, the higher the blood cholesterol level.

5e-20 9a Co 4 (i) D

Can you imagine a mouse retaining all the properties of a small mouse, but becoming as large as an elephant?

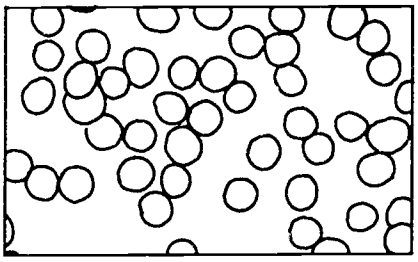
Compared with the elephant, this mouse would

A use more energy per average gram of body weight.
B have a greater rate of respiration.
C have a greater basal energy requirement.
D use a lower volume of oxygen per minute while at rest.

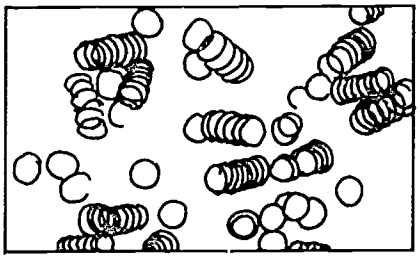
5e-21 – Ap 2 (i) C

Red blood cells carry oxygen to the tissues of mammals for respiration to occur.

Consider the following diagrams of red blood cells.



Normal non-aggregation of red blood cells six hours after a low-fat meal.



Red blood cell aggregation and rouleaux formation six hours after a high-fat meal.

From the above information the following conclusions may be made.

A Most of the red blood cells in the blood of a person six hours after a low-fat meal are available to carry the maximum amount of oxygen to the cells.
B Most of the red blood cells in the blood of a person six hours after a high-fat meal are restricted in their ability to carry oxygen.
C If the breathing rate is kept constant, more energy can be made available for activity in a person after a high-fat meal than after a low-fat meal.
D The amount of oxygen carried by the blood is affected by the diet of the individual.

6 POPULATIONS

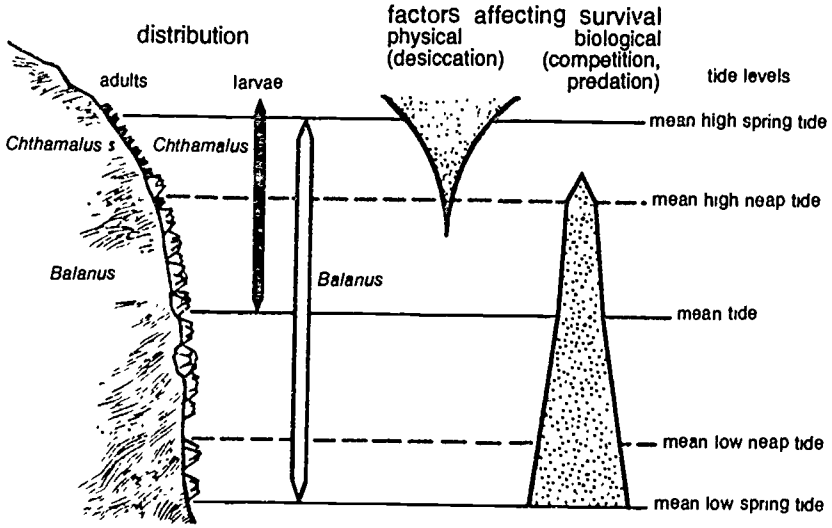
Numbers of Organisms

6a—Factors affecting distribution of a species

CORRECT response items

The next 2 items refer to the following information:

The data presented in the diagram below is derived from a study of the distribution of two species of barnacle *Balanus* and *Chthamalus*. The adults of each species have a characteristic distribution on the rocky ocean floor. Barnacles have a planktonic larva which eventually settles on a surface and develops into an adult if the conditions are favourable.



6a-1 Which statement is **best** supported by the data?

3a Co 3 (c) B

A The larvae of each species of barnacle are able to select the 'settling location' which is ideal for subsequent development.

B Barnacle larvae will settle in a much wider range of environments than adult barnacles can tolerate.

C Predation is a major cause of mortality in *Chthamalus* above mean high neap tide.

D Adult *Balanus* are unable to reproduce above mean high neap tide level.

6a-2 Which of the following statements is **best** supported by the data?

3a An 3 (c) C

A The species of barnacle best able to tolerate harsh conditions of the physical environment is *Balanus*.

B *Balanus* is excluded from the higher zones of the sea shore by competition from *Chthamalus*.

C *Chthamalus* is capable of tolerating desiccation stress but is not an effective competitor with *Balanus* below mean high neap tide level.

D *Chthamalus* settling below mean high neap tide level are more likely to die of desiccation than from competition with *Balanus*.

The next 6 items refer to the following information:

Today a great deal of scientific work is carried out in circumstances where there is only a limited number of 'possible' hypotheses to explain a particular observation. In cases such as these, when one of the competing hypotheses is rejected, the original hypothesis is said to be supported. You are to assume that this is true of the hypothesis described in the passage below.

Under natural conditions, the major species which preys upon the freshwater mosquito fish (*Gambusia affinis*) is a larger fish, the pickerel (*Esox americanus*). If *Esox* is introduced into an aquarium containing a school of *Gambusia*, it is observed that *Gambusia* react in a characteristic way, swimming ungrouped at the surface with fins erect.

A biologist studying the relationship between the two species formed the hypothesis:

'*Gambusia* react to one or more chemical substances which pass into the water from the body of *Esox*'.

Among the experiments he performed when investigating this hypothesis was the following.

Experiment 1: *Esox* was placed into an aquarium for one hour; then, after removing *Esox* from the water a group of *Gambusia* was introduced into the aquarium.

6a-3 17e Co 3 (c) A

When Experiment 1 was performed, it was found that when *Gambusia* were placed in the aquarium from which *Esox* had recently been removed, the fish swam ungrouped at the surface with fins erect.

This observation

A supports the hypothesis but does not prove it to be correct.
B proves the hypothesis to be correct.
C proves the hypothesis to be incorrect.
D does not provide data which is relevant to this particular hypothesis.

6a-4 17e Co 4 (c) C

Which of the following **best** describes the relationship between Experiment 1 and the hypothesis?

A The experiment is designed to provide data on which to base a new hypothesis.
B The experiment is designed to check on the accuracy of the original observation on which the hypothesis was based.
C The experiment is designed to test a prediction made from the hypothesis.
D The result of the experiment will either prove or disprove the hypothesis.

After completing Experiment 1 the biologist carried out another experiment.

Experiment 2: *Esox* was placed into an aquarium for one hour. After removing *Esox* the water in the aquarium was quickly filtered through activated charcoal (which is known to be capable of absorbing many chemical substances). *Gambusia* were then introduced into the aquarium.

6a-5 17e Co 4 (c) A

If *Gambusia* in Experiment 2 behaved normally (i.e. did not swim ungrouped at the surface with fins erect), this observation would

A provide additional support for the hypothesis, but not prove it to be correct.
B prove conclusively that the hypothesis is correct.
C prove conclusively that the hypothesis is incorrect.
D contradict the results from Experiment 1.

6a-6 17e Co 4 (c) D

If in Experiment 2 the *Gambusia* had been observed to swim ungrouped at the surface with fins erect, this observation would

A provide additional support for the original hypothesis but not prove it to be correct.
B prove conclusively that the hypothesis is correct.
C prove conclusively that the hypothesis is incorrect.
D neither support nor disprove the original hypothesis.

Two further experiments were conducted.

Experiment 3: A wooden model of *Esox* was introduced into an aquarium containing *Gambusia*.

Experiment 4: A glass aquarium containing *Esox* was placed alongside another glass aquarium containing *Gambusia* so that the *Esox* would be seen by the *Gambusia*.

6a-7 17e Co 4 (c) A

If in both Experiment 3 and Experiment 4 the *Gambusia* behaved normally (i.e. did not swim ungrouped at the surface with fins erect), this observation would

A provide support for the original hypothesis.
B prove that *Gambusia* reacted to the presence of chemicals which pass into the water from the body of *Esox*.
C prove that the original hypothesis is incorrect.
D neither support nor disprove the original hypothesis.

6a-8 17f Co 4 (c) D

If in all four experiments, 1, 2, 3, and 4, the *Gambusia* swam ungrouped at the surface with fins erect, which one of the following statements would be justified?

A The *Gambusia* react in this characteristic way only if they can see *Esox*.
B The *Gambusia* react in this characteristic way only if chemical substances released by *Esox* are present in the water.
C The *Gambusia* react in this characteristic way only if they can see *Esox* or if chemical substances released by *Esox* are present in the water.
D None of A, B, or C would be justified.

6a-9 – Kn 2 (c) B

The distribution of a species refers to

A the change in the numbers of that species over time.
B the area over which a species is found.
C the factors which affect where an organism will be found.
D the number of organisms in a particular area.

6a-10 – Co 1 (c) D

The natural distribution of a species such as the Pacific gull is least affected by

A the physical factors of the environment.
B the density of natural predators.
C the level of competition within the species.
D the length of the life cycle of the individuals.

The next 3 items refer to the following information:

Macquarie Island is a rugged strip of land 34 km long and 5 km wide jutting from cold waters of the Southern Ocean. Snow is present much of the year, and icy westerly winds constantly sweep the island at speeds of up to 160 km per hour. Rain or fog occurs on an average of 300 days per year.

The island sustains a prolific wildlife including three introduced species. the European rabbit, the weka and wild cats. The weka is a flightless New Zealand bird which in its native environment feeds on crickets, mice and the eggs of other birds. The rabbits grow to almost twice the size of the average rabbit in Australia.

Scavenging skuas, which feed on the dead and weak animals, are among the most plentiful birds on the island. The island previously supported another large bird population. These were the burrowing petrels which nested on the island and fed on fish.

6a-11 The vegetation on the island might be expected to be

3c
Ap
2
(c)
C

A dominated by pines and other tall gymnosperms.
B mainly tea trees and banksias, the typical coastal vegetation of Australia.
C mainly low-growing wiry shrubs and tough grasses.
D very sparse, with occasional encrustation of lichen and moss on otherwise bare rocks.

6a-12 The decline in the population of burrowing petrels could **not** be the result of

6f
Co
4
(c)
A

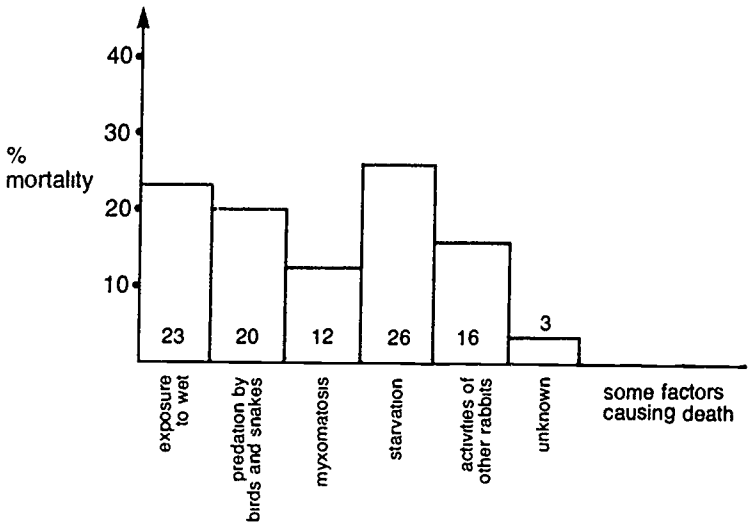
A predation by skuas.
B predation by wekas.
C competition by rabbits.
D predation by cats.

6a-13 Which of the following is the best explanation for the large size of the rabbits on Macquarie island?

3c
Ap
3
(c)
C

A Large rabbbits would have a survival advantage because they would be better able to dig burrows in the semi-frozen, rocky soil.
B The rabbits initially released on the island as a food source for sealers had been well fed and grown to a large size.
C Large rabbits would be able to conserve heat more efficiently because of their size.
D Large rabbits would be better equipped to protect themselves against predators such as cats.

6a-14 The following graph shows a comparison of some factors causing death in a rabbit population.
3a
An
5
(c)
C



Most deaths were caused by

A shortage of resources.
B weather.
C members of other species.
D members of the same species.

6a-15 The sketch below represents the bottom of a typical fern gully in a mountain range. Tree ferns grow mainly on the gully floor. Beneath the tree ferns grow the mosses and filmy ferns, often on fallen tree trunks.
–
Ap
2
(c)
C

It is likely that

A mosses and filmy ferns require organic matter to live.
B tree ferns are the only autotrophs of the gully community.
C mosses and filmy ferns have similar requirements.
D mosses and filmy ferns depend on each other for survival.

6b—Factors affecting populations and densities

CORRECT response items

6b-1 – Co 1 (c) A

The capture–recapture method of measuring a population would most likely be used for measuring the population of

A wedge-tailed eagles.
B soil bacteria.
C *Eucalyptus regnans*.
D dairy cattle.

6b-2 – Co 2 (c) C

A group of students was to estimate the fish population of a dam. They captured 100 fish, marked them in a way that did not affect their survival and released them back into the dam. Three days later they captured 120 fish and found that 10 of these were marked.

The most accurate estimate of the fish population is

A 120 .
B 1000 .
C 1200 .
D 12 000 .

6b-3 6c Co 3 (c) B

In about the year 1800 three proposals concerning the human population were made.

These can be summarized as:

1 The population is limited by the available food resources.
2 The population increases where the food resources increase unless prevented by some very powerful checks.
3 Checks to population increase are needed to repress the population growth and keep its effect on a level with the available food resources. These checks are all resolvable into conscious human effort to control population size by moral restraint.

To explain today's human population explosion, in terms of these three proposals only, we would say it has been caused by

A better medical care.
B increased primary production.
C better hygiene.
D declining moral values.

6b-4 – Co 3 (c) B

The tsetse fly sucks blood from the large grazing mammals that live in the African grasslands. It needs to feed frequently, especially during hot weather, but it does not stay on or near its victim after taking a meal so each meal is preceded by an independent search for a victim. If victims are few or sparsely distributed a fly may have little chance of getting enough food to live long enough to reproduce, despite the fact that the amount of blood in a single grazing mammal would be more than enough to support many flies.

Which one of the following generalizations is illustrated by the information above regarding the tsetse fly population?

A The density of a population influences the chances of survival of its individual members.
B The density of a population is influenced by the population densities of other organisms in the environment.
C The density of a population is affected by birth rate, death rate, immigration rate, and emigration rate, but the survival of individual members of the population is affected by other factors.
D The density of a population of a highly mobile organism (such as the tsetse fly) is more affected by fluctuations in food supply than is the population density of a less mobile organism.

The next 4 items refer to the following information:

The cactus *Opuntia stricta* (prickly pear) was introduced into Australia in the nineteenth century as an ornamental plant. It spread rapidly, covering large areas of New South Wales and Queensland.

The *Cactoblastis* moth was brought to Australia from Argentina in 1925, and within five years of its introduction large areas of prickly pear were destroyed.

6b-5 6a Co 1 (c) D

The initial success of prickly pear was probably because

A people carefully cultivated their ornamental plants such as cacti.
B the climate of Australia is cooler than the cactus' native climate.
C it had few competitors.
D its natural predators were absent.

6b-6 Co 2 (c) A

Which of the following determined the suitability of *Cactoblastis* as a control?

A it ate only prickly pear cactus
B it had a varied diet of cacti
C it had few natural predators
D it had few natural competitors

6b-7 2b Co 4 (c) A

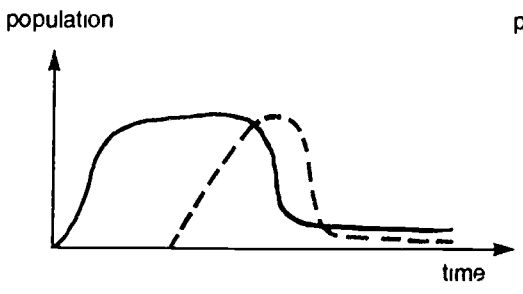
The name *Cactoblastis* is this organism's

A generic name.
B specific name.
C family name.
D descriptive name.

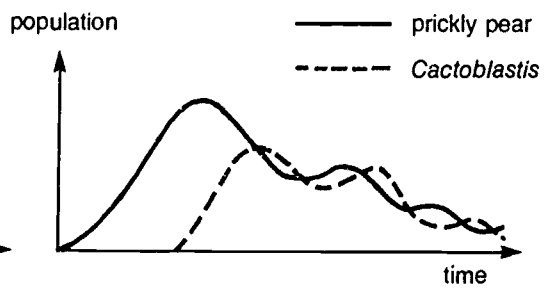
6b-8 6a Ap 4 (c) C

The best graphical representation of the changes in population is

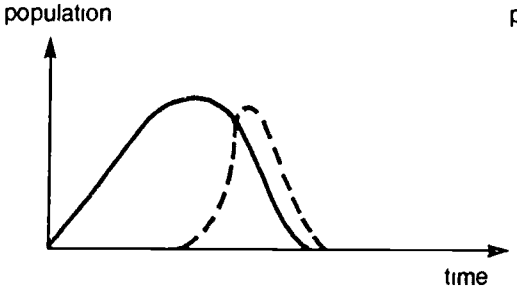
A



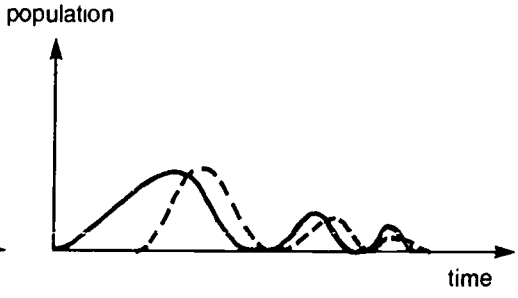
C



B



D



The next 3 items refer to the following information:

Salmon tend to swim together in large, well defined schools. In order to estimate the population of a migrating school of salmon, a number of fish was caught, marked by putting a small nick in their tail fins with a razor blade, and immediately returned to the population. When the fish arrived at their destination, a net was used to capture a random sample of them. The proportion of marked fish in the sample was then found, and used to estimate the population size.

Let N = the estimated number of fish in the migrating population at the beginning of the migration;
M = the number of fish originally captured, marked, and returned to the population;
R = the number of fish caught at random in the net at their destination; and
S = the number of fish which were marked, released, and captured.

6b-9 17d Co 3 (c) C

Which one of the following can be used to calculte N?

A N = SM/R
B N = R/SM
C N = RM/S
D N = S/RM

6b-10 17d Co 4 (c) A

Which one of the statements below, if true, would make the reasoning used in the investigation to calculate N **incorrect**?

A Marking the tail fin of a salmon reduces its ability to swim to its destination.
B A weak unhealthy fish is just as likely to be caught for marking as a strong healthy fish.
C Marked salmon remain clearly distinguishable from unmarked salmon at the end of the process of migration.
D The probability of capturing a marked salmon depends on the proportion of marked salmon in the population.

6b-11 17f Ev 3 (c) C

Subsequent investigation shows that about 25 per cent of the salmon which begin the migration do not arrive at their destination.

Four students are discussing the effect this loss will have upon the estimate of N.

Whose argument is the most sound in view of the information given?

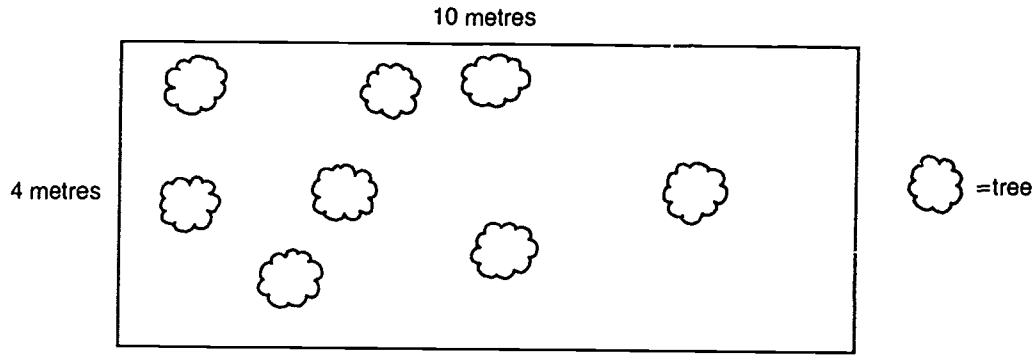
A Margaret:
'As 25 per cent of the population has been lost, the calculated value of N underestimates the actual size of the population beginning their migration.'

B Michael:
'The calculated value of N gives a good estimate of the size of the population arriving at the destination, but overestimates by 25 per cent the number beginning their migration.'

C Susan:
'Population losses will affect both the marked and the unmarked fish in the same ratio, the calculated value of N therefore gives a good estimate of the number of fish beginning their migration.'

D Stuart:
'Since population losses begin to occur only after the marked fish have been returned to the population, the calculated value of N still gives a good estimate of the number of fish arriving at their destination.'

6b-12 – Co 4 (c) C The following diagram represents an area studied by a class of students. The position of each tree is shown by a symbol.



The students should state the density of trees in the study area as

A 8 per 40 m^2 .
B 7 per 20 m^2 .
C 0.2 per m^2 .
D 0.35 per m^2 .

6b-13 – Co 4 (c) B An ecologist carrying out a preliminary study of a woodland community wished to estimate the number and diversity of insects.

Which method would **best** be used to gain a quick estimate with minimum affect on the community?

A capture, mark, release, recapture
B capture by sweeping with a sweep net, then release
C enclose a known area then count all insects
D capture a random sample of birds and examine the stomach contents

The next 2 items refer to the following information:

In an area of 50 hectares the kangaroo population was 40. Two months later, in the same area, the population was halved.

6b-14 – Co 3 (c) C The population density changed from

A 0.8 to 0.4.
B 1 per 0.8 hectare to 1 per 0.4 hectare.
C 0.8 per hectare to 0.4 per hectare.
D 1 per 0.4 hectare to 1 per 0.8 hectare.

6b-15 – Ap 3 (c) A Which one of the following is **least** likely to account for the rapid change in population size?

A The kangaroos stopped breeding.
B A new disease-causing organism was brought into the mob.
C Predators became more numerous.
D Emigration had occurred.

6b-16 – Ap 3 (c) C

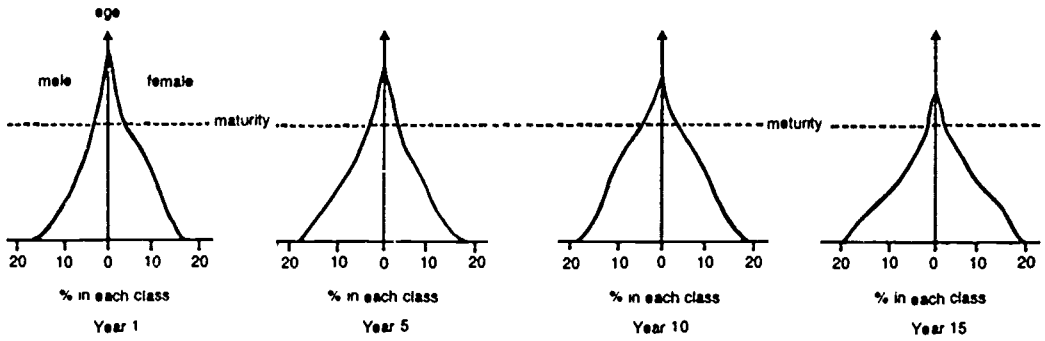
The capture–recapture method was used to estimate the size of a population and a sample of 300 animals were caught, tagged and released. Later, 300 animals were recaptured and 50 were found to be tagged.

The population would be estimated at

A 50.
B 300.
C 1800.
D 15 000.

6b-17 – An 2 (c) C

The four graphs of whale populations show the relative percentages of whales of both sexes at four times in a 15-year study.



Which one of the following best summarizes these observations?

A There are more young whales in year 15 than there were in year 1.
B The total number of whales has declined considerably between year 1 and year 15.
C The proportion of older whales has decreased from year 1 to year 15.
D The proportion of young whales has declined from year 1 to year 15.

6b-18 – An 3 (c) B

A biologist studying the distribution of a particular species of possum estimated the population sizes of three separate possum populations occurring in widely separated regions. His results are tabulated below.

Region	Estimated size of possum population
X	3200
Y	2800
Z	7800

In his description of the distribution of the species, the biologist stated that regions Y and Z supported populations of comparable density, but region X had a very much smaller population density.

This means that

A the area of region X is very much less than that of region Y and less than the area of region Z.
B the area of region X is very much greater than that of region Y.
C region Z is of comparable area to region Y.
D the area of region Y is much greater than that of either X or Z.

6b-19 – Ap 3 (c) B *

On a field excursion in a jarrah forest a student was asked to estimate the population density of jarrah trees. In a plot of size 100 metres by 100 metres, 20 jarrah trees were counted.

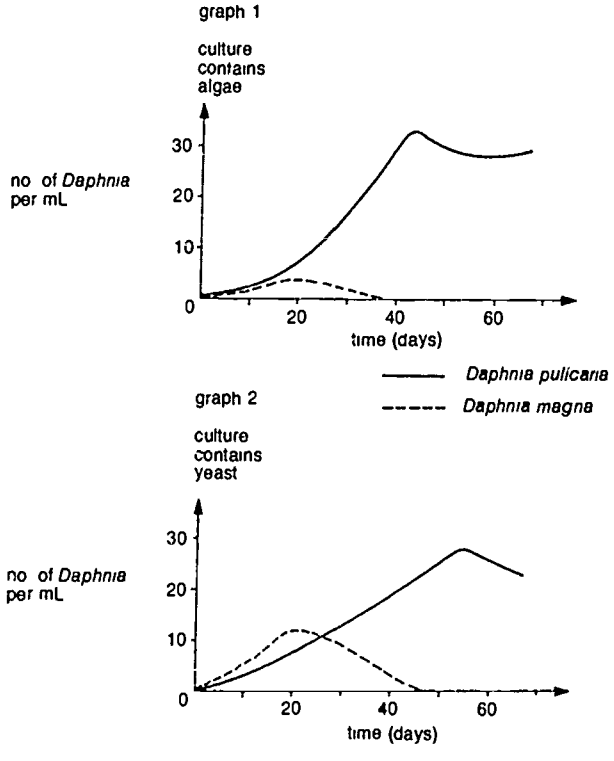
The best estimate of the jarrah density would be

A 20 000 trees per km^2.
B 2 000 trees per km^2 .
C 200 trees per km^2.
D 20 trees per km^2 .

The next 2 items refer to the following information:

Two species of *Daphnia* (small freshwater crustaceans) were grown in mixed culture with algae and, in another experiment, with yeast.

The following graphs show the changes in population size which occurred.



6b-20 Which of the following statements is **best** supported by the data in graph 2?

An 2 (c) D

A *D. pulicaria* is a predator of *D. magna.*

B *D. magna* cannot reproduce as rapidly as *D. pulicaria.*

C *D. pulicaria* is larger than *D. magna.*

D *D pulicaria* is better adapted to these conditions than *D. magna.*

6b-21 Which one of the following statements is **best** supported by the data in the graphs?

An 3 (c) A

A Yeast is a more favourable food than algae for *D. magna.*

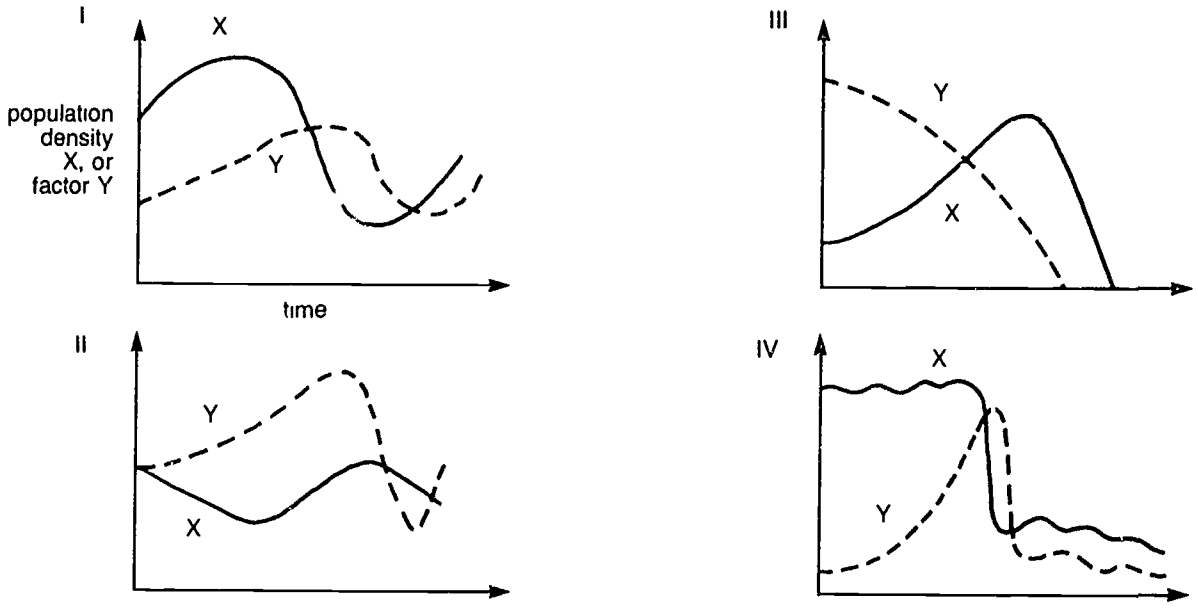
B Neither yeast nor algae can be suitable food for *D. magna.*

C *D. pulicaria* can survive on a wide variety of food types.

D The type of food supplied does not affect the interaction between the two *Daphnia* species.

The next 3 items refer to the following information:

The heavy line (X) in each of the graphs I to IV represents the changes in the density of a population of organisms with time. The dotted line (Y) represents **either** the changes in density of another population, **or** changes in some other environmental factor.



6b-22 – An 3 (c) A Which graph represents the density of population (X) being held in check by a population of predators (Y)?

A I
B II
C III
D IV

6b-23 – An 2 (c) C Which graph represents a population (X) growing in a closed container with a limited supply of food (Y)?

A I
B II
C III
D IV

6b-24 – An 2 (c) D Which graph represents a population (X) suffering from an epidemic of a disease caused by a microorganism (Y)?

A I
B II
C III
D IV

The next 3 items refer to the following information:

Clover seedlings of three strains (X, Y, and Z) were planted in similar experimental plots at both a low density and a high density. In some plots one strain only was planted whilst in other plots all three strains were mixed in together. In each mixed plot equal numbers of seedlings of each strain were planted. After two years the plants were counted and the results were tabulated below.

Table 1

	Percentage of plants surviving in plots containing **one** strain only		
Density	X	Y	Z
Low	77	69	90
High	27	49	24

Table 2

	Percentage of each strain surviving in plots containing **all three** strains X, Y, and Z		
Density	X	Y	Z
Low	16	22	5
High	63	78	43

6b-25 – An 4 (c) C Which one of the following sets of reading of percentage survival shows that strain Y competes more successfully?

A 27, 49, 24
B 69, 49
C 63, 78, 43
D 22, 78

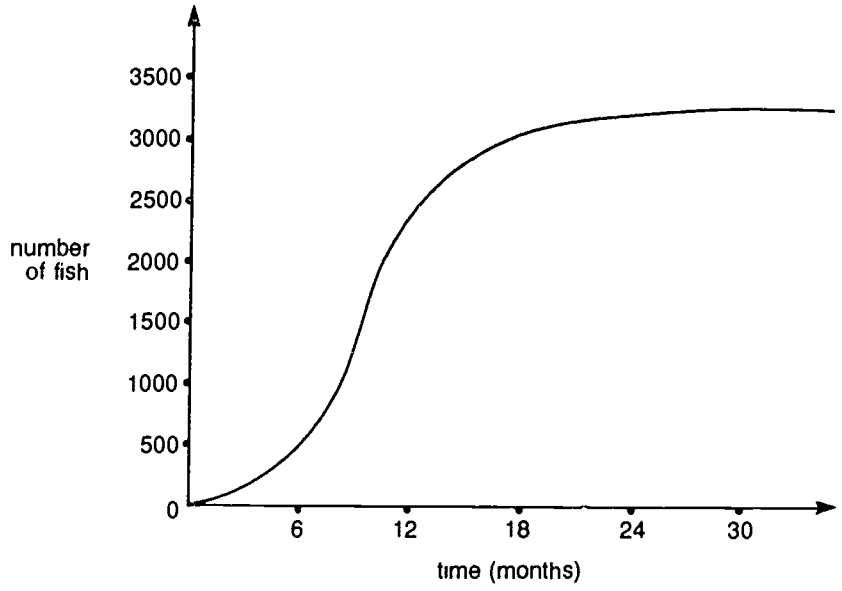
6b-26 – An 4 (c) D In which plot would you expect to find **most** plants surviving after a period of three years, if the same growing conditions continued?

A low density containing X, Y, and Z
B high density containing X, Y, and Z
C low density containing only Y
D low density containing only Z

6b-27 – An 3 (c) A What is the average percentage of all plants surviving in low density plots containing a mixture of strains X, Y, and Z?

A 14 per cent
B 43 per cent
C 129 per cent
D The percentage cannot be determined from the information given.

6b-28 The graph below describes the changes in a fish population in a large dam.
8d
An
4
(c)
A



If the fish were to be commercially harvested, which management strategy would result in maximum yield?

A Harvest the fish at a rate that would maintain the population at about 1500.
B Make every effort to maintain the fish population at about 3100.
C Harvest the fish until the population is about 100 then allow it to rise to about 3000 before harvesting again.
D Maintain the population at around 3000 and harvest 100 fish every 18 months.

INCORRECT response items

Populations of organisms in a particular place may be extremely large in some instances. For example, sour milk may contain 100 000 000 bacteria per cubic centimetre. It is obviously impractical to actually count every organism in such a case. Biologists use various methods to estimate populations and express number of organisms in different ways.

6b-29 It is true to say that
17g
Co
3
(i)
A

A in many cases it is sufficient to state whether the numbers are static, increasing or decreasing.
B the number or amount of organisms can be expressed in ways such as weight per unit area.
C in cases of very large population, sampling methods are more practical.
D when organisms are unevenly distributed sampling methods cannot be relied on.

6b-30 The world human population is following an exponential growth pattern.
–
Ap
2
(i)
D
*

Natural animal populations do not have a sustained exponential growth pattern because

A they have limited resources.
B there may be barriers limiting their ability to spread.
C predators and disease keep numbers down.
D they adapt themselves to suit their environment.

6c—Rates of change

CORRECT response items

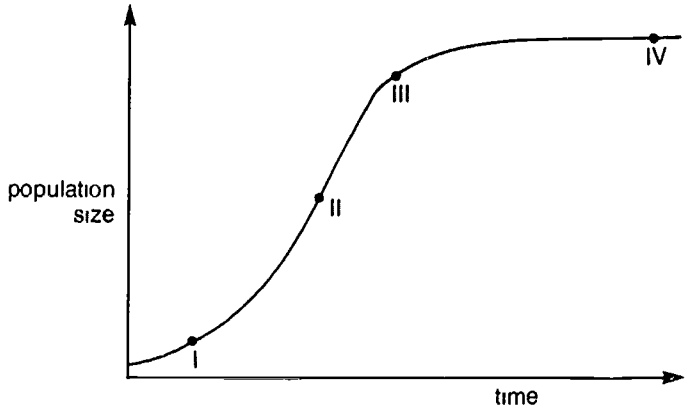
6c-1 – Co 2 (c) C

Factors which affect the rate of growth of a population (r) are birth rate (b), death rate (d), emigration (e) and immigration (i).

Which of the following must be true if (r) has a negative value?

A (e) is greater than (i)
B (d) is greater than (b)
C (d) + (e) is greater than (b) + (i)
D (i) + (e) is greater than (b) + (d)

The next 2 items refer to the following graph:



6c-2 6b Co 2 (c) D

Carrying capacity is the maximum number of organisms that can be supported by a particular environment.

Which point on the graph represents the carrying capacity of the area in which the population lives?

A I
B II
C III
D IV

6c-3 – Co 2 (c) B

On the above graph at point I

A birth rate equals death rate.
B birth rate is greater than death rate.
C birth rate is less than death rate.
D birth rate minus death rate equals zero.

6c-4 – Ap 4 (c) B

A fishing port had a population of 6500 people at the beginning of 1980. During the year 250 people died, 150 were born, 670 migrated out and 120 moved into the port.

What was the overall rate of change for 1980?

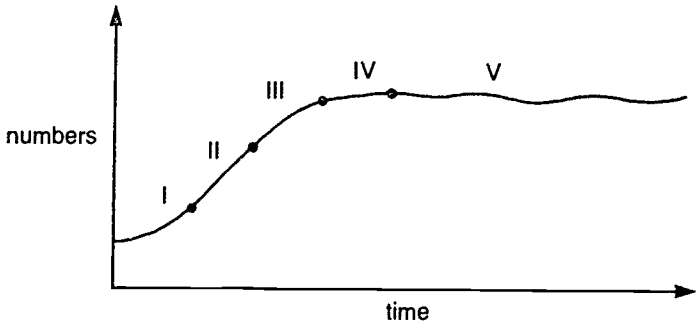
A -65 per thousand per year
B -100 per thousand per year
C -390 per thousand per year
D -650 per thousand per year

The next 2 items refer to the following information:

A particular community is found to contain the following food chain

alga ⟶ tadpole ⟶ long-necked tortoise ⟶ Murray cod ⟶ bacterium

A growth curve for a population normally takes the following shape:



6c-5 – Ap 4 (c) D Under stable conditions which part of the curve would represent the population of the Murray cod?

A I
B II
C IV
D V

6c-6 – Ap 3 (c) A Suppose a disease killed most of the long-necked tortoises.

What part of the curve would best represent the short-term effect on the tadpole population?

A I and II
B II and III
C III and IV
D IV and V

The next 2 items refer to the following information:

Two fruit flies (one male, one female) were placed into a large fly cage containing 20 mL of nutrient material. For each new generation, the total number of flies present in the cage was counted. Based on the assumption that each female produces 60 young flies, the hypothetical maximum number of flies was also calculated.

The results and calculations are summarized below.

		Generation			
	Initial	1	2	3	4
Observed number	2	80	200	5	0
Calculated number	2	62	1922	59 582	1 847 042

6c-7 6a Ap 2 (c) B What is the most likely reason for the difference between the hypothetical and the observed population changes?

A Overcrowding caused a disease.
B The food supply was used up.
C Mating did not occur due to lack of space
D The migration rate was not taken into account in the calculations.

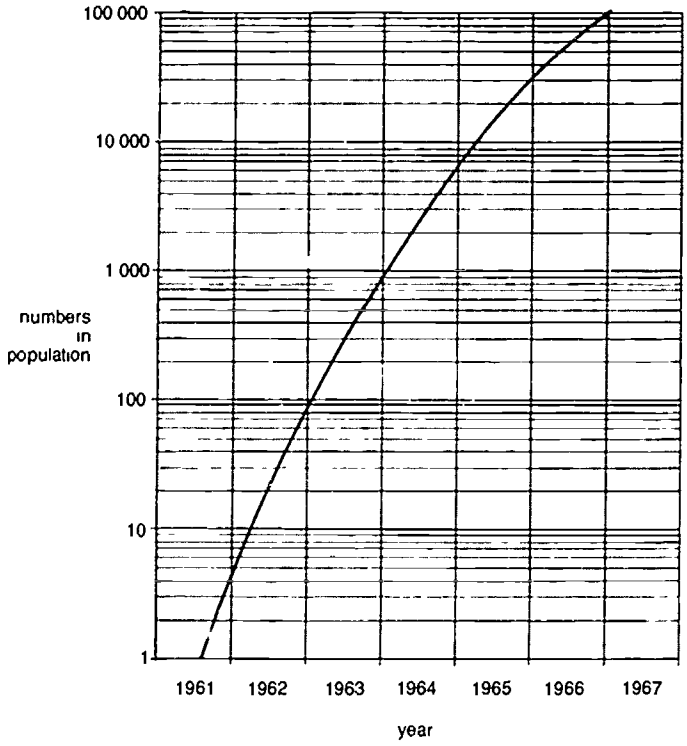
6c-8 From the observed results, what was the overall rate of increase shown by the flies between generations 1 and 2?

6a Ap 4 (c) C

A 600 per thousand per generation
B 1400 per thousand per generation
C 1500 per thousand per generation
D 3500 per thousand per generation

The next 2 items refer to the following information:

Below is a population graph plotted on semi-logarithmic graph paper.



6c-9 In what year did the population first pass 40 000?

– An 2 (c) C

A 1964
B 1965
C 1966
D 1967

6c-10 What was the population in mid-1964?

– An 2 (c) C

A 1000
B 1150
C 2500
D 3000

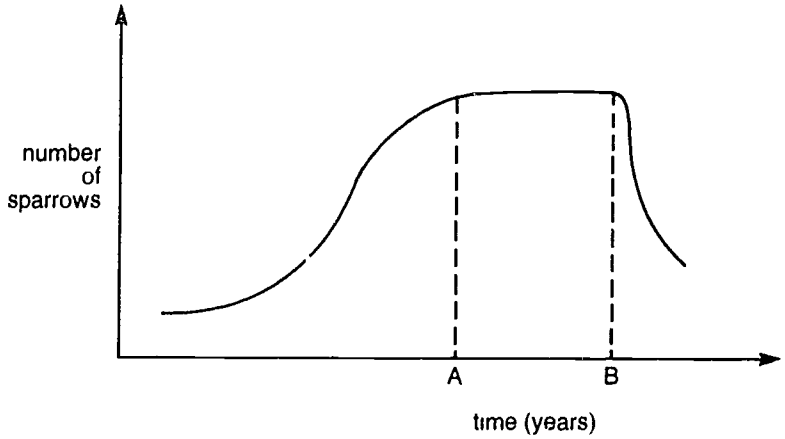
6c-11 – Co 4 (c) B *

If we assume that zero population growth (ZPG) is desirable, the rate of change of the population would be

A negative.
B nil.
C slightly positive.
D constant.

6c-12 – An 3 (c) C

The graph below represents the size of a population of sparrows over a number of years. No immigration or emigration occurred over the period represented by the graph.



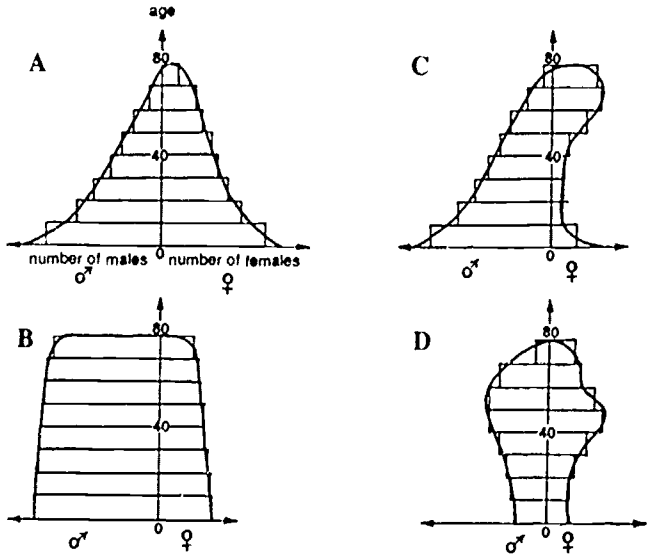
From this data, which of the following statements is **most** valid?

A At time A, there is unlimited growth of the sparrow population as there is plenty of food and nesting sites.
B The decline in sparrow population after time B was more likely caused by shortage of food than shortage of nesting sites.
C At time A, the birth rate of the sparrow population is approximately equal to the death rate.
D At time B, the death rate of the sparrow population was much greater than the birth rate.

6c-13 – An 4 (c) A

Human populations are sometimes represented by age-sex pyramids.

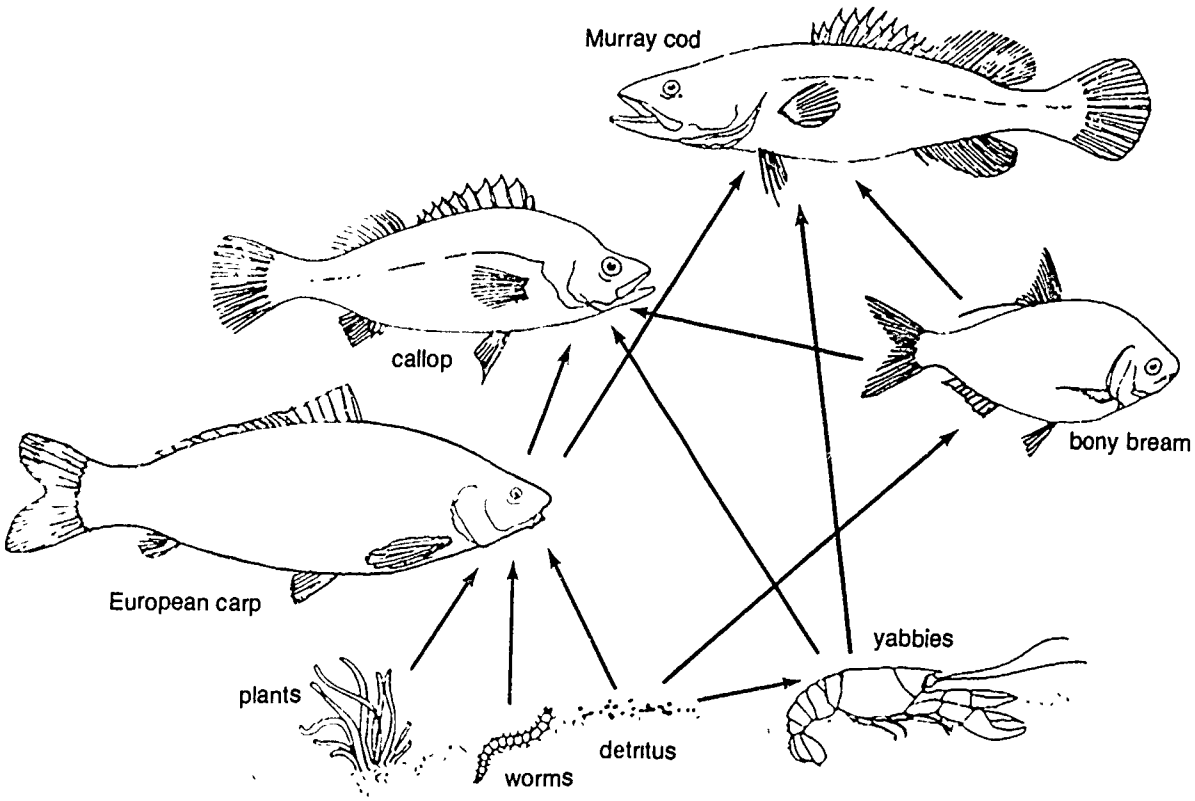
Which one of the following probably represents the most rapidly increasing population?



The next 2 items refer to the following information:

Over the last few years, there has been a decrease in the abundance of the most common native fish species (callop, cod, cat fish, silver perch, bony bream) in the River Murray within South Australia.

Studies of the river community have revealed the following food web:



6c-14 – An 4 (c) C

From the above information, the great increase in carp numbers from 1970–1976 is most probably due to

A lack of natural predators.
B a great increase in the Murray redfin population.
C little competition for food.
D a corresponding increase in the plant and worm populations.

6c-15 – An 4 (c) D

Over this time there has been a dramatic decline in Murray cod numbers.

From the above information, the most probable reason is

A the introduction of European carp.
B a decline in the availability of food.
C an overall decline in River Murray fish numbers
D other unspecified environmental factors.

6d—Living in groups

CORRECT response items

6d-1 The difference between a home range and a territory is that

–
Kn
2
(c)
B

A territories are generally larger than home ranges.
B territories are defended, home ranges are not.
C larger animals occupy a home range, smaller animals occupy a territory.
D social animals occupy a territory, non-social animals occupy a home range.

6d-2 Flies collect around fresh animal dung.

–
Kn
2
(c)
D

Such a group of organisms would be called

A a species.
B a society.
C a colony.
D an aggregation.

6d-3 Among animals, competition between members of the *same* species is usually more intense than that between members of *different* species.

6a
Co
2
(c)
B

The **most** probable explanation for this is that

A there is considerable variation among individuals even though they are of the same species.
B members of the same species have very similar requirements.
C members of the same species instinctively know each other's behaviour patterns and are thus better equipped to compete with one another.
D members of the same species may be organized into a social hierarchy.

6d-4 An authority on apes made the following observations about chimpanzees.

–
Co
3
(c)
C

Threatening male chimpanzees may exhibit any one or a combination of behaviours such as high pitched screaming, glaring with mouth tensed, slapping the ground, shaking branches, hitting tree trunks, slapping motions towards the threatened victim or object, arm swinging while walking erect or brandishing a broken branch.

The behaviours described would be called

A social.
B territorial.
C agonistic.
D courtship.

6d-5 Each of the following is a quotation about animals which live in groups.

–
Co
3
(c)
D

Which of the descriptions could refer to a caste system?

A 'Males are more aggressive and much larger than females. High ranking or dominant males protect the group from predators and break up fights among group members.'
B 'After the morning feed, the family, with the father carrying the youngsters, heads for its border. After the neighbours appear they purposely put their feet over the territorial boundaries and all sorts of arguing results.'
C 'When a kill is made, the adults form a protective circle around it so young can feed without danger of other animals stealing the food.'
D 'One female is the sole source of new individuals because only she can produce eggs. Sterile females work for the group but males are tolerated only at certain times and do no useful work.'

6d-6 Which one of the following is characteristic of **most** animal societies?

– Co 3 (c) B

A All members of the society are able to obtain sufficient food and space.
B The society is co-ordinated and competition between individuals is reduced.
C The group separates into pairs (so that reproduction still occurs) if resources are in short supply.
D The society never becomes so large that there is competition for food or space.

6d-7 For individuals of a species to be able to co-ordinate their activities into social behaviour, it is essential that they have

– Co 3 (c) B

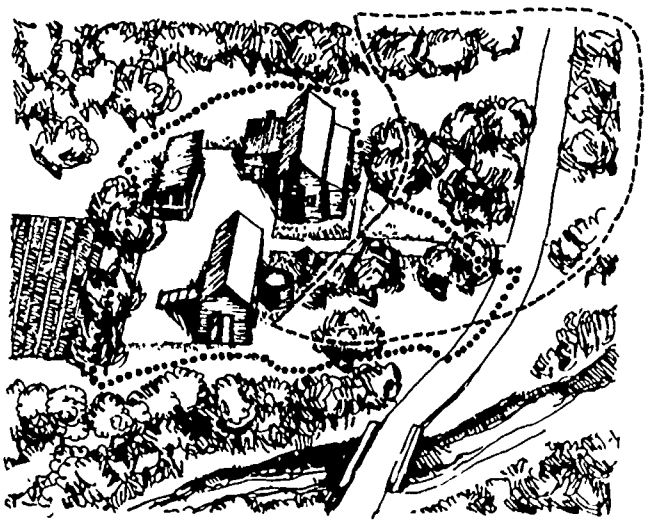
A a reasonable level of intelligence.
B some system of communication.
C division of labour.
D a social hierarchy.

The next 2 items refer to the following information:

The diagram shows the territorial boundaries of birds of two species inhabiting an area.

territorial boundaries for species X ••••••••••

territorial boundaries for species Y – – – – – –



6d-8 The birds probably maintain these boundaries by

– Co 4 (c) A

A singing or other forms of display from vantage points near the boundaries.
B repeated pecking fights between individuals of species X and species Y.
C building nests at central points within their territories.
D organizing themselves to drive out intruders of other species.

6d-9 The information in the diagram suggests that

– Co 3 (c) D

A species Y is a predator of species X.
B species X and species Y have identical food requirements.
C individuals of species Y are much larger than those of species X.
D species X and species Y are not in direct competition.

The next 5 items refer to the following information:

A biologist studying behaviour in a small colony of native American mice, *Peromyscus*, made the following observations:

> When two mice meet in the course of feeding (or searching for food) they perform a pattern of behaviour which includes nosing, grooming, and sometimes fighting. When individuals approach and nose each other, one usually begins to groom the other. If both individuals attempt to groom each other, a fight may develop. Usually, however, one of the mice passively allows itself to be groomed. The passive mouse curls in a corner or may even roll over on its back and allow the active groomer free access to any part of its body. When the active mouse stops grooming, it continues exploring or feeding but returns at intervals to resume grooming. The passive mouse rarely leaves its position until the active mouse leaves the vicinity.

To investigate this behaviour further, the biologist numbered each mouse and, over a period of time, observed which mice were actively grooming and which mice were passively being groomed. His results were as follows:

			mouse actively grooming								
			male					female			
			1	2	3	4	5	1	2	3	4
mouse being groomed passively	male	1		///	//		////				
		2									
		3		//			//				
		4	////	//	///		///				
		5		///							
	female	1	//	//	/	///	/			//	////
		2	/	///	/	//	/	///		///	//
		3	///	/	/	/	//				
		4	//	/	//	/	//			/	

A stroke (/) indicates that grooming behaviour was observed between two mice; the number of strokes indicates the number of times such behaviour was observed.

6d-10 17f Ap 3 (c) D From the above information and a knowledge of interaction behaviour between animals of the same species, which one of the following inferences can **not** be justified?

A Either for health or other reasons, grooming behaviour has survival advantage for *Peromyscus*.

B Grooming is used as a social signal or means of communication in *Peromyscus*.

C Nosing, grooming, and fighting are agonistic behaviours.

D *Peromyscus* exhibits a division of labour in which male mice take responsibility for grooming other mice.

In answering the next 4 items, assume that *Peromyscus* mice exhibit a social hierarchy similar to the 'pecking order' of domestic fowls.

6d-11 17f An 3 (c) D Which one of the following statements is consistent with the evidence given?

A Some males will submit to some females.

B Female 2 is dominant to female 1.

C Female 3 submits to no other mouse.

D All males are dominant to all females.

6d-12 Male 2 could accurately be described as
17f
An
2
(c)
B

A the leader of the mouse colony.
B the first in rank in the colony's social hierarchy.
C the strongest mouse in the colony.
D the mouse least needing grooming.

6d-13 Which one of the following is **not** correct in view of the above information?
17f
An
3
(c)
D

A Male 2 submits to no other mouse.
B Female 2 submits to all other mice.
C Male 3 dominates only males 1 and 4 (and all females).
D Female 4 submits to males only.

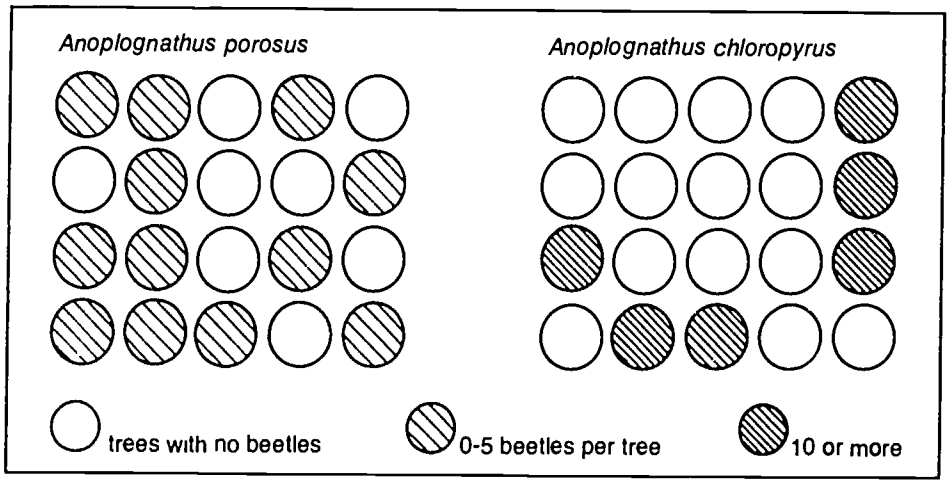
6d-14 Another male mouse, X, is introduced and it is observed to be groomed by male 3 and male 1.
17f
An
4
(c)
A

It can be confidently assumed that male mouse X will also

A submit to male 5.
B dominate male 5.
C dominate male 4.
D submit to male 4.

6d-15 – An 3 (c) C

Christmas beetles, *Anoplognathus spp.*, are insects which feed on the leaves of eucalypts. The diagram below shows the results of a CSIRO survey of two species of Christmas beetles in a eucalypt forest.



Differences in the Patterns of Distribution of the Two Species

Of the two species, the one which would cause most damage to individual trees would be

A *A. chloropyrus* because there are more beetles per unit area of forest.
B *A. porosus* because there are more beetles per unit area of forest.
C *A chloropyrus* because there are more beetles per affected tree.
D *A porosus* because more trees are affected by beetles.

6d-16 – An 3 (c) A

The letters T, U, V, W, X, Y and Z represent different roosters in a flock of domestic fowls. There is a rigid hierarchy in the flock.

The following instances of pecking were observed:

Z pecked W	U pecked Z
X pecked T	X pecked U
V pecked Z	Y pecked V
T pecked W	V pecked X

The second most dominant rooster in the social hierarchy of the flock

A was V.
B was X.
C was Y.
D cannot be determined from the data.

INCORRECT response items

6d-17 – Co 2 (i) B

Each of the following is an advantage derived by animals, from living in an organized group as opposed to solitary existence.

A increased protection from predators
B increased protection from disease-causing organisms
C increased efficiency in capture of prey
D increased protection from cold

6d-18 – Co 3 (i) B

Chemical communication occurs between members of a hive of honey-bees. Chemicals produced by the mandibular glands perform different functions in different castes. The secretion of worker bees serves as an alarm signal. The secretion of the queen inhibits worker bees from raising new queens and is spread through the colony as a result of grooming. But, in a new queen, vapour from these glands attract males.

In view of this information and your knowledge of animal behaviour, it seems reasonable to conclude that

A if contact between the queen and workers in a hive is prevented, the behaviour of the workers will change.
B grooming is essential for the transmission of alarm signals.
C these chemicals are pheromones.
D the response by other bees to the secretion of the queen depends on the caste of the bee which receives the stimulation of the chemical.

6d-19 – Ap 4 (i) A

In wildebeest groups, (South African antelopes), there exists a strict order of dominance between males. The best feeding grounds are always taken by the dominant males and the lowly ranked males feed on poor quality pastures. Females feed only on the good pastures and mate only with the dominant territory holders. Lowly ranked males never mate, even though they may be sexually mature.

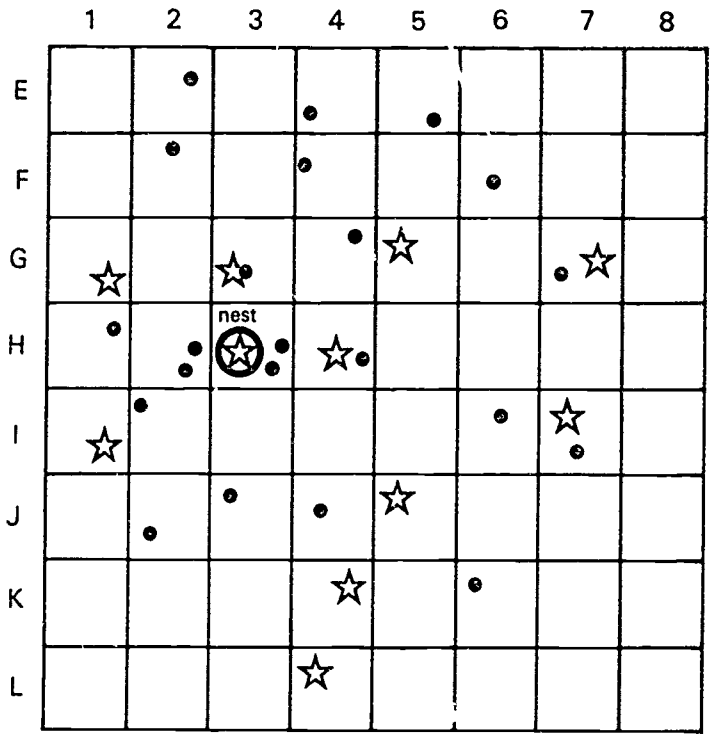
From these observations one could reasonably conclude that

A wildebeest mating behaviour patterns are innate.
B lowly ranked males probably could not mate with a female even if given the opportunity.
C the dominant males have territorial defence and mating high in their hierarchy of behaviour patterns.
D differences in behaviour between the two male groups are related to differences in their internal conditions.

The next 2 items refer to the following information:

The grid below represents an area around a nest built by a pair of magpies.

In the questions the squares are specified according to the numbers and letters on the grid, e.g. the top right-hand square is 8E and the square in which the nest is located is 3H.



The two magpies were observed over a period of three weeks during their nesting season. Points marked ☆ are positions where one of the birds was observed in conflict with other animals. Positions marked ● are positions where one of the birds was observed, sometimes in the presence of other animals, but not in conflict with them.

6d-20 Each of the following squares probably forms part of the birds' territory.

An 2 (i) C

A 2G
B 2I
C 5E
D 6G

6d-21 Each of the following squares probably forms part of the birds' home range.

An 2 (i) C

A 4L
B 5F
C 8K
D 3E

6e—Adaptation, variation and selection

CORRECT response items

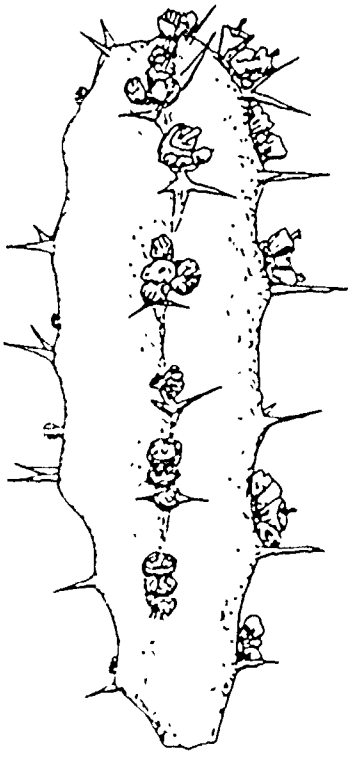
6e-1 Natural selection is **best** described as a process whereby
15e
Co
1
(c)
C

A new variations arise in a population.
B new variations are passed on to succeeding generations.
C those organisms best adapted to an environment survive and reproduce.
D the most successful organisms live longer than others.

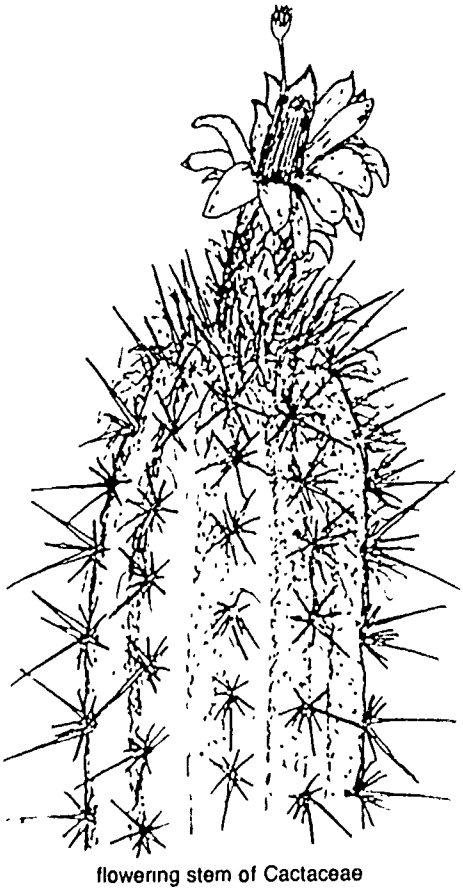
6e-2 If there were no variation among organisms of a species
–
Co
3
(c)
A

A the species could not adapt to changes in its environment.
B the population of the species would gradually increase.
C undesirable characteristics would gradually become established.
D the individual's chances of survival would decrease.

6e-3 Cacti and other succulents have adaptations that suit them to life in very dry climates. Euphorbiaceae and Cactaceae, pictured below, live in very similar environments.
2e
Co
3
(c)
C

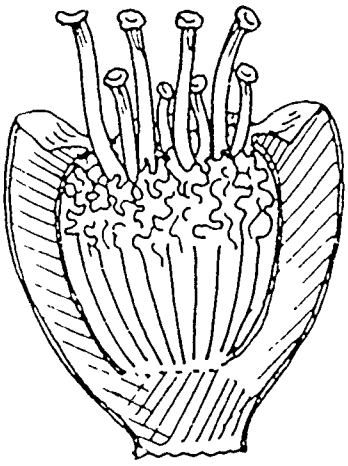


flowering stem of Euphorbiaceae

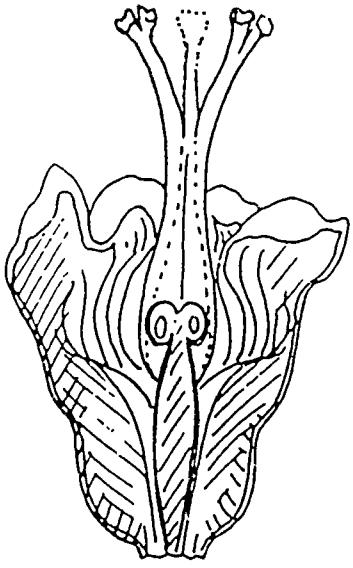


flowering stem of Cactaceae

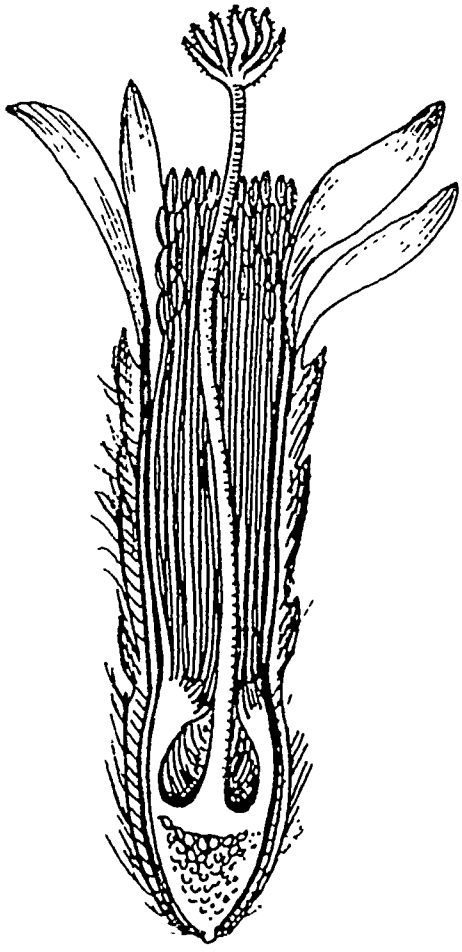
Botanists use reproductive structures, in this case flowers, to classify cacti, based on the hypothesis that flowers evolve slowly but leaves, stems and roots can evolve quickly. The following diagrams show longitudinal sections through typical flowers of the two plant types.



a male flower
of Euphorbiaceae



a female flower
of Euphorbiaceae



Cactacese flower

Euphorbiaceae and Cactaceae have many similar structures because they

A both belong to the same species.
B have been acted on by the same selective agents.
C have developed similar structures in response to the plants' requirements.
D had a recent common ancestor.

6e-4 – Ap 2 (c) B

Which of the following is an example of a change which comes about as a result of natural selection?

A There are many drugs to which people develop tolerance. They have to take larger doses of the drug for it to have the same effect.
B The cotton boll weevil, through exposure to insecticides, has become resistant to almost every chemical available.
C A group of Japanese macaque monkeys, when introduced to a new food, sweet potatoes, developed the practice of washing them in a stream.
D A dog, when fed at the same time each day, began to wait at its food dish at that time.

The next 2 items refer to the following information:

The effects of cattle tick cost graziers millions of dollars each year. The first ticks were introduced into Australia in 1872 and until recently the main method of control has been spraying affected animals with chemicals. Serious cases of tick resistance to the various chemicals used are now occurring. The long term solution to the cattle tick problem seems to be the development of naturally tick resistant cattle.

6e-5 – Co 5 (c) D

The increase in resistance of the tick to pesticides would be due to

A the migration of resistant ticks from other areas.
B individual ticks developing resistance and passing it on to their offspring.
C changed tick behaviour so that their contact with the pesticide is less.
D widespread use of pesticides for a long period of time.

6e-6 – Ap 4 (c) A

The best way to develop naturally tick resistant cattle would be to

A select those cattle with the fewest ticks and use them for breeding.
B keep cattle isolated from ticks for several generations.
C feed cattle small but increasing doses of a pesticide which kills ticks.
D import cattle from countries where there are no ticks.

6e-7 15d Ev 3 (c) B

Some household insect sprays, which were highly effective against mosquitoes when first put on the market, now kill a lower proportion of mosquitoes sprayed with them.

Which statement is **most** consistent with a scientific explanation of the means by which adaptations arise?

A The mosquitoes which survive one spraying become immune to the insecticides.
B Many of today's mosquitoes are descendants of mosquitoes with characteristics which made them resistant to the sprays.
C Mosquitoes are adapting themselves to this man-made change in their environment.
D When the sprays were first introduced, all mosquitoes were destroyed except those which were immune to the spray.

6e-8 15d Ev 5 (c) A

Two of the 'great cats' of Africa, the leopard and the cheetah, show a superficial resemblance to each other in colouration and fur markings. When one compares body shape, however, the cheetah (which runs down its prey on the ground) is more lightly built with relatively longer legs than the leopard (which habitually pounces from a tree onto its passing prey).

Which statement is **most** consistent with a scientific explanation of the means by which adaptations arise?

A Cheetahs which are slower moving than other cheetahs are more likely to die in times of food shortage.
B Cheetahs are slender and long-legged so that they will have a better chance of running down fleet-footed antelope and other prey.
C Leopards have spots to enable them to conceal themselves effectively among the dappled light and shade of their leafy habitat.
D Both leopards and cheetahs have adapted themselves to their own particular environments so that they will have better survival chances.

The next 3 items refer to the following information:

The *Myxoma* virus, which is transmitted by mosquitoes, was introduced into Australia in 1950. In the first year, mortality among affected rabbits was 99.9 per cent. Ten years later many naturally infected wild rabbits survived.

Use the following key for the next 3 items:

A When a rabbit recovers from the disease it has developed an immunity which is passed on to its offspring.

B Rabbits which happen to have a natural inborn resistance to the disease tend to pass on this resistance to their offspring.

C Use of DDT as a pesticide has reduced mosquito numbers, so that the virus is spread less efficiently than formerly.

D Strains of the virus which do not kill the rabbit quickly have the best chance of being transmitted.

6e-9
15d
Ap
2
(c)
C

Which one of the hypotheses (A, B, C, or D) is **irrelevant** to an investigation of the number of rabbits which recover?

6e-10
15d
Ap
3
(c)
D

One of the hypotheses (A, B, C, or D) could be investigated by obtaining a large number of samples of virus from wild rabbits and using these to infect laboratory rabbits from a disease-free stock. Which one is it?

6e-11
15d
Ap
3
(c)
A

One of the hypotheses (A, B, C, or D) could be investigated by infecting laboratory rabbits from a disease free stock with a mild strain of virus, allowing them to breed and infecting their offspring with the original lethal virus strain. Which one is it?

6e-12
15d
Ev
5
(c)
D

The blind cave fish inhabits certain pools or streams found in underground caverns. It possesses no eyes, although hollows resembling eye sockets are observable on the sides of the head.

Which statement is **most** consistent with a scientific explanation of the means by which adaptations arise?

A The cave fish is probably a very primitive fish from which other more advanced types, with eyes, have evolved.

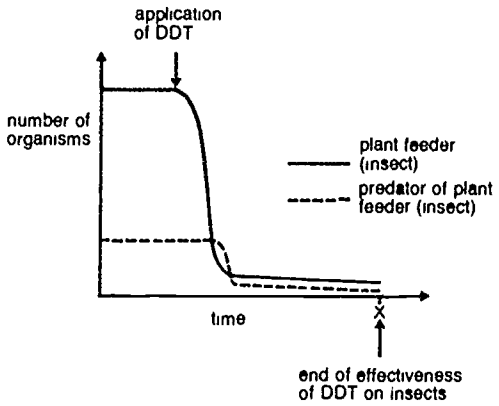
B The cave fish, over countless generations, has lost its eyes because they are not needed in the darkness of the cave.

C The cave fish has lost the power of sight to enable its other sense organs to become more acute.

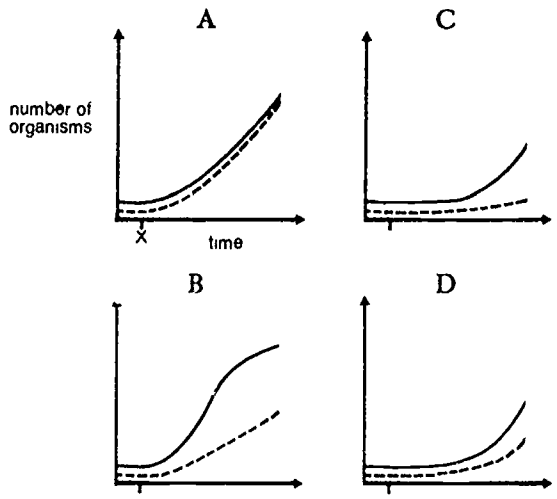
D The possibility of injury or disease of the eyes could reduce the survival chances of cave fish with eyes compared to cave fish without eyes.

6e-13
15d
Co
3
(I)
A

The following graph shows the changes in two insect populations after DDT was used to protect a crop against a pest.



Each of the following graphs would be likely to follow from the end of the effectiveness of the DDT.



6e-14
-
Co
4
(i)
D

There are some species of disease-causing bacteria which have become resistant to the drugs to which they were once susceptible. This fact has been cited as evidence for natural selection.

Each of the following conditions is essential for the development of resistant strains of bacteria.

A natural variation occurring within a species
B environmental conditions changing with time
C variations being inherited
D rapid rate of reproduction

6e-15 Natural selection can change the characteristics of
15d
Co
4
(i)
B

A a species.
B an individual.
C a race.
D a population.

6f—Factors affecting population survival

CORRECT response items

The next 2 items refer to the following information:

A scientist compared the competitive behaviour of two species of flour beetles under different temperatures and relative humidity. The tables indicate the most abundant species when raised separately or together.

Conditions tested		Most abundant species	
Temperature	Humidity	Grown separately	Grown together
Cool	Dry	*T. confusum*	*T. confusum*
Cool	Moist	*T. castaneum*	*T. confusum*
Moderate	Dry	*T. confusum*	*T. confusum*
Moderate	Moist	*T. castaneum*	*T. castaneum*
Warm	Dry	*T. confusum*	*T. confusum*
Warm	Moist	*T. confusum*	*T. castaneum*

6f-1 Which of the following statements is **not** indicated by the data?
–
Co
3
(c)
B

A *T confusum* was more competitive than *T. castaneum* under warm dry conditions.
B *T confusum* was less competitive than *T. castaneum* under cool dry conditions.
C *T castaneum* was more competitive than *T confusum* under moderate, moist conditions.
D *T castaneum* was less competitive than *T. confusum* under cool, moist conditions.

6f-2 From the above information and assuming both species of beetle are present in the grain, the best form of pest control for the beetles would be
–
Ap
3
(c)
D

A alternating the moisture content of the stored grain.
B alternating the temperature level of the stored grain.
C spraying the grain once with an insecticide before it is stored.
D alternating both moisture and temperature of the stored grain.

6f-3 Relatively few Australian tree-kangaroos still exist.
17m
Co
2
(c)
A

In trying to ensure the survival of the species it would be best to

A retain adequate areas of suitable habitat.
B keep the species in captivity.
C discover some economic use for the species.
D eradicate the predators of the species.

The next 2 items refer to the following information:

A microbiologist wanted to know how rapidly a certain bacterium multiplied. He half-filled several 5-litre flasks with a liquid culture medium favourable for the growth of this bacterium. He inoculated each flask with approximately the same number of bacteria and maintained the cultures at an appropriate temperature.

He measured the growth of the bacterial populations by taking a 1 mL sample from each flask every 20 minutes and counting the number of bacteria present in the sample using standard counting methods.

6f-4 6b Co 4 (c) B *

Such a sampling method is suitable as a means of obtaining an estimate of the *rate of population growth* provided that

A all populations grow at precisely the same rate.
B the cultures are shaken to keep the bacteria evenly dispersed through the medium.
C the 1 mL samples are put back into the cultures after counting.
D each culture has exactly the same number of bacteria initially.

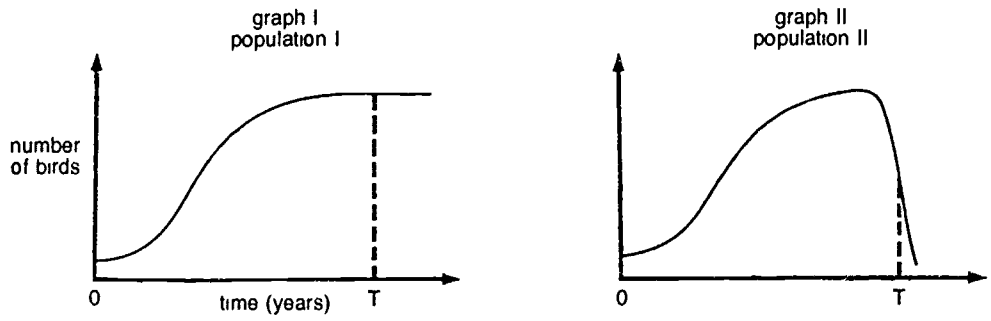
6f-5 – Co 2 (c) D

If the cultures were allowed to grow, without interference, for an indefinite period, one would expect that the bacterial populations would

A continue to increase at an increasing rate.
B continue to increase, but at a constant rate.
C eventually reach a maximum size, and remain at that size.
D eventually reach a maximum size, and then begin to decline.

6f-6 – An 3 (c) D

Graphs I and II illustrate the growth of two populations of a particular species of bird.



In both populations neither immigration nor emigration has occurred.

Which one of the following is the **most** probable explanation for the different shapes of the two curves?

A Population I shows unlimited growth, whereas population II shows limited growth.
B The growth of population II is more likely to have been limited by a shortage of nesting sites than by a shortage of food.
C At time T years, the birth rate of population I is much higher than the death rate, whereas the birth rate of population II is much lower than the death rate.
D At time T years, population I has not outstripped its food supply, whereas population II has.

7 INTERACTION AND CHANGE IN THE NATURAL WORLD

Organisms in the Community

7a—Community structure

CORRECT response items

7a-1 – Co 2 (c) D

If you were walking through a mountainous alpine area, which you knew had a high rainfall and contained many wallabies, koalas, snow gums and rocks, the best name for the region would be

A a wallaby community.
B a snow gum community
C a high rainfall biome.
D an alpine ecosystem.

7a-2 – Co 3 (c) C

Four pairs of organisms are shown below.

The pair whose relationship in a community is different from the other three is

A pelican – fish.
B frog – insect.
C kangaroo – grass.
D kookaburra – snake.

7a-3 – Co 2 (c) B

It is important for biologists to name the various types of communities that they encounter.

Which of the following pairs of factors is usually considered when communities are named?

A The climate and the geographical location of a community.
B The dominant species and the physical appearance of a community.
C The dominant species and the types of consumers present.
D The physical appearance of a community and the predominant soil type.

The next 2 items refer to the following information:

Life in the oceans extends from the surface to the greatest depths. The organisms found throughout the oceans show great diversity. They range from tiny plants and animals within the upper layer of water to the deep sea fish.

7a-4 – Co 2 (c) B

Which statement best describes the term community?

A the organisms in one layer and their environment
B the organisms of various types found together in one layer
C the organisms of the same type living in different layers
D the organisms in a layer and the available organic material

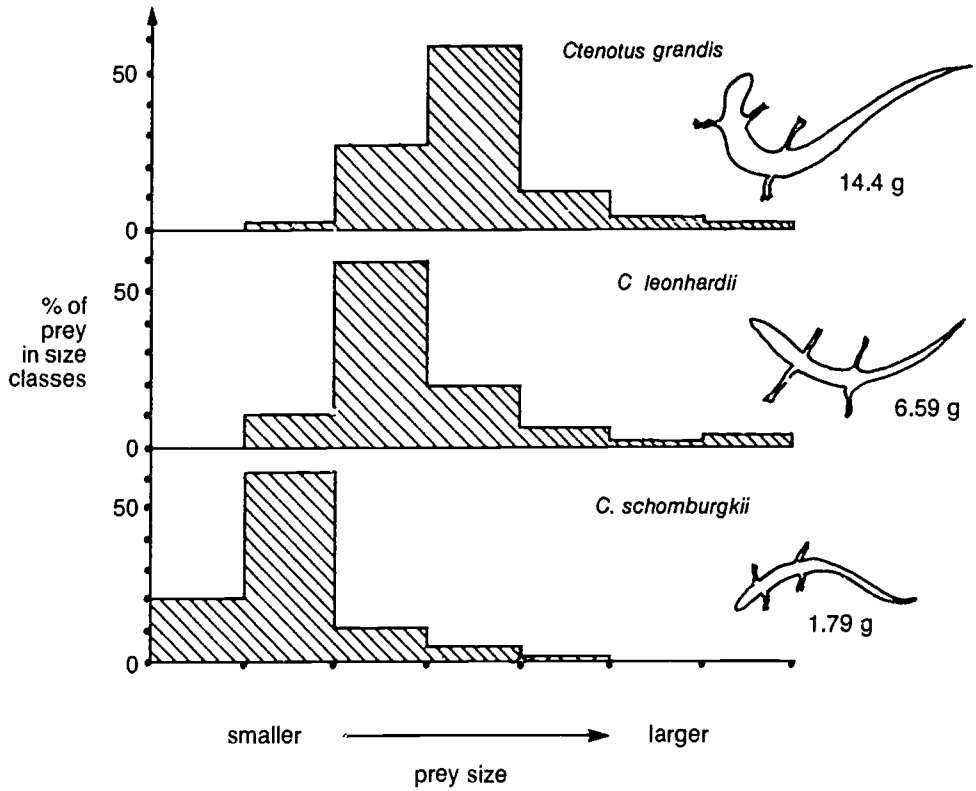
7a-5 7b Co 2 (c) A

In comparing the upper and deep layers it would be reasonable to suggest that

A only the upper layer contains photosynthetic producers.
B consumers are found in the deeper layer only.
C only one layer contains decomposers.
D the consumers of the deeper layer are all fish.

7a-6 – Co 2 (c) C

The following graph refers to three Australian lizard species living in a desert environment. All three species feed mainly on termites.



Which would be a valid conclusion from the above data?

A *C. grandis* eats smaller prey than *C. schomburgkii.*
B *C. grandis* eats more prey than *C. schomburgkii.*

7a-7 3d Co 4 (c) A

A hypothetical woody plant begins life as a nutritionally independent organism attached to a shrub. Sometime later the shrub slowly dies because the first plant extracts water and nutrients from it. The hypothetical plant eventually loses its leaves but continues to survive on the organic matter derived from the dead shrub.

The hypothetical plant would be described first as

A an epiphyte, then as a parasite and, finally, as a saprophyte.
B a parasite, then as an epiphyte and, finally, as a saprophyte.
C a saprophyte, then as a parasite and, finally, as an epiphyte.
D a saprophyte, then as an epiphyte and, finally, as a parasite.

7a-8 – Ap 1 (c) A

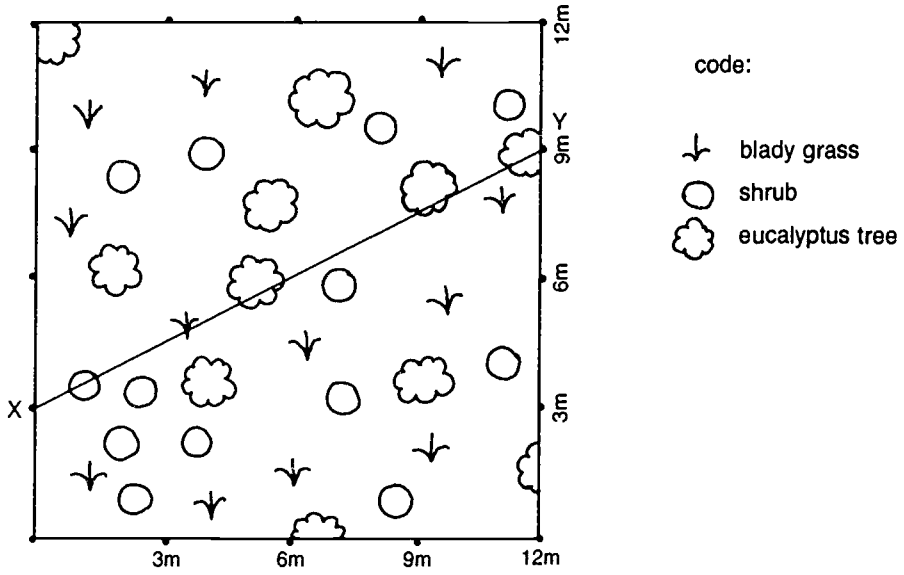
Atriplex vesicaria (bladder saltbush) is often found in land areas where the rainfall is less than 250 mm a year. It is a small shrub which usually grows as single widely spaced plants with much bare ground in between.

The best explanation for this is that the juvenile plants are

A competing for water.
B being eaten by predators.
C destroyed by temperature variations.
D unable to withstand the high salt content.

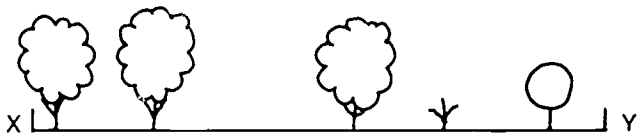
The next 2 items refer to the following information:

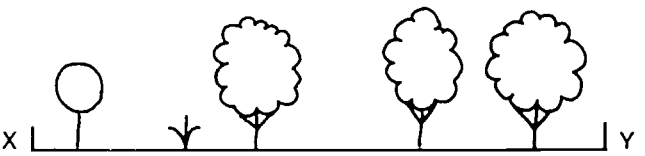
The diagram represents a sample plot of a community near a beach.

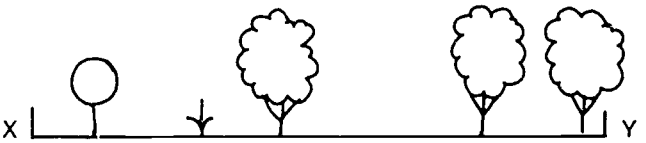


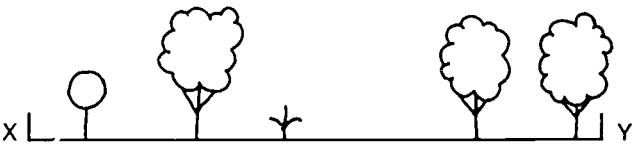
7a-9 Which of the following cross sections best represents the transect XY?

6a
Co
2
(c)
C

A


B


C


D


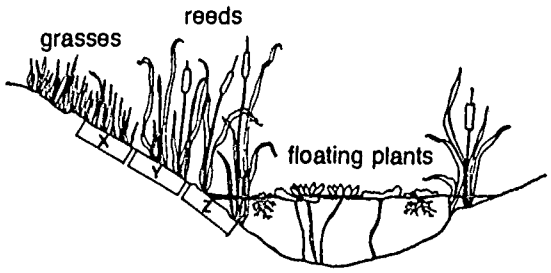
7a-10 The most likely name that a biologist would give this community is

–
Co
2
(c)
D

A an open forest community.
B a blady grass, shrub, eucalypt woodland.
C a mixed woodland community.
D a eucalypt woodland.

The next 2 items refer to the following information:

On a particular occasion a biologist made a study of a pond community, and drew a sectional view of it (see diagram below).



7a-11 – Co 2 (c) D

If asked to identify the boundary of the pond community, the biologist would state that it lay in

A region X only.
B region Y only.
C region Z only.
D any of regions X, Y or Z.

7a-12 – 3c Ap 3 (c) C

It is probable that there are **fewest** species or organisms, with characteristics which make them suited to life, in

A both the grasses and the reeds.
B both the reeds and the water.
C both the grasses and the water.
D the water only.

7a-13 – An 2 (c) B

An observer spent some time watching the birds in a forest to see where each species was feeding. The following table lists the data that he collected. Each number is the percentage of birds of each species that were feeding in a part of the forest during the period of observation.

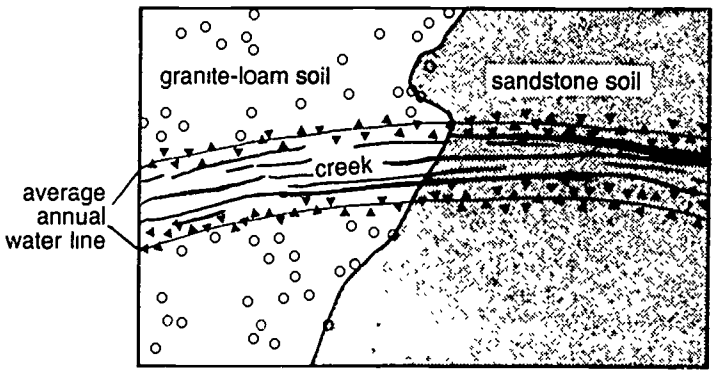
	Bird species						
Portion of forest	Lyre-bird	White-browed Scrub-wren	Brown Thornbill	Crimson Rosella	Striated Thornbill	Parda-lote	White-throated Tree-creeper
Eucalypt foliage (27–85 m)	–	–	–	55	78	100	–
Wattle foliage (16–27 m)	–	–	14	3	22	–	–
Understorey foliage (1–16 m)	–	1	73	34	–	–	–
Ground and fern layer (0–1 m)	100	99	13	8	–	–	–
Tree trunks	–	–	–	–	–	–	100

Which of the following is best supported by the data?

A Very few food organisms exist on the tree trunks.
B The ground and fern layer contains the greatest variety of bird life.
C The Brown Thornbill's main competitor for food is the Striated Thornbill.
D The Crimson Rosella spends most of its time on the ground.

The next 2 items refer to the following information:

The diagram illustrates the effects of two conditions—soil type and soil moisture-- on the distribution of two types of plant in a certain area.



▲ marks a fern plant
○ marks a *Eucalyptus* plant

scale
5m

7a-14 The distribution of the *Eucalyptus* plants is most probably determined by

An 3 (c) C

A the soil type only.
B the moisture content of the soil only.
C both soil type and moisture content of soil.
D neither the soil type nor moisture content of soil.

7a-15 The distribution of the fern is most probably determined by

An 2 (c) B

A the soil type only.
B the moisture content of the soil only.
C both soil type and moisture content of soil.
D neither the soil type nor moisture content of soil.

7a-16 The table below was compiled from a student survey of vegetation in a natural community south-east of Perth.

Ap 2 (c) B

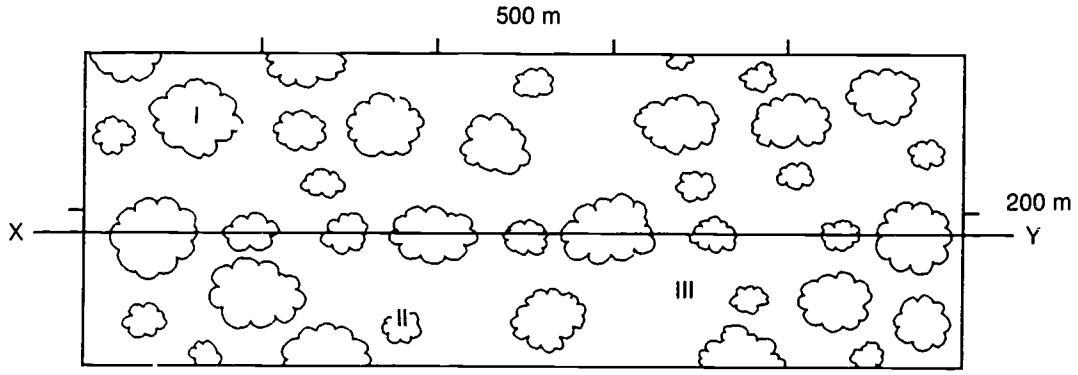
Name of plant	Height (m)	Population density (plants/km²)
Jarrah	40–60	20
Banksia	7–10	100
Acacia	2–3	50

The most suitable name for this community would be

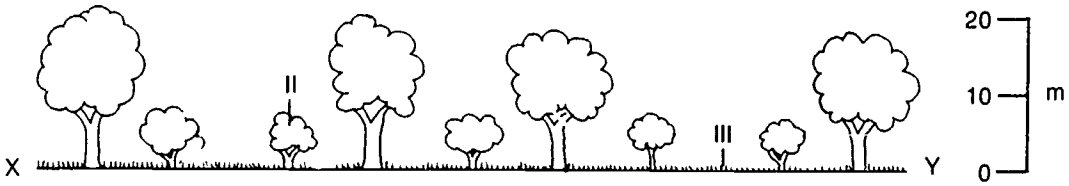
A *Jarrah* forest.
B *Banksia* woodland.
C *Jarrah–Banksia* woodland.
D *Jarrah–Banksia–Acacia* community.

7a-17 A biologist conducted an intensive study of a woodland community and some of his data are presented below.

Ap
4
(c)
D



map of sample area



transect

	Species	No. of individuals per hectare
I	*Eucalyptus viminalis*	18
II	*Banksia serrata*	19
III	*Poa australis*	4250

On the basis of the data presented above, the biologist would conclude that

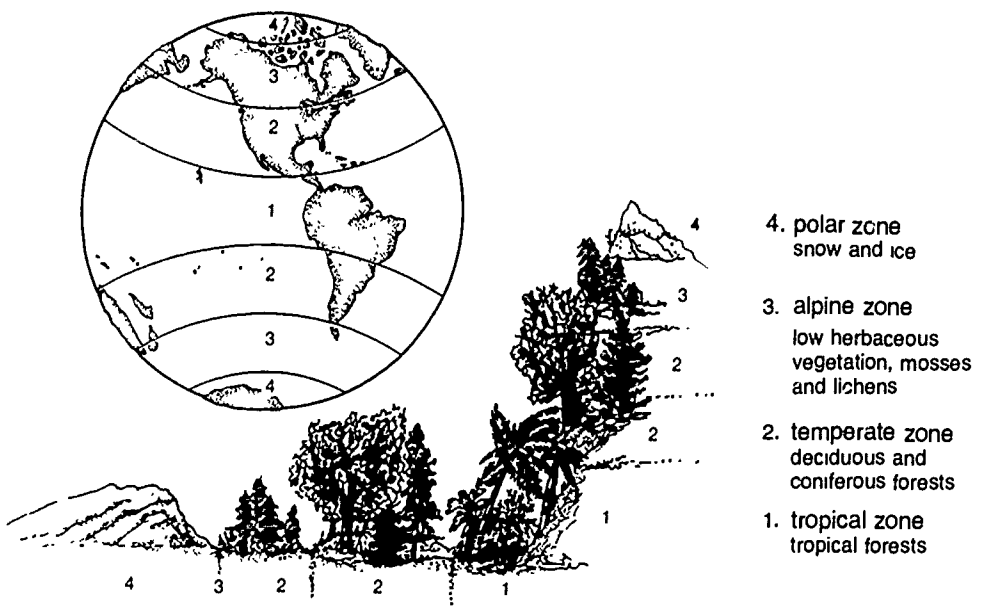
A *Poa australis* is the dominant species because it is the most abundant plant.

B *Banksia serrata* is the dominant species because it is the most abundant woody plant.

C All three species are equally dominant.

D *Eucalyptus viminalis* is the dominant species because it is the most conspicuous.

7a-18 – An 2 (c) B The diagram shows that the horizontal sequence of terrestrial life zones between equator and pole is repeated more or less exactly in a vertical direction up the slopes of mountains.



The correspondence between latitudinal and altitudinal life zones

From the diagram and your own knowledge it would be reasonable to conclude that

A the width of the zones in reality is the same horizontally and vertically.
B temperature and rainfall are important factors in the formation of zones.
C mountains at all latitudes will show the same sequence from tropical to polar zones.
D the boundaries between the zones are clearly defined geographically.

INCORRECT response items

7a-19 – Co 1 (i) B The following is a description of a community:

Rock wallabies rest in the shade of the large rocks. A lizard, brown like the rock, is sunning itself beside a patch of lichen while a kookaburra watches from a nearby mulga tree.

The members of this community include the

A lizard.
B rocks.
C kookaburra.
D lichen.

7a-20 – Co 2 (i) B On the edge of a stream there is an area of long grass that contains many grasshoppers, some lizards which sun themselves on a pile of rocks and a pair of insect-eating birds which rest in a gum tree.

Each of the following is a member of this community.

A gum tree
B rocks
C insect-eating birds
D long grass

7a-21 – Co 2 (i) C

The following are valid statements about communities.

A An organism can be a member of different communities at different times.
B Most communities can be thought of as collections of smaller communities.
C An organism is considered a member of a community if it directly interacts with all members of that community.
D Communities differ from one another in composition—in the species they contain and the numbers of each.

7a-22 – Co 3 (i) C

For convenience biologists give names to communities and they employ various methods to do so.

The most widely accepted methods are usually based on

A the name of the dominant plant species found in the community.
B a description of the appearance of the community.
C the percentage of soil covered by the plants in the community.
D the type of leaves found on most of the plant species present in the community.

7b—Community interrelationships

CORRECT response items

7b-1 – Kn 1 (c) C

A bacterium that derives its energy by the oxidation of sulfur or iron is called a

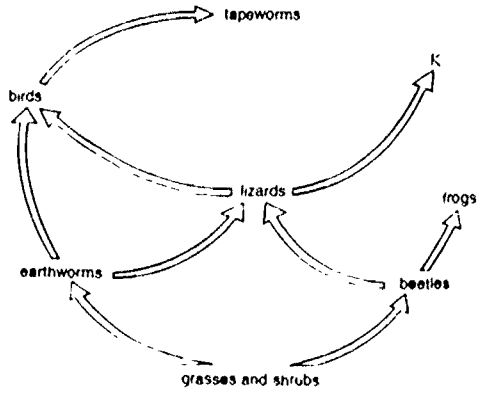
A heterotroph.
B consumer.
C chemosynthetic autotroph.
D photosynthetic autotroph.

7b-2 – Kn 2 (c) A

Lichens are best described as

A fungi in symbiotic association with algae.
B parasitic fungi able to exist under a range of adverse conditions.
C algae which are parasitic on a particular fungus.
D fungi which are parasitic on a particular alga.

The next 6 items refer to the following food web:



7b-3 In the above food web, the position of birds is best described as

8b Co 3 (c) D

A first-order consumers.
B second-order consumers.
C third-order consumers.
D either second- or third-order consumers.

7b-4 A word to describe plants and animals living together in an area like the one illustrated above is:

7a Kn 2 (c) C

A habitat.
B environment.
C community.
D microclimate.

7b-5 Which one of the following could not occupy position K in the food web?

8b Co 2 (c) D

A a parasite
B a fungus
C a microorganism
D an autotroph

7b-6 The more one studies the interactions between organisms living together in an area,

– Co 1 (c) B

A the simpler the food web becomes.
B the greater the number of relationships in the food web that are discovered.
C the easier it is to classify the consumer organisms by order such as first-, second-, etc.
D the more difficult it becomes to isolate the ultimate source of energy.

7b-7 The actual number of individuals of any one type varies within the web.

– An 3 (c) D *

Which one of the following would be least numerous?

A tapeworms
B frogs
C birds
D There is not enough information to decide between, A, B, and C.

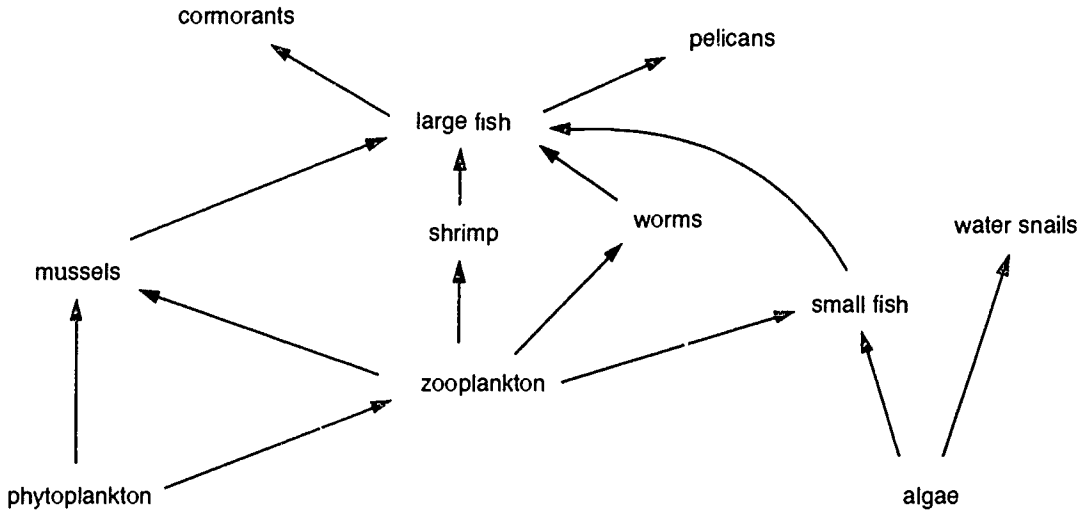
7b-8 Assuming that we could weigh all the plants and animals represented in the food web, which one of the following would give the greatest combined weight?

8b Co 3 (c) A

A grasses and shrubs
B earthworms and beetles
C birds, lizards and frogs
D tapeworms

The next 4 items refer to the following information:

The diagram represents the food web of an estuary.



7b-9 Which group of organisms has been omitted from the food web?

– Kn 3 (c) C

A the fifth-order consumers
B the browsers
C the decomposers
D the filter feeders

7b-10 Which of the following organisms would you expect to be present in the greatest numbers?

– Co 2 (c) D

A pelican
B large fish
C worms
D zooplankton

7b-11 Which of the following organisms is only a first-order consumer in this food web?

– Ap 3 (c) A

A water snail
B mussel
C shrimp
D small fish

7b-12 If most of the shrimp are caught by amateur fishermen, what is likely to be the **first** observable change in the food web?

– Ap 2 (c) B

A an increase in the number of worms
B a decrease in the number of large fish
C an increase in the number of mussels
D a decrease in the number of cormorants

The next 4 items refer to the following information:

The surface waters surrounding Antarctica contain large amounts of nutrient salts of nitrogen and phosphorus. These support minute plant organisms known as phytoplankton. Small, bright red shrimp-like creatures are very common, they are krill, probably the largest herd of grazing creatures in the world. Apart from such small vegetarians, the rest of antarctic marine life is carnivorous. Whales, seals, penguins, sea-birds and innumerable small fishes and squid feed on the krill.

The squid become the favourite food of the emperor penguin and many of the seals. Very fierce leopard seals and killer whales prey on any creatures they can catch.

7b-13 Which food chain best represents the above community?

– Ap 2 (c) A

A phytoplankton → krill → squid → whales

B phytoplankton → krill → squid → fish

C phytoplankton ← krill ← squid ← fish

D phytoplankton ← krill ← squid ← whales

7b-14 Compared to tropical seas, the relatively cold antarctic ocean can support such large numbers of krill because, compared to tropical water, the cold water holds significantly

3b Kn 2 (c) C

A more dissolved carbon dioxide.

B less dissolved carbon dioxide.

C more dissolved oxygen.

D less dissolved oxygen.

7b-15 To the emperor penguins, leopard seals are

– Ap 3 (c) C

A predators.

B competitors.

C both predators and competitors.

D neither predators nor competitors.

7b-16 The krill is a

– Co 2 (c) B

A producer.

B first-order consumer.

C second-order consumer.

D decomposer.

7b-17 On coral reefs, such as those around Heron Island, Queensland, small striped 'cleaner fish' establish 'stations' where bigger fish come to be cleaned of their parasites. The big fish relax and open their mouths and gills, and the cleaner fish feed on the parasites on the gills of the larger fish.

– Co 2 (c) B

The relationship between the cleaner fish and the parasite is

A mutualism.

B predation.

C parasitism.

D collaboration.

7b-18 *Escherichia coli* is a bacterium which feeds on unused food material in the large intestine of many animals. The animals do not show any noticeable ill effects from the presence of the bacteria.

– Co 2 (c) B

This relationship most closely resembles

A mutualism.

B collaboration.

C parasitism.

D predation.

7b-19 – Co 2 (c) A

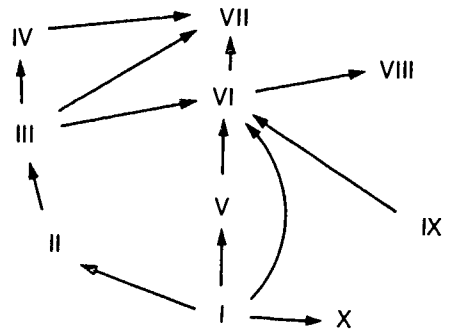
Within the cells of one species of the coelenterate *Hydra*, there exist many unicellular green algae of the genus *Zoochlorella*. They are present in such large numbers that they give a green colour to the hydra. The algae obtain carbon dioxide and nitrogen compounds from the hydra. The hydra has waste products removed, is supplied with oxygen, and can also draw on the carbohydrates manufactured by the algae.

This association is called

A mutualism.
B collaboration.
C parasitism.
D predation.

The next 3 items refer to the following diagram:

In this food web, each numeral represents an organism.



7b-20 – Co 2 (c) A

An organism which supplies organic compounds needed by other organisms in the community is

A IX.
B VII.
C VIII.
D X.

7b-21 – Co 3 (c) C

Organism VI is

A a carnivore.
B a herbivore.
C an omnivore.
D a parasite.

7b-22 – Co 3 (c) D

An organism occupying position V could be

A a carnivore.
B an autotroph.
C a second-order consumer.
D a first-order consumer.

7b-23 – Co 3 (c) D

Many internal parasites of animals produce large numbers of eggs, because

A not many will reach the outside world.
B few of the eggs will be fertilized by the male.
C the present host provides good conditions for the parasite's offspring.
D the chances of reaching another host are small.

The next 3 items describe certain relationships between organisms:

7b-24 – Co 3 (c) B A tiny crab lives inside the shell of a large mussel. It eats food remains rejected by the mussel.

This relationship is best described as

A mutualism.
B collaboration.
C parasitism.
D predation.

7b-25 – Co 3 (c) C When food for the mussel is scarce, the crab described in the previous question may attack the tissues of the mussel.

This relationship is best described as

A mutualism.
B collaboration.
C parasitism.
D predation.

7b-26 – Co 1 (c) D If the crab already described gets too close to the feeding currents of the mussel, it is swept inside the mouth and is eaten by the mussel.

This relationship is best described as

A mutualism.
B collaboration.
C parasitism.
D predation.

7b-27 17b Co 3 (c) A Some species of termites contain large numbers of protozoa in their hind-gut. Without these protozoa, the termites do not survive long on their usual diet of wood.

As wood contains a large amount of cellulose it would be reasonable to suggest that

A the protozoa digest cellulose for their own and the termite's use.
B cellulose digestion does not take place in the hind-gut.
C cellulose is harmful to the termites in the absence of protozoa.
D a diet of wood protects the termites from the protozoa.

7b-28 – Co 3 (c) A Selective logging of timber occurs in the rainforests of North Queensland and results in 50 per cent of the canopy being removed. Biologists have studied the effect of this logging on three ring-tail possum species which live in the rainforest:

the Green Ringtail Possum	*Pseudocheirus archeri*
the Herbert River Ringtail Possum	*P herbertensis*
the Lemuroid Ringtail Possum	*P lemuroides*

On the basis of this and the following information, which population is most likely to be affected by the selective logging of the timber?

A *P lemuroides*, a canopy dweller which lives in family groups. It is able to leap up to 2 metres from one branch to another. Of the three possums, it is the most reluctant to come down to the ground.
B *P archeri*, a solitary animal which lives in the canopy of Strangler Fig trees. Its diet includes the fruits of the fig trees. The Strangler Fig tree is not sought after by the loggers.
C *P herbertensis*, a canopy dweller, which is generally a solitary animal. It lives in a 'den', e.g. a hollow tree or an epiphytic clump.
D It cannot be determined from the information given.

The next 2 items refer to the following information:

The underground orchid *Rhizanthella gardneri* is a rare and endangered species. It grows a few centimetres below the ground and is only found in association with the broom honey myrtle, *Melaleuca uncinata* and a certain fungus. Fungal threads have to enter a special pore on the orchid seed before the seed can germinate. The fungus then acts as a nutritional 'bridge' between the *Melaleuca* and the underground orchid.

7b-29 The relationship between the *Melaleuca* and the underground orchid is best described as

– Co 4 (c) C

A competition.
B predation.
C parasitism.
D mutualism.

7b-30 If the fungus was destroyed after the orchid seed had germinated, it is most likely that

– An 3 (c) A

A the orchid only would die.
B the *Melaleuca* only would die.
C both the orchid and the *Melaleuca* would die.
D neither the orchid, nor the *Melaleuca* would die.

The next 2 items refer to the following information:

Members of one species are often found associated with members of other species. These associations of organisms with one another suggest that there is some relationship between the organisms involved. Careful observations have enabled these associations to be recognized and they can be classified by using the criteria shown in the table below.

How necessary the relationship is	Degree of benefit in the relationship		
	benefit to both	benefit to one, no harm to another	benefit to one, harm to other
necessary to both	i	ii	iii
necessary for one	iv	v	vi
not necessary for either	vii	viii	ix

7b-31 The relationship between a flea and a dog would be classified as

– Co 1 (c) C

A i.
B iii.
C vi.
D vii.

7b-32 The termite has in its gut protozoa that digest cellulose without themselves being digested by the termite.

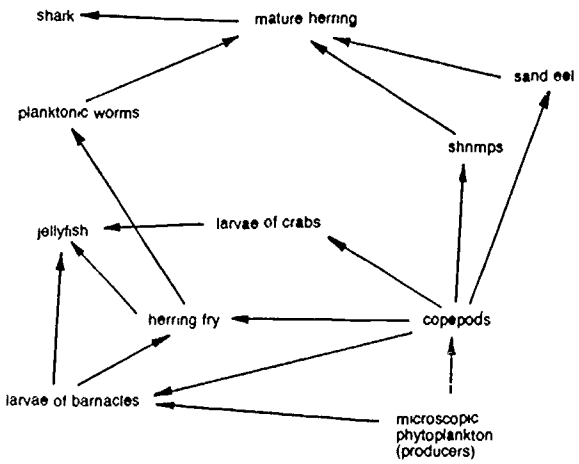
This relationship would be classified as

– Co 2 (c) A

A i.
B ii.
C iv.
D v.

The next 4 items refer to the following diagram.

This diagram represents the food web of a region of open ocean:



7b-33 An arrow, as used in this diagram, e.g. P ⟶ Q, means

8b Co 2 (c) B

A Q is eaten by P.
B Q obtains energy from P.
C P gives rise to Q.
D P obtains energy from Q.

7b-34 One group of first-order consumers is represented by the

8b Co 3 (c) D

A sharks.
B shrimps.
C phytoplankton.
D copepods.

7b-35 Of the animals included, it is likely that the **least** numerous in this region are the

8b Ap 3 (c) A

A sharks.
B sand eels.
C copepods.
D jellyfish.

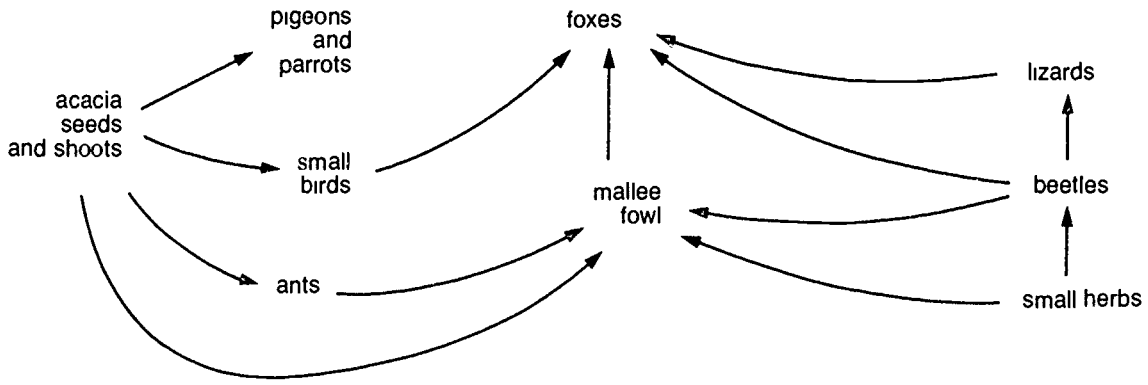
7b-36 Following a season when fishermen netted a large number of mature herring in a particular area, it is unlikely that, after a period of time, there would be an increase in the number of

8b Ap 1 (c) A

A sharks.
B shrimps.
C sand eels.
D planktonic worms.

The next 3 items refer to the following information:

The diagram shows a food web for a mallee scrub community in north-western Victoria.



7b-37 – Co 2 (c) B An organism which can be regarded as both a first- and a second-order consumer is the

A fox.
B mallee fowl.
C ant.
D lizard.

7b-38 – Ap 2 (c) B Assume that the foxes were eradicated from this community. Over the next few years several changes might be expected to occur within the mallee scrub community.

The change most expected to occur would be

A a decrease in the number of mallee fowl.
B a decrease in the number of ants.
C an increase in the number of small herbs.
D an increase in the number of pigeons and parrots.

7b-39 – Ap 3 (c) A It was noticed that if there was an unusual increase in the number of parrots in a particular year there was a significant decrease in the number of beetles.

A most likely explanation for this observation is that

A mallee fowl ate more beetles as acacia seeds and shoots became harder to find.
B foxes switched their dietary preferance to lizards as acacia seeds and shoots became scarcer and the beetle population grew too large and eventually collapsed.
C the beetles were unable to compete successfully with the small birds for an increasingly limited supply of acacia seeds and shoots.
D the beetles were unable to compete with the parrots who had changed their eating habits to eat the small herbs.

7b-40 – Co 4 (c) C A simple food chain is shown below:

Grass → Grasshopper → Frog → Snake.

Most of the energy obtained from the frog by the snake is

A transferred to bacteria when the snake dies.
B passed out in wastes and recycled through the ecosystem.
C lost from the ecosystem in the form of heat.
D used up by the snake for its body functioning.

7b-41 Orchid seeds do not grow into mature plants unless they are infected by a mycorrhiza, a type of fungus within the root. If the fungus is not present in the soil, germination of the seeds is arrested at the partly developed 'protocorm' state. Some orchids will survive for up to 24 months in this condition.

3c Co 3 (c) A

The best conclusion that can be drawn from this information is that

A orchid plants depend on mycorrhiza for some vital nutrient.
B only infected orchid seeds can germinate.
C mycorrhizas cannot grow outside an orchid.
D orchid seeds are the stage in the orchid life cycle most vulnerable to infection by the fungus.

7b-42 The best reason why food chains seldom have more than five levels is that

– Co 4 (c) B

A there are usually not enough producers to support more than five levels.
B the density of the fifth level carnivores is too low to support another level.
C the fifth level herbivores lack a good supply of plant material.
D disease and decomposers usually eliminate the fifth level organisms.

7b-43 In the litter on the floor of a gully are numerous bacteria and tiny invertebrate animals. Careful investigation shows that the various species feed on different components of the litter. If a chemical bacteriocide (i.e. a chemical which kills bacteria only) is sprayed on the litter, it is found that eventually most of the other litter organisms also die.

– Ap 2 (c) C

This is probably because

A the litter organisms are autotrophs.
B the bacteriocide was not specific for the bacteria.
C the bacteria are part of the litter food chains.
D the organisms sharing the litter have similar requirements.

The next 2 items refer to the following information:

Hay is boiled in water and the infusion allowed to stand. This clear solution becomes cloudy as bacteria multiply. A week later the solution becomes clearer and the microscope reveals many protozoa.

7b-44 The protozoa are best described as

– Co 3 (c) D

A parasites.
B decomposers.
C producers.
D heterotrophs.

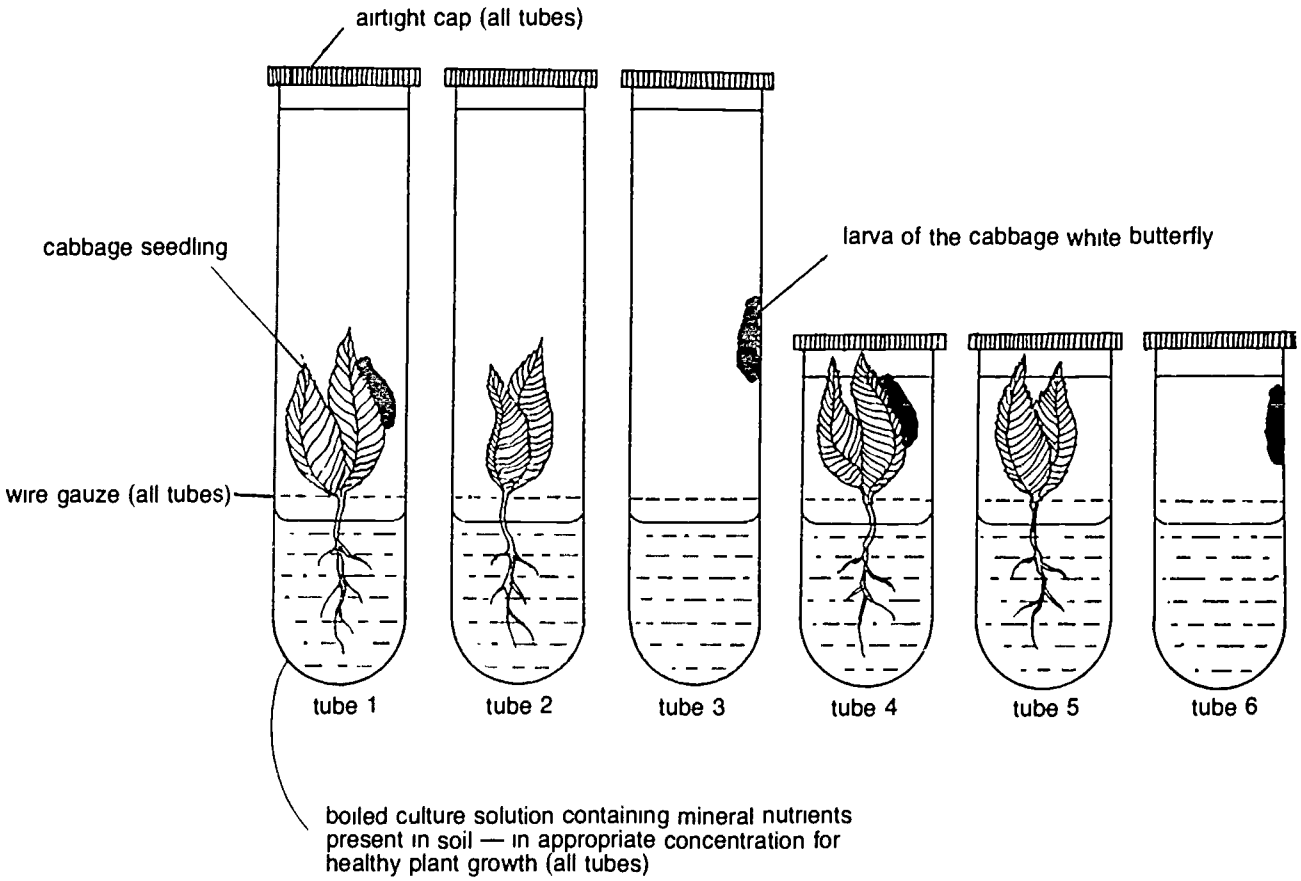
7b-45 Which of the following organisms might best be introduced to make the community more balanced?

– Ap 3 (c) B

A snails
B algae
C insect-larvae
D fungi

The next 4 items refer to the following information:

In a class experiment each group of students set up six glass test tubes as shown in the diagram below.



Tubes 1, 2, and 3 were twice the volume of tubes 4, 5, and 6. A few drops of the indicator 'neutral red' were added to each test tube. (This indicator appears red in acidic solution, yellow in alkaline solution and orange in neutral solution. Solutions of carbon dioxide are acidic, solutions of oxygen are neutral.) At the beginning of the experiment the solution in each tube appeared orange.

The tubes were placed where they received normal daylight and observations were made at sunrise and sunset each day. Assume that all of cabbage seedlings were identical, as were all of the larvae.

7b-46 Two variables which were under the control of the experimenter w re

8b
Ap
2
(c)
B

A the indicator colour and the time taken for the larvae to die.

B the organisms present and the sizes of the tubes.

C the indicator colour and the number of larvae that died.

D the culture solution and light intensity.

The next 3 items refer to the following ADDITIONAL information:

When the tubes were examined at sunrise, on the morning after the experiment was set up, one of the larvae was found to be dead.

7b-47 8b Co 3 (c) B *

In the tube containing the dead larva, the indicator had changed colour.

This would have resulted from

A the using up of oxygen.
B the production of carbon dioxide.
C the decomposition of the larva.
D the occurrence of photosynthesis.

7b-48 8b Co 2 (c) D

The indicator colour in the tube with the dead larva, recorded in the morning, would most probably have been

A yellow.
B green.
C orange.
D red.

7b-49 8b Az 5 (c) D

The larva that died was probably in either

A tube 1 or tube 4.
B tube 3 or tube 4.
C tube 3 or tube 6.
D tube 4 or tube 6.

7b-50 – Co 4 (c) D

In a parasite found living in the blood of a rat, which one of the following is probably the most highly developed?

A the digestive organs
B the reproductive organs
C the sense organs
D the respiratory organs

7b-51 8a Ap 2 (c) D

If a party of explorers finds a pond community in a completely dark cave, it is most probable that

A photosynthesis occurs somewhere in the cave.
B some animals frequently move in and out of the cave.
C all the inhabitants are blind and lack body colouration.
D food is coming in from the outside by some means.

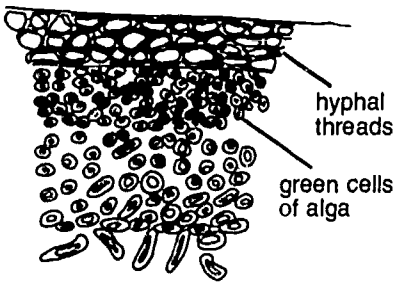
7b-52 17c Ap 3 (c) B

Embedded in the tissues and skeleton of corals are a large number of algae. Investigators of this relationship have killed the algae only and observed the resultant effect on the coral.

Which of the following effects on the coral could be reasonably predicted?

A an increase in coral growth due to a decrease in competition with the algae for organic nutrients
B a decrease in coral growth due to a decrease in supply of organic nutrients produced by the algae
C no change in coral growth as the relationship with the algae would not be one of nutrition
D the death of the coral due to a lack of mineral ions from the algae

The next 2 items refer to the following information:

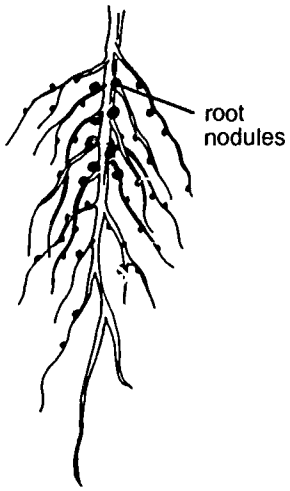


Consider the following relationships.

Lichen e g. *Peltigera*

—the fungus protects the alga and obtains moisture

—the alga photosynthesises providing organic substances for itself and the fungus



Root nodules of leguminous plant:

—the bacteria change atmospheric nitrogen to a form which can be used by the plant

—the bacteria are provided with shelter and food

Several relationships can exist between two populations of species existing in the same place at the same time.

7b-53 The lichen is an example of

– Ap 4 (c) B

A competition.
B mutualism.
C collaboration.
D parasitism.

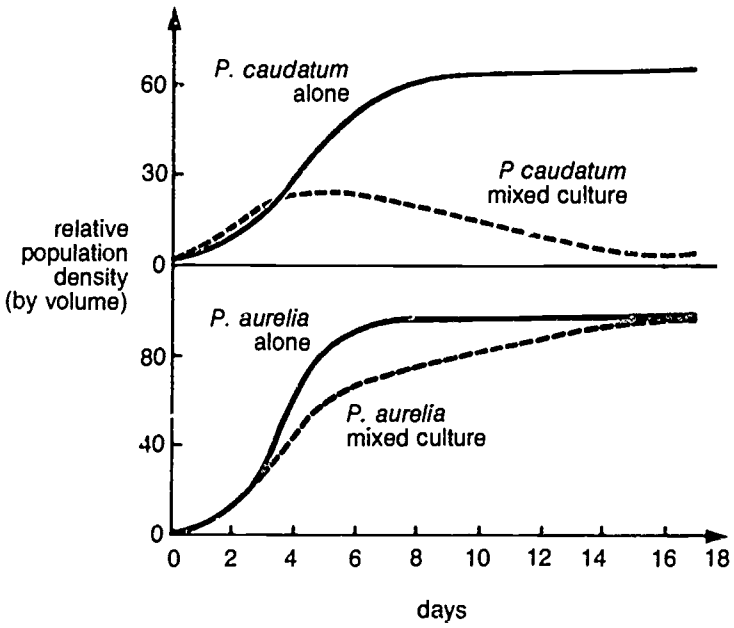
7b-54 The relationship between the bacteria and the leguminous plant is an example of

– Ap 3 (c) B

A competition.
B mutualism.
C collaboration.
D parasitism.

The next 2 items refer to the following information:

The graphs show the effect of mixing cultures of two species of *Paramecium*. The solid curves show the growth of population density of each species alone in a controlled environment with a fixed food supply. The dotted curves show the change in population density of the same species when cultured with each other under the same conditions.



7b-55 When cultured together, the growth curves show evidence of

–
Ap
2
(c)
B

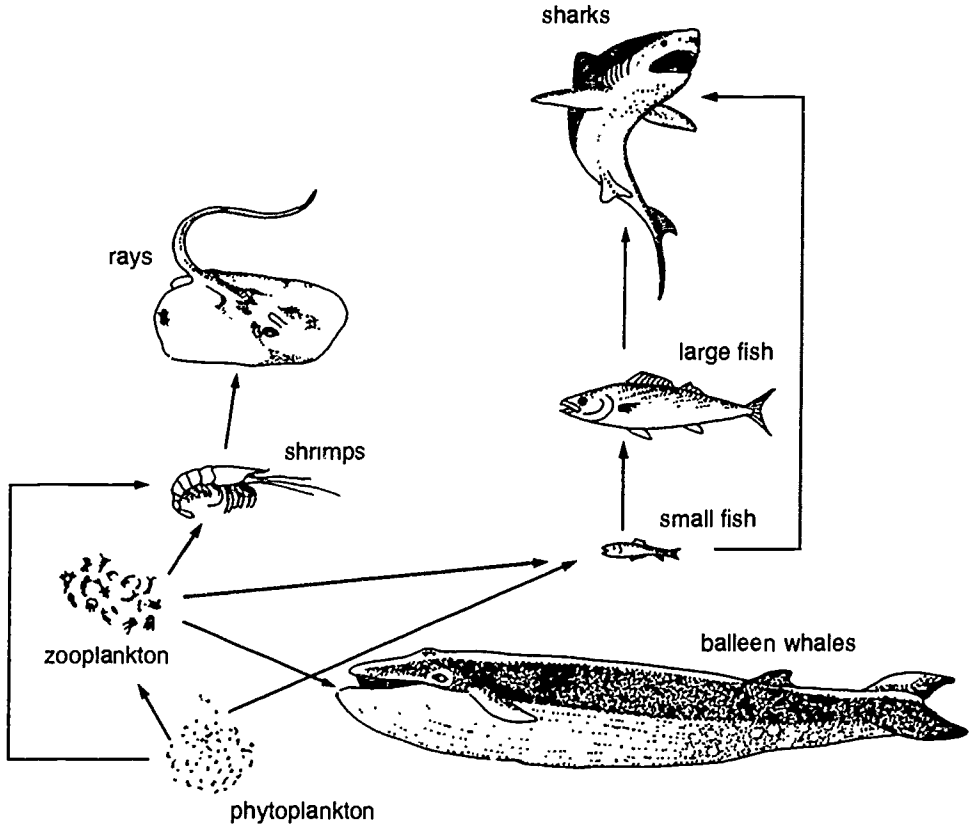
A adaptation.
B competition.
C predation.
D succession.

7b-56 Of the two species, *P. aurelia* is probably

–
Ap
2
(c)
D

A stronger.
B larger.
C less susceptible to disease.
D better able to utilize the culture solution.

The next 2 items refer to the following diagram of a food web for a marine community.



7b-57 Which of the following may be deduced from the data?

– Ap 4 (c) D

A Changes in the population density of small fish would not affect Balleen whales.
B An increase in the number of rays would not affect the number of small fish.
C This community is dependent exclusively on zooplankton for its survival.
D Balleen whales are dependent upon phytoplankton.

7b-58 From the above food web, it would be correct to state that

– Co 2 (c) A *

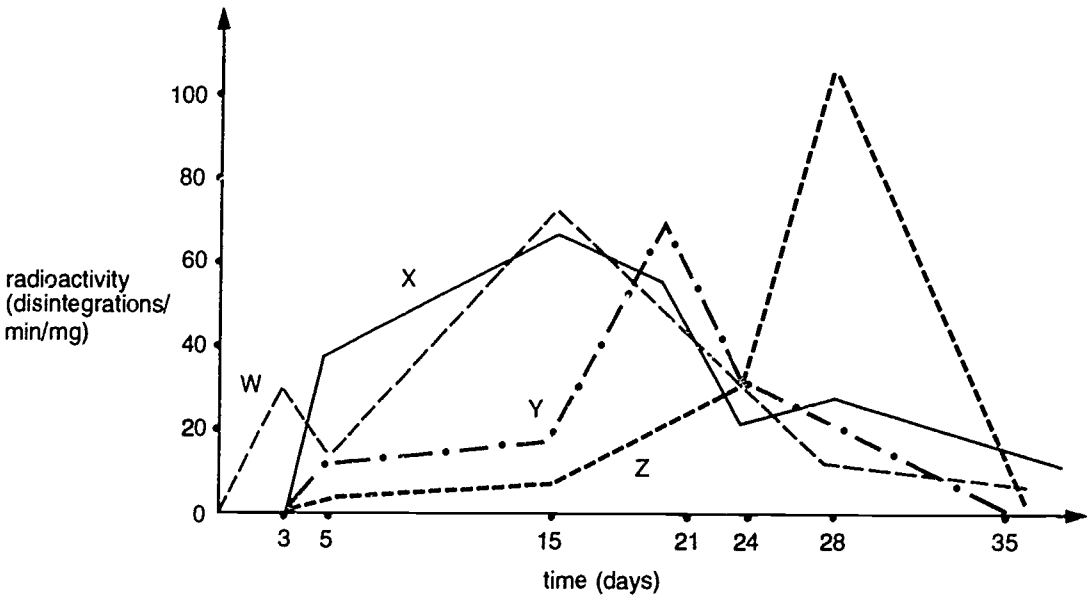
A the total biomass of all the animals in the community is less than that of the phytoplankton.
B the biomass of zooplankton is greater than that of phytoplankton.
C there are more sharks than Balleen whales in the community.
D the total biomass of the small fish is greater than that of the zooplankton.

7b-59 17d An 2 (c) D

Plants in a plot of natural grassland were labelled with a radioactive tracer ^{32}P in order that the transfers in the food chain could be followed.

Four organisms, W, X, Y and Z, in the food web, were measured for radioactivity over a period of 35 days.

The results were graphed as follows:



Which one of the four organisms was most likely a predator?

A W
B X
C Y
D Z

INCORRECT response items

7b-60 Each of the following is true of both food chains and food webs.

– Co 3 (i) D

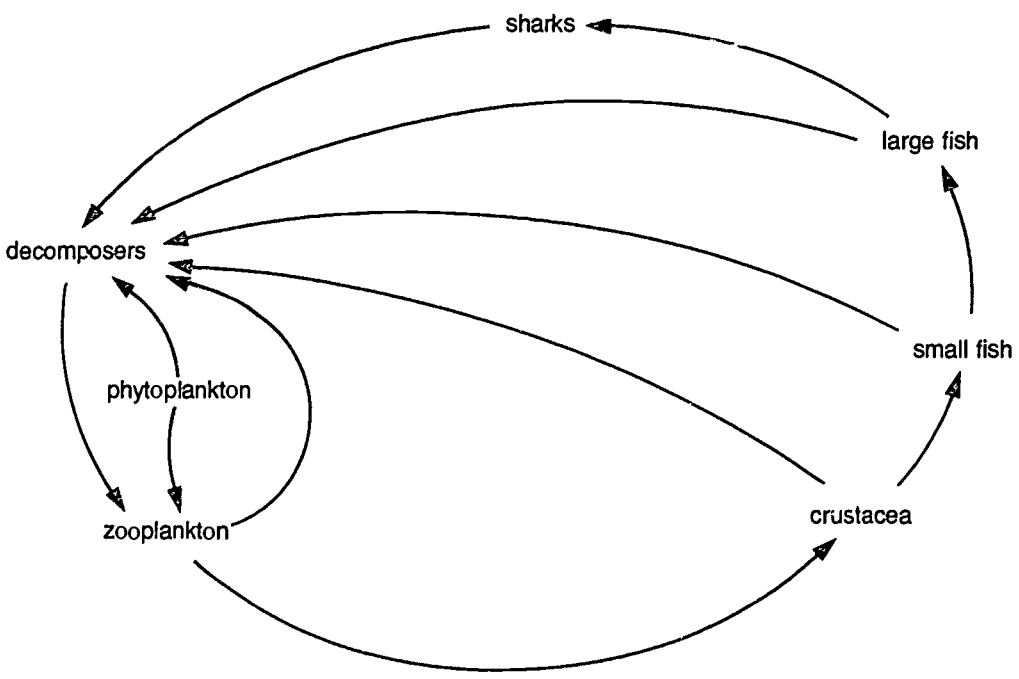
A They involve all the organisms in the community being studied.
B They include both plants and animals.
C They demonstrate that an organism depends on others to survive.
D They involve only one organism from each trophic level.

7b-61 Each of the following is an adaptation to a parasitic existence.

3c Co 3 (i) A

A the presence of a nervous system in a tapeworm
B the presence of anti-coagulant in the saliva of a female mosquito
C the presence of hooks on a hookworm
D the shape of a flea's body

The next 3 items refer to the following diagram of a food web.



7b-62 Some possible food chains are

– Co 1 (i) A

A zooplankton → crustacea → decomposers → shark
B phytoplankton → zooplankton → crustacea → small fish
C shark → decomposer → zooplankton → crustacea
D decomposer → zooplankton → decomposer → zooplankton

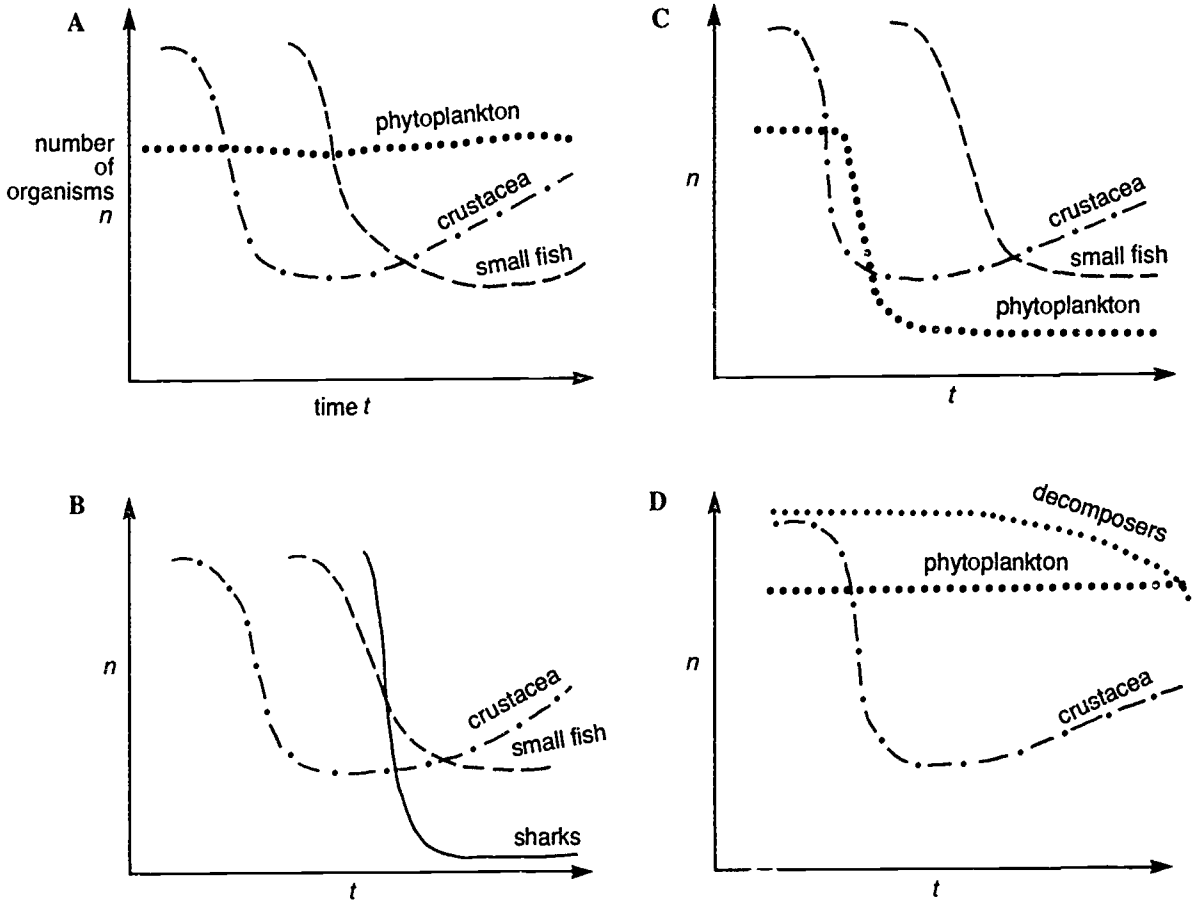
7b-63 The decomposers could be regarded as being

– Co 3 (i) D

A heterotrophs.
B sixth-order consumers.
C second-order consumers.
D producers.

7b-64 Each of the following population changes could occur in this food web.

–
An
4
(i)
C



7c—Infectious disease

CORRECT response items

7c-1 An almost universal sign of infectious disease in birds and mammals is

–
Kn
2
(c)
C

A loss of feathers or hair.
B loss of body weight.
C rise in body temperature.
D rise in aggressive behaviour.

7c-2 For contagious diseases the time between contact and the onset of the disease is known as the period of

–
Kn
2
(c)
C

A inoculation.
B infection.
C incubation.
D immunisation.

7c-3 – Kn 2 (c) D

Which one of the following could **not** be described as a disease?

A colour blindness
B fractured forearm
C tooth decay
D menstruation

7c-4 2f Kn 2 (c) D

A virulent virus is one that

A increases the vigour of an organism.
B attacks other viruses.
C is non-pathogenic.
D kills a large number of organisms quickly.

7c-5 – Kn 2 (c) C

An increase in the population of *Escherichia coli* in the small intestine of humans can lead to gastroenteritis.

E. coli is best described as

A an ectoparasite.
B a carcinogen.
C a pathogen.
D a vector.

7c-6 – Kn 3 (c) A

Antibiotics are effective against

A bacteria.
B fungi.
C viruses.
D protozoa.

7c-7 – Co 2 (c) D

Research seems to indicate that the **most likely** reason for a person developing the common cold is

A changes in temperature.
B wet clothing.
C lack of vitamin C in the diet.
D availability of the pathogen.

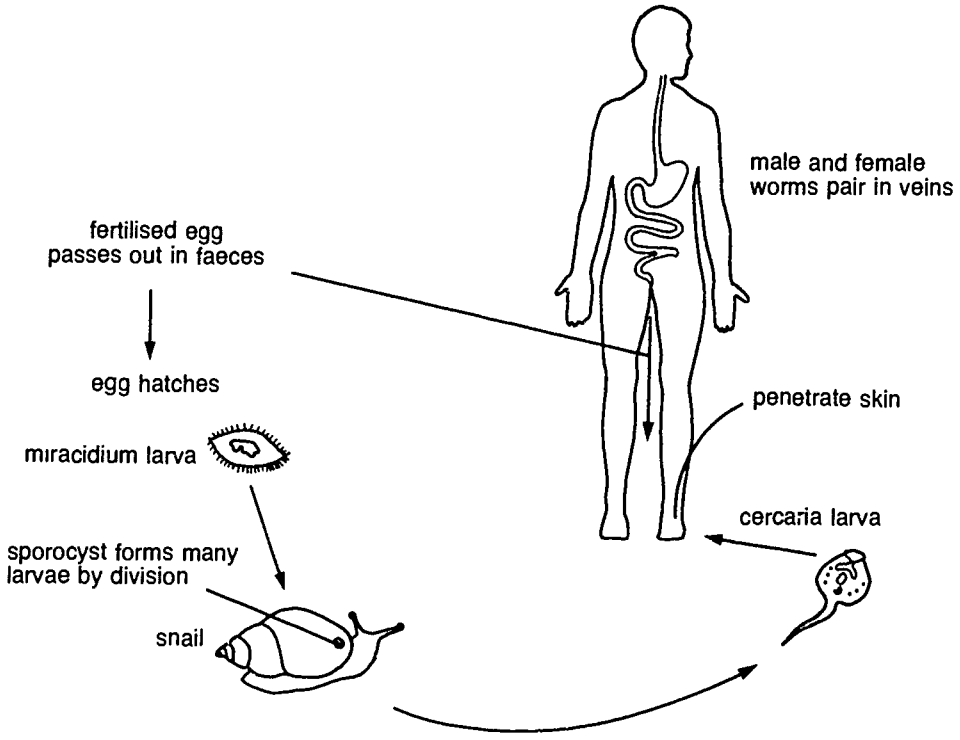
7c-8 – Ap 2 (c) B

In the early eighteenth century inoculation parties were popular in Turkey, Africa, England and America. A small wound was made in the arm and a few drops of smallpox pus was put in and a walnut shell was tied over the infected arm. Then all the party-goers were isolated together. About 98 per cent of the party-goers developed immunity to smallpox.

The best explanation is that

A the people were also inoculated with antibodies against the disease.
B the people developed a mild case of smallpox and produced antibodies against the disease.
C the pus contained smallpox antibodies which caused the people to develop their own antibodies against the disease.
D 98 per cent is the usual recovery rate during an epidemic of smallpox, and once recovered, a person cannot catch the disease again.

The next 2 items refer to the following life cycle of *Schistosoma mansoni*.



7c-9 – Ap 2 (c) A The vector for the disease schistosomiasis is the

A snail.
B human.
C cercaria larva.
D miracidium larva.

7c-10 – Ap 3 (c) B Which of the following is **least** likely to promote the continuation of the life cycle of *Schistosoma mansoni*?

A an increase in snail population
B the eating of snails by humans
C wading in infected waters without shoes
D a decrease in the predators of snails

7c 11 – Ap 2 (c) B The eggs of *Echinococcus granulosus* (the hydatid tapeworm) are easily transferred to cattle if they eat egg-infested grass. The eggs then hatch and form cysts in the cattle. Dogs may then become infected if they eat contaminated meat. Eggs may pass out with the faeces and so the cycle continues. Children can pick up the tapeworm eggs by playing with dogs.

Which alternative would be **least** effective in breaking the life cycle of *E. granulosus*?

A farmers not feeding the internal organs of cattle to dogs
B surgical removal of adult worms from children
C chemical treatment of the intermediate host
D chemical treatment of the primary host

7c-12 – Co 2 (c) B There are three main control principles for infectious diseases

X: kill the pathogen in the host;
Y: increase the resistance of the host;
Z: prevent dispersal of the pathogen.

The following are some examples of human activities used in fighting diseases.

I Imported animals are held in quarantine.
II Tourists to certain countries are innoculated against some diseases.
III Used plant pots are sterilized before reuse.
IV Animals in contact with suspected contagious diseases are destroyed.
V Copper sulfate solution is sprayed on fruit trees to control fungus.

Which of the following correctly matches the human activities with the control principles?

	Control principle		
	X	Y	Z
A	I II III	IV	I V
B	V	II	I II III IV V
C	II V	I II	I II III IV
D	II III V	I	II IV

7c-13 – Co 3 (c) D Which of the following is not an environmental factor affecting the spread of tuberculosis in humans?

A sanitation
B occupation
C population density
D virulence of disease

INCORRECT response items

7c-14 – Kn 4 (i) A The water used at an abattoir is regularly checked. If a culture is grown, contamination is confirmed by the presence of

A *Lactobacillus plantarum.*
B *Salmonella typhi.*
C *Escherichia coli.*
D *Clostridium tetani.*

7c-15 – Kn 4 (i) B A person has an infected wound on the sole of the foot, and attends a doctor. A culture grown from swabbing the wound could grow the pathogen

A *Staphylococcus aureus.*
B *Streptococcus lactis.*
C *Clostridium tetani.*
D *Escherichia coli.*

7d—Types of change

CORRECT response items

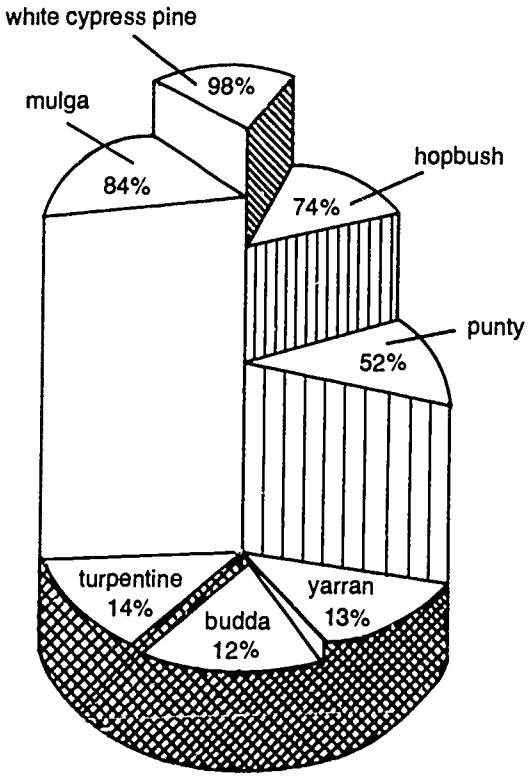
7d-1 – Kn 3 (c) B *

After a severe bushfire in an Australian native forest, the **most likely** plants to show signs of immediate regeneration are

A tea trees.
B eucalypts.
C lichens.
D banksias.

7d-2 – Co 1 (c) A

The chart below shows the percentage of shrubs killed during fires.



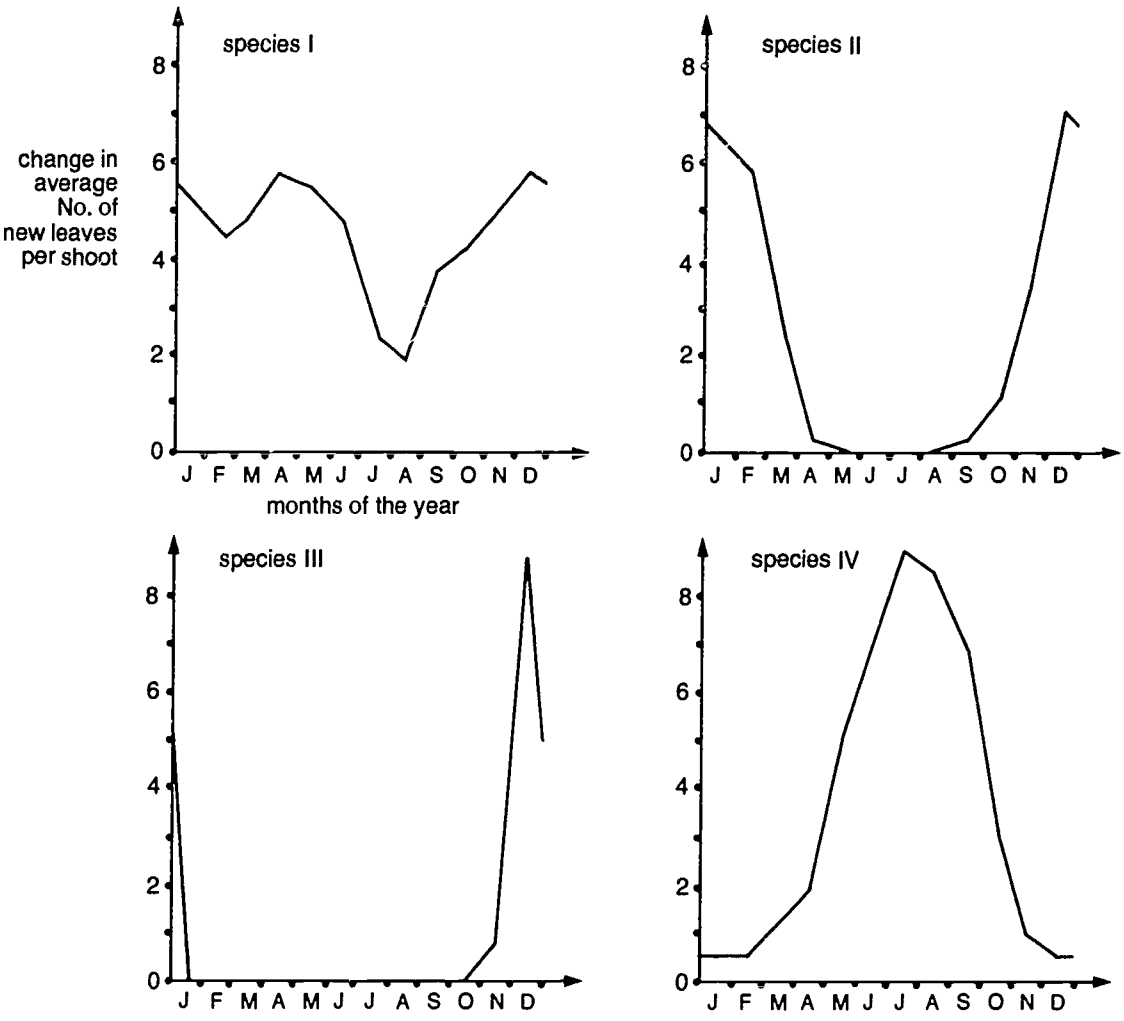
Percentage of Shrubs Killed During the 1974-75 Fires in Western New South Wales

The shrubs which probably have the thickest bark are

A budda and yarran.
B mulga and white cypress pine.
C hopbush and punty.
D punty and turpentine.

The next 6 items refer to the following information:

The graphs show the change in the number of new leaves on the shoots of three different plant species found in Australia.



7d-3 For species I photosynthesis would be expected to be at its maximum in

1b Ap 3 (c) D

A April.
B August.
C September.
D December.

7d-4 Which species would have the highest rates of photosynthesis?

1b An 4 (c) D

A I and II
B III and IV
C II and III
D cannot be determined from the data.

7d-5 For species I the decrease in growth for February **is most probably** caused by limits in the availability of

1b Co 1 (c) B

A light.
B water.
C CO_2.
D O_2.

7d-6 The species that is **most probably** an annual is

1b Ap 4 (c) C

A I.
B II.
C III.
D IV.

7d-7 Which one of the following combinations of physical factors could account for the period of maximum growth of species IV?

1b An 3 (c) B

	Temperature	*Daylength*	*Rainfall*
A	high	long	low
B	low	short	high
C	low	long	high
D	high	short	low

7d-8 Which species are **most likely** to be found in desert areas of low winter rainfall?

1b An 2 (c) A

A II and III
B III and IV
C I and II
D I and IV

INCORRECT response items

7d-9 – Kn 3 (i) A

Many species of eucalypts are able to survive forest fires.

Each of the following features would enhance the survival of individuals of the species.

A seeds which require fire to germinate
B swollen regions (lignotubers) at the soil surface
C rough or thickened bark
D buds beneath the surface of bark

7d-10 – Kn 3 (i) B

The food web of a community is continuously changing.

In any food web

A animals which depend on a seasonally available food may migrate seasonally from one community to another.
B population densities will not alter with changes in the non-living surroundings.
C some species are more affected by weather changes than others.
D species which are present and active in a community throughout the year often change their foods as the seasons change.

7d-11 – Kn 4 (i) B *

A bushfire destroys much of the vegetation and much of the food, shelter and breeding sites used by animals. However, in communities subjected to repeated fires, many of the species living there have characteristics that assist their survival from fire.

For plants, these characteristics include

A thick, rough bark.
B tough leaves with a heat-resistant cuticle.
C a lignotuber at the base of the tree.
D horizontal stems well underground.

7d-12 – Co 2 (i) D

Periodic change is characteristic of the living world around us and it involves many of the species that occur in natural communities.

Examples of this type of change include

A the emergence of fiddler crabs onto sand flats to feed at low tide.
B the head of a sunflower plant turning gradually during the day to always face the sun.
C the shedding of leaves by deciduous trees.
D germination of *Acacia* seeds after bushfires.

7d-13 – Co 2 (i) D

The activities of organisms in a community change as time passes. Some of these changes follow a regular pattern, others do not.

Each of the following could be described as a regular change.

A Fiddler crabs emerge at low tide to feed and return to their burrows at high tide.
B Bats come out of caves at night to feed on insects.
C Many trees lose their leaves in winter.
D Desert landscapes become carpeted with flowering plants after drought-breaking rains.

7e—Effects of change

CORRECT response items

7e-1 – Co 2 (c) D

Lichens are often the first organisms to begin succession on bare rock.

This is because they

A increase the nutrient ion content of the rock.
B decrease water flow over the rock.
C shade the rock from solar radiation.
D physically or chemically break apart the rock.

7e-2 – Co 4 (c) C

Which of the following is an abiotic factor affecting the distribution pattern of a species?

A intraspecific (within species) competition
B interspecific (between species) competition
C chemical conditions
D predator availability

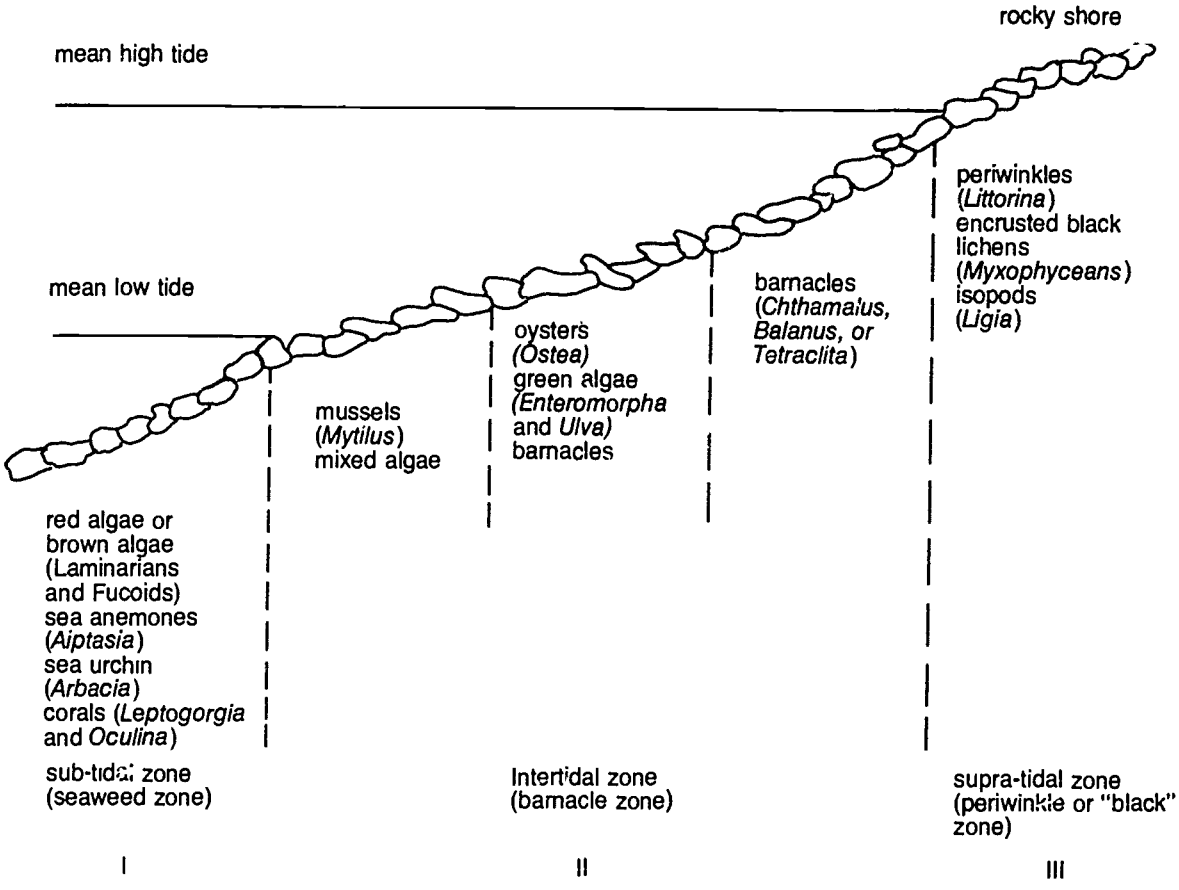
7e-3 2d Co 1 (c) C

It was found that a particular species of bacteria removed from a human lung would only grow if cultured in living tissue.

The bacterium is

A an autotroph.
B a saprophyte.
C a parasite.
D a predator.

The next 2 items refer to the following diagram:



7e-4 The organisms in the diagram are an illustration of

7a Kn 2 (c) D

A succession.
B a biosphere.
C a biome.
D zonation.

7e-5 Animals in area II are mainly

7d Ap 2 (c) B *

A mobile in order to keep covered with water most of the time.
B able to resist dehydration because of hard outer coverings.
C adapted to absorb oxygen directly from the air.
D second-order consumers because few plants grow in this zone.

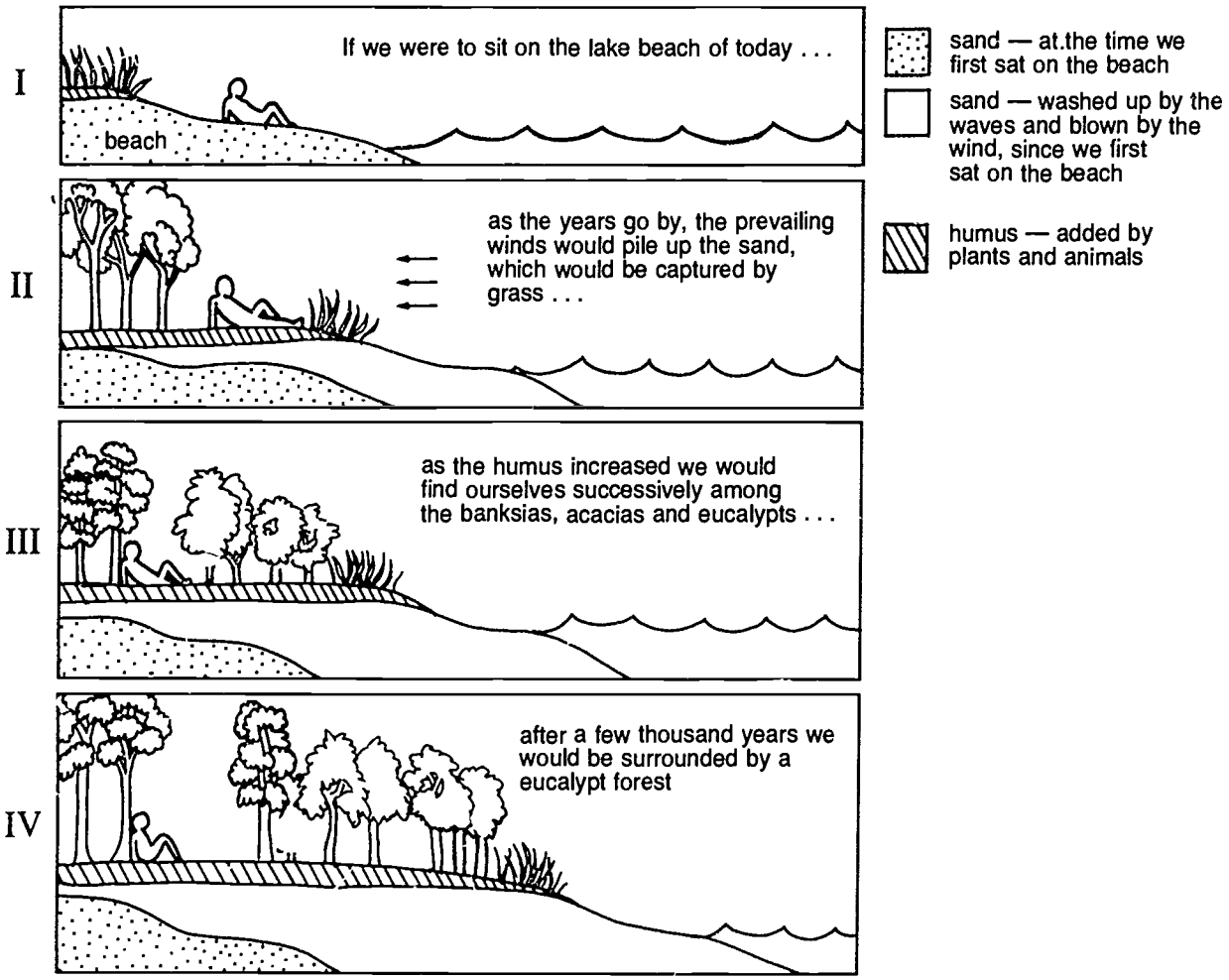
7e-6 Which statement best refers to the climax stage in succession?

– Co 2 (c) A

A It remains until the environment changes significantly.
B It usually occurs just after a fire or flood.
C It has total decomposition exceeding total photosynthesis.
D It contains fewer species of plant than any other stage.

The next 3 items refer to the following information:

Evidence suggests that the following changes could occur to a particular beach over several thousand years.



7e-7 The changes in the original beach illustrate

Ap 1 (c) B

A vertical zonation.
B community succession.
C an unstable ecosystem.
D a food web.

7e-8 Diagram IV shows

7d Ap 3 (c) A

A a climax community.
B a community cycle.
C a complete ecosystem.
D an ecological niche.

7e-9 If the climate remained constant for a few more thousand years the scene would most probably

7d Ap 4 (c) C

A be like diagram I as all the trees would have died from old age.
B be covered with dense growth at all levels.
C show the lake had gone and trees growing where the beach was.
D be basically the same as in diagram IV.

7e-10 The following table lists some trends to be expected in the development of ecosystems.
7d
An
2
(c)
C

Ecosystem attribute	Developmental stages	Mature stages
Net community production (yield)	high	low
Food chains	linear, predominantly grazing	weblike, predominantly detritus
Total organic matter	small	large
Species diversity	low	high
Size of organism	small	large
Life cycles	short, simple	long, complex
Mineral cycles	open	closed
Nutrient exchange rate between organisms and environment	rapid	slow
Stability	poor	good

Which of the following statements is consistent with the above data?

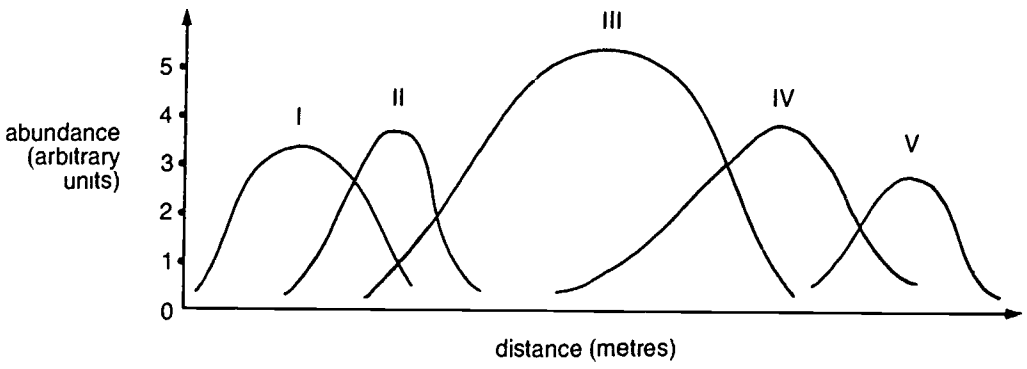
A Consumers of fungi are more likely to be found in the developmental stages than in the mature stages.

B Open mineral cycles in the developmental stages result in a nett loss of nutrients from the ecosystem so that the mature stage has lower levels of nutrients.

C The community in mature stages is more able to tolerate extremes of the physical environment than in the developmental stages.

D You would not expect to find large numbers of small organisms, such as insects, in the mature stages of an ecosystem.

7e-11 – An 3 (c) B An ecologist estimated the distribution and abundance of five species of shrubs, I, II, III, IV and V, along a belt transect 500 m long.



The data presented above

A are evidence that ecological succession is occurring in the area.

B show community zonation but cannot be interpreted as a succession.

C provide evidence that the physical microenvironment is uniform over the area.

D would have been different if the estimates had been made 10 years ago.

7e-12 8a Ap 3 (c) B

A biologist noted that after heavy spring rains the size of a shrimp population at the mouth of a river had decreased.

Which one of the following could **best** account for the decrease.

A an increase in the depth of water reducing light intensity at the bottom
B a decrease in the salinity of the water
C a decrease in the oxygen concentration
D a decrease in the number of shrimp predators

INCORRECT response items

The next 2 items refer to the following information:

In 1883 the tropical volcanic island of Krakatoa erupted, leaving a sterile rocky outcrop. Today the island is covered by a thick natural forest and there are over 1200 species of animals. The island is about 40 kilometres from Java and Sumatra.

7e-13 – Co 1 (i) D

Of the following, which most probably first became established on the island after the eruption?

A trees
B ferns
C mosses
D lichens

7e-14 – Co 2 (i) B *

We would expect that recovery of the communities on Krakatoa would have occurred over a shorter period if Krakatoa had been situated

A in the same relative position to land, but in a zone of higher rainfall.
B in the same relative position to land, but in a colder climate.
C closer to other land.
D in the path of stronger ocean currents.

8—THE LIVING WORLD

The Natural World

8a—Interdependence of community and environment

CORRECT response items

8a-1 – Co 4 (c) C

An aquarium was set up that contained gravel, water, small custraceans, small fish, snails and harmless bacteria. It was then sealed and left in a bright position in the laboratory for three weeks. At the end of this time all the organisms had died.

Which of the following is the **best** explanation for this result?

A There was a build up of wastes that contaminated the water.
B There were no decomposers in the aquarium.
C There was insufficient replacement of energy lost from the living system.
D There were too many second-order consumers in the tank.

8a-2 – Ap 3 (c) B

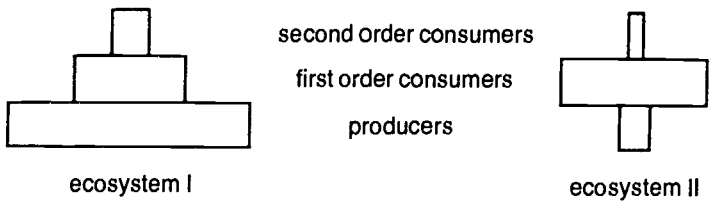
In an attempt to preserve its fishing industry one country has recently announced that foreign ships will no longer be permitted to fish within 80 kilometres of its coast.

The only way this proposal will succeed in preserving the fishing industry is if it results in an increase in

A the amount of plankton on which fish feed.
B the number of fish surviving to sexual maturity.
C the average size of fish caught.
D the number of fish surviving in grounds beyond the 80 kilometre limit.

8a-3 8b Co 4 (c) B

A biologist studied the distribution of biomass (measured in g/m^2) among the feeding levels of two different ecosystems and prepared the two biomass 'pyramids' shown below to summarize the data.



Another ecologist studying the data would **best** conclude that

A the biomass pyramid for ecosystem II is inaccurate because the total biomass of producers must exceed the total biomass of consumers.
B the biomass pyramid for ecosystem II could be accurate if the producer organisms have very high rates of growth.
C ecosystem II must have experienced drought or some other catastrophe, and the biomass of first-order consumers can be expected to decline.
D ecosystem II is a stable system while ecosystem I is undergoing change in its feeding patterns.

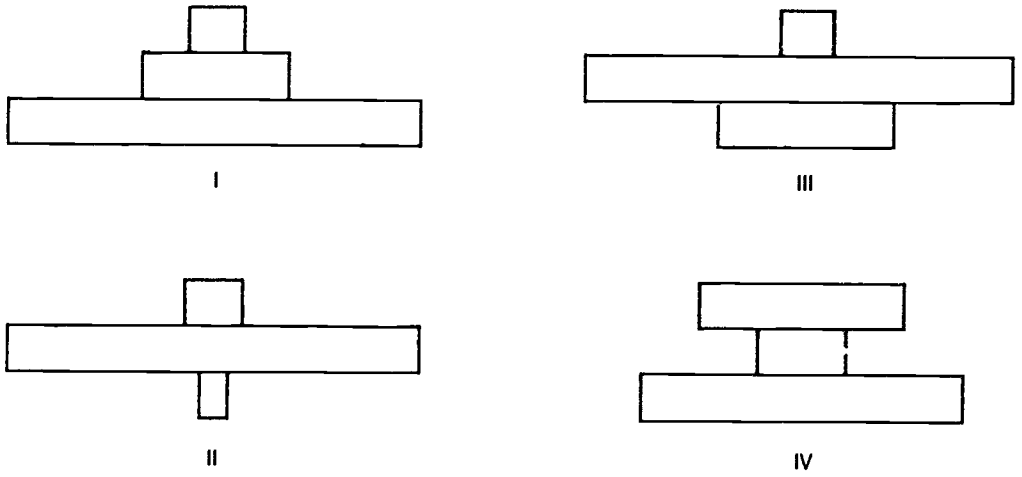
8a-4 – Kn 2 (c) D

Which of the following classes of organisms will usually have the greatest biomass in a community?

A third-order consumers
B second-order consumers
C herbivores
D producers

8a-5 8e Ap 3 (c) B

The diagrams below represent the feeding relationships in four separate communities at different times of the year, as pyramids of biomass in g/m^2.



If man introduced a new disease species into each community which almost entirely eliminated the first-order consumers, in which community would the producer population respond with the largest percentage increase in biomass?

A I
B II
C III
D IV

INCORRECT response items

The next 2 items refer to the following information:

Australia's numerous cattle, which were introduced by Europeans, produce enormous quantities of dung. The dung provides a breeding site for flies and prevents pasture growth. In a program initiated by CSIRO, dung beetles were introduced into Australia. The beetles roll the dung into pellets and bury it as food for their larvae.

8a-6 – Ap 4 (i) B

The introduction of dung beetles into Australia would be useful if the beetles

A use the dung as food and, as a result, fertilize the soil.
B can also use the dung of native animals as food.
C expose more soil for pasture growth by burying the dung.
D compete for the dung with pests such as bush flies.

8a-7 – Ap 2 (i) C

For the program to be successful throughout Australia, it is necessary for the beetles to

A breed rapidly.
B be free of diseases.
C be of the one species.
D breed only in dung.

8b—The dynamic ecosystem

CORRECT response items

8b-1 – Kn 3 (c) D

Which of the following best describes the term ecosystem?

A the flow of matter and energy through a community
B a food web and its energy flow
C the producers and consumers together
D a community and its environment

8b-2 – Co 1 (c) D

A food chain in a particular area includes foxes, grasses, hawks and rabbits.

Which sequence represents the direction of energy flow in the food chain?

A grasses → hawks → rabbits → foxes
B hawks → grasses → rabbits → foxes
C hawks → foxes → rabbits → grasses
D grasses → rabbits → foxes → hawks

8b-3 – Co 3 (c) D

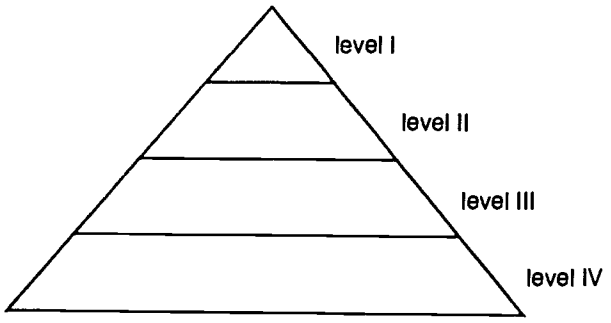
It is claimed that it is more efficient to feed the world's population on plants than on animals.

The underlying reasoning for this claim is that

A plants contain more stored energy per average unit mass than do animals.
B many of the people in the world have a vegetarian diet.
C animals are unable to store energy which orginates from the sun.
D energy available for consumers is reduced at each step in a food chain.

The next 2 items refer to the following information:

A food pyramid, such as this one, can be drawn to indicate the total biomass of organisms at different functional levels within a community.



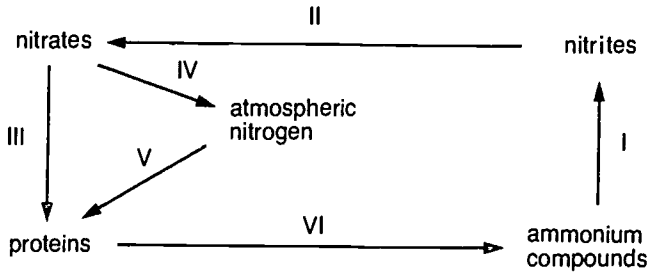
8b-4 – Co 2 (c) B In the pyramid above, level I would represent the

A least numerous organism.
B highest order consumer.
C producers of the community.
D largest individual organism.

8b-5 – Kn 3 (c) B In a marine community which of the following organisms would most likely be found at level II of the food pyramid?

A whales
B small crustaceans
C zooplankton
D phytoplankton

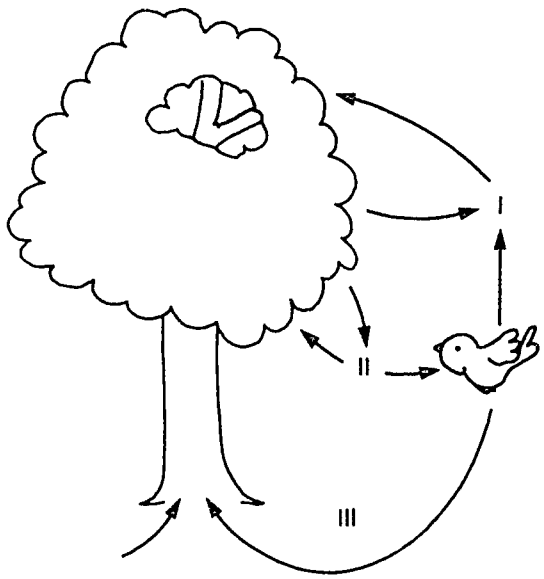
8b-6 – Co 4 (c) A The diagram below summarizes the circulation of nitrogen in an ecosystem.



Which of the following statements is correct?

A VI represents decomposition, and IV represents denitrification.
B III represents nitrogen fixation, I represents nitrification.
C IV represents denitrification, I represents decomposition.
D V represents nitrogen fixation, III represents nitrification.

The next 3 items refer to the following diagram, representing a natural cycle of matter.



8b-7 The substance labelled I would be

1b
Co
2
(c)
B

A oxygen gas.
B carbon dioxide gas.
C nitrogen gas.
D water vapour.

8b-8 Which of the following would **not** be recycled in such a system?

–
Kn
3
(c)
A

A chemical energy
B the element carbon
C the compound water
D the element nitrogen

8b-9 The process which produces substance II is called

1b
Co
4
(c)
D

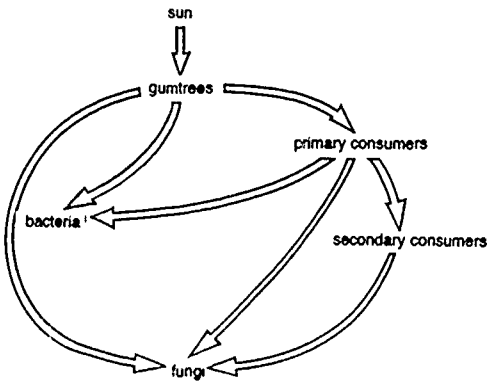
A respiration.
B transpiration.
C excretion.
D photosynthesis.

8b-10 In which of the following food chains is the **least** amount of solar energy transferred to humans?

–
Co
2
(c)
D

A Solar energy → rice → human
B Solar energy → lucerne → steer → human
C Solar energy → phytoplankton → zooplankton → human
D Solar energy → grass → grasshopper → frog → trout → human

The next 3 items refer to the following food web:



8b-11 The correct term for the fungi in this food web would be

– Co 4 (c) A

A consumer organisms.
B producer organisms.
C chemosynthetic autotrophs.
D autotrophic decomposers.

8b-12 Assume that 90 per cent of the energy taken in by an organism is not passed on to the next organism.

– Ap 4 (c) B

How much of 100 units of energy taken into the gumtrees would be obtained by a fungus which derives its energy from primary consumers?

A 0.1 units
B 1 unit
C 9 units
D 10 units

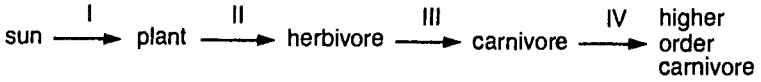
8b-13 The eventual fate of all the 100 units of energy mentioned in the previous question will be that they are

– Kn 4 (c) A

A returned to the non-living surroundings.
B recycled for living things.
C passed on to organisms other than those shown in the above diagram.
D broken down and destroyed.

8b-14 Four steps in the flow of energy are represented as follows.

– Co 2 (c) C



In what forms is energy being transferred in stages I and IV respectively?

A light, heat
B heat, light
C light, chemical
D chemical, chemical

The next 3 items refer to the following information:

In ancient times, mythological creatures called **ttalks** roamed the earth, grazing on lush green grass.

Ttalkflies layed their eggs on the grass. Grazing ttalks inhaled some of these eggs which were then caught in the membranes of the nose where they hatched into wormlike forms called maggots. These maggots fed on the material in the head which caused the ttalk to die. Hence, no more ttalks today.

8b-15 The ttalks were

7b
Co
2
(c)
B

A producers.
B first-order consumers.
C second-order consumers.
D third-order consumers.

8b-16 The ttalkfy maggots were

7b
Co
3
(c)
C

A producers.
B first-order consumers.
C second-order consumers.
D third-order consumers.

8b-17 The grass—ttalk—maggot relationship best represents

7b
Co
2
(c)
B

A an ecosystem.
B a food chain.
C a carbon cycle.
D a food web.

8b-18 The table below shows the amounts of elements entering and leaving a forest ecosystem.

–
Co
3
(c)
C

Element	Input (kg/hectare/year) Weathering of rock	Precipitation (rain, snow)	Air stream	Total	Output (kg/hectare/year)
calcium	21.1	2.2	–	23.3	13.9
magnesium	3.5	0.6	–	4.1	3.3
sodium	5.8	1.6	–	7.4	7.4
potassium	7.1	0.9	–	8.0	2.4
phosphorus	–	0.04	–	0.04	0.02
sulfur	0.8	12.7	6.1	19.6	17.6
nitrogen	–	6.5	14.2	20.7	4.0
chlorine	–	6.2	–	6.2	4.6

Which element is retained **most** by the plants in this ecosystem?

A calcium
B sulfur
C nitrogen
D sodium

8b-19 Which of the following requires the **least** amount of sunlight energy to reach maturity.

– Co 5 (c) B

A kilogram of

A beef.
B rice.
C salmon.
D mushrooms.

INCORRECT response items

8b-20 The presence of nitrogen in communities is important because

– Kn 4 (i) B

A it is an important part of the molecules of proteins necessary in both plants and animals.
B 78 per cent of the air is nitrogen and plants obtain some of their nitrogen directly from the air.
C the activities of denitrifying bacteria in decaying matter results in an output of nitrogen gas into the air.
D nitrogen compounds can be broken down to ammonium ions by the process of mineralization for use by plants.

8b-21 Ecosystems depend for their existence on a certain input and output of matter and energy.

– Kn 5 (i) C

This concept involves

A producer organisms being able to synthesize organic materials from inorganic substances in the presence of light energy.
B breakdown of organic compounds by both producers and consumers.
C a continual recycling of matter and energy through the system.
D the return of inorganic nutrients to the non-living surroundings.

8b-22 Atmospheric nitrogen can be converted to nitrogenous compounds which can be used by plants.

– Kn 4 (i) A

This process is achieved by

A fertilizers.
B lightning.
C leguminous plants.
D nitrogen-fixing bacteria.

8b-23 The organisms which make up a community are usually dependent on one another to some extent, particularly for food. These relationships are sometimes described as food webs.

– Co 2 (i) B

Characteristics of food webs include

A a cycling of materials involving consumers and producers.
B a series of alternative pathways or food chains for all the animals in the webs.
C a dependence on an external energy source for their continuation.
D a sensitivity to man-made interference to a part or parts of the webs.

8b-24 Energy within an ecosystem

– Co 2 (i) B

A has the sun as its ultimate source.
B can be recycled by the actions of producers and consumers.
C is mostly lost from the system as heat.
D can be stored within molecules as chemical energy.

8b-25 When comparing the photosynthesis and respiration rates in a community over a 24 hour period

– Co 2 (i) A *

A the overall respiration rate is far greater than the photosynthesis rate.
B photosynthesis only occurs during the day as it is dependent on light energy.
C respiration occurs both day and night in plants and animals.
D photosynthesis and respiration can occur simultaneously in a plant.

8c—The biosphere

CORRECT response items

8c-1 – Kn 4 (c) B

Which of the following does **not** cycle within the biosphere?

A ions
B energy
C water
D gases

8c-2 – Kn 3 (c) A

Organisms can be arranged in levels of increasing complexity.

The correct ranking is

A populations, communities, ecosystems, biosphere.
B communities, populations, ecosystems, biosphere.
C biosphere, ecosystems, populations, communities.
D ecosystems, communities, biosphere, populations.

8c-3 – Ev 3 (c) B

Carefully consider the following statement:

Large scale fluctuations occur naturally in marine populations, sustained and widespread monitoring over years, even decades, will be necessary to detect the biological effects of pollution in the open ocean.

Which of the following points of view supports this statement?

A Man is having an increasingly obvious effect on the oceans.
B Man cannot automatically be blamed for all sudden declines in marine life.
C The oceans are so large that we can discount the effect of localized industrial pollution.
D In the long run man cannot alter the major ecosystems of the ocean.

INCORRECT response item

8c-4 – Kn 4 (i) A

Each of the following is re-cycled within the biosphere.

A energy
B water
C mineral ions
D gases

Effects of Human Activity

8d—Typically human ecosystems

CORRECT response items

8d-1 6c Co 1 (c) C

In 1824 Thomas Malthus attempted to logically analyse the future of humanity on this planet. He noted that the human population tended to grow at an ever increasing rate even though the resources available to humans were limited.

If this situation had been allowed to continue unchanged, what would have been the final result?

A The birth rate would be controlled.
B The emigration rate would increase.
C The population would outstrip the food supply.
D The total land area available for food production would increase.

The next 3 items refer to the following table:

	Birth rates per 100		Death rates per 100	
Country	1940	1960	1940	1960
Chile	33.0	35.4	22.0	11.9
Ceylon	35.8	37.0	20.6	9.1
Japan	29.4	17.2	16.8	7.6
Australia	20.3	22.6	9.0	8.5

In answering the following questions, ignore the effect of immigration and emigration.

8d-2 6c An 2 (c) A

Which country experienced a reduction in population growth rate between 1940 and 1960?

A Japan
B Ceylon
C Chile
D Australia

8d-3 6c An 4 (c) B *

Which country had the greatest *change* in population growth rate between 1940 and 1960?

A Chile
B Ceylon
C Japan
D Australia

8d-4 6c Ap 2 (c) C

The *change* in Chile's population growth rate between 1940 and 1960 is **most** likely due to

A reduction in food production.
B greater use of birth control methods.
C greater use of medical advances.
D reduction in the number of community education programs.

8d-5 – Co 2 (c) C *

The human population of the world is increasing rapidly due to medical advances and increases in human food production.

Assuming that this trend will continue, the factor ultimately limiting human populations will be the availability of

A food.
B water.
C space.
D oxygen.

8d-6 6d Co 2 (c) A

The rate of growth of the human population of the world is more rapid now than it was 100 years ago.

The factor most responsible for this is the increase in

A survival rate of children.
B life expectancy of adults.
C use of birth control throughout the world.
D immigration to countries such as Australia.

8d-7 – Ap 2 (c) D

Human populations are making increasing demands on world resources.

If these demands continue to rise, all of the following are likely consequences **except**

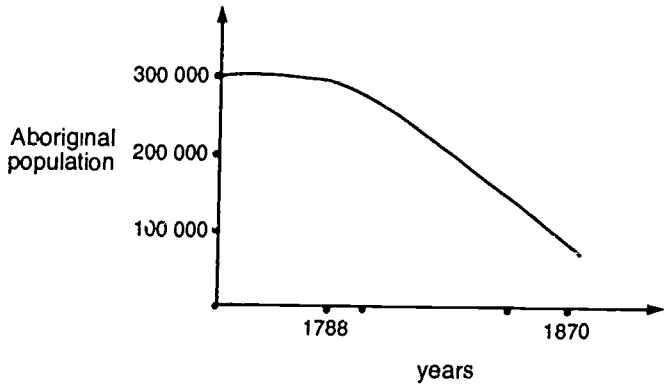
A a fall in birth rates.
B an increase in death rates.
C a decrease in the standards of living.
D an increase in the availability of shelter.

8e—Human activity and the biosphere

CORRECT response items

8e-1 – Kn 2 (c) C *

The following graph shows the estimated population of Aborigines in Australia before and after European settlement.



Which of the following factors is likely to have had the most influence on this trend?

A extinction of traditional food animals
B soil and vegetation changes
C disease
D droughts

8e-2
8d
Kn
2
(c)
B

An agricultural ecosystem is different from a natural ecosystem in that the agricultural ecosystem

A has more recycling of matter.
B has a greater output of organic matter.
C requires less inorganic material.
D is exposed to a greater amount of light.

8e-3
–
Co
2
(c)
D

The water hyacinth is a plant which occurs naturally in tropical parts of South America. When introduced to Australia it became a serious pest, clogging waterways and irrigation channels. It was decided to try to control water hyacinth biologically by introducing an insect which would feed on the plant.

The best place to look for such an insect would be

A the tropical areas of Australia.
B near clogged waterways and irrigation channels.
C any area in the tropics.
D the tropical parts of South America.

The next 2 items refer to the following information:

Autoextinction of some insect pests is now being practised. One technique involves the introduction of large numbers of males, sterilized by irradiation, into the natural population. In cases where this technique has proven to be successful, the pest has practically disappeared after several more generations.

8e-4
–
Ap
3
(c)
B

Of the following, the **most** likely reason for this autoextinction is that

A sterile males fail to mate with females.
B sterile males compete with normal males for females.
C sterilized males pass on their sterility to their mates.
D radiation results in the death of the males.

8e-5
–
Ap
3
(c)
A

The success of this method depended on the fact that

A effective mating occurred only once in the female's life-time.
B parthenogenesis could occur.
C the males were weakened by the sterilization process.
D sterility was inherited by the offspring.

8e-6 – Co 4 (c) B

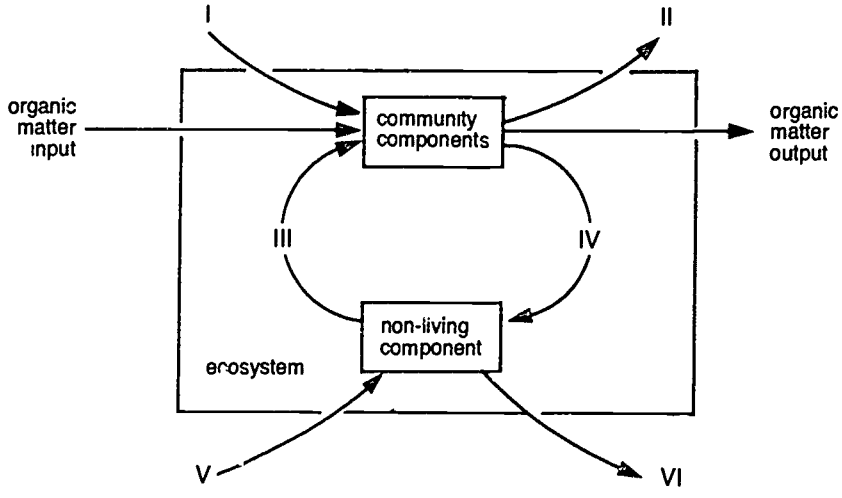
Australian hunter-gatherer communities have been claimed to be living in harmony with their environment.

Which of the following activities is **inconsistent** with this claim?

A social control of birthrate
B lighting of fires in the vegetation
C competing for territory with other groups
D hunting kangaroos.

The next 3 items refer to the following information:

The diagram illustrates the flow of matter and energy through a typical ecosystem.



8e-7 8b Co 4 (c) B

Which arrow represents the movement of nitrogen during nitrogen fixation by soil bacteria?

A I
B III
C IV
D V

8e-8 8b Co 2 (c) B

The arrow that represents heat energy is

A I.
B II.
C IV.
D VI.

8e-9 – Co 5 (c) A

In an **agricultural** ecosystem, compared with a natural ecosystem, one would observe that

A III and V would be greater but IV and VI would be reduced.
B both organic matter input and output would be greater, but III and IV would be reduced.
C I would be greater and III and IV would increase.
D III and VI would be greater but IV and V would be reduced.

8e-10 – Ap 1 (c) A

The floating water weed, *Salvinia molesta*, was first recorded in Australia in 1952. It is now found in every state in Australia, where it creates a problem in still waters. Because of its phenomenal growth rate (doubling its dry weight every two and a half days under good conditions) it can quickly choke waterways.

In Brazil, the original source of *Salvinia*, scientists located a weevil which attacks the weed. The weevils were imported to Australia and reared by CSIRO. Tests showed that they would not feed on anything other than *Salvinia*. In June 1980, 1500 of the weevils were released onto a *Salvinia*-covered lake near Mt Isa, and there was a further release of 1500 weevils six months later. By April 1981 all the *Salvinia* was dark brown and sampling of the weevil population suggested that there were more than 100 million weevils feeding and breeding on the weed.

When considering future changes, which of the following is **most** likely?

A Small numbers of both the weed and the weevil will occur.
B The weed will die out completely and the weevils will then die out.
C The weed will eventually return in its former numbers.
D Weevil populations will remain high and prevent any weed growth.

8e-11 8f Ap 3 (c) A

Pesticide concentrations were measured in four organisms in and near a river estuary. The results are as follows:

Organism	Pesticide concentration (ppm)
K	22.00
L	0.001
M	2.00
N	8.20

These organisms were

I small herbivorous fish
II pelicans
III algae
IV carnivorous fish

A correct match of the actual organisms with the letters in the table above would be

	Identity of organism			
	I	II	III	IV
A	M	K	L	N
B	N	M	K	L
C	L	N	M	K
D	K	L	N	M

INCORRECT response items

8e-12 Methods of biological control include
–
Kn
2
(i)
D
*

A development and breeding of resistant crop strains.
B sterilization and release of individual pests.
C use of pheromones as bait in special traps.
D research and utilization of more powerful pesticides.

8e 13 The biosphere is composed of three types of ecosystem
–
Kn
3
(i)
A

(i) Natural
(ii) Agricultural
(iii) Urban

Of these it is true to say that

A an urban ecosystem has little recycling and low heat output.
B an agricultural ecosystem has some recycling and a large output of organic matter.
C a natural ecosystem has much recycling, with organic matter input approximately equal to organic matter output.
D all three ecosystems rely on light as one source of energy input.

8e-14 Because of the problems associated with the use of pesticides some alternatives have been introduced.
–
Kn
4
(i)
D

These include

A breeding resistant strains of the crop or domestic animal to limit the need for pesticides.
B introducing a natural enemy of the pest into the environment.
C releasing sterile individuals of the pest species to reduce the number of offspring.
D using pheromones to deter the individuals of the same species from entering that area.

8e-15 In waterways, where fertilizers or other chemicals reach high concentrations, there may be excessive algal growth.
–
Co
1
(i)
C

A consequence of this condition would be

A an explosion of the fish population.
B a depletion of oxygen in the water.
C an increase of carbon dioxide levels in the water.
D an increase in decomposer activity.

8e-16 Use of pesticides has provided many problems because of unforeseen long-term effects.
–
Co
3
(i)
D

These problems have arisen because many pesticides

A cannot be completely broken down in the bodies of organisms.
B spread to areas of the biosphere where they have not been directly applied.
C accumulate to lethal levels in higher order consumers.
D show high specificity to certain organisms.

8e-17 The table lists pesticide concentration (in parts per million) in organisms from a river estuary.
–
Co
3
(i)
A

Source	Pesticide concentration (ppm)
water	0.000 05
plankton	0.04
plankton-feeding fish	0.2
predatory fish	2
gull (a scavenger)	6
cormorant (feeds on large fish)	26

From the table, it is reasonable to conclude that

A cormorants are killed by DDT toxicity.
B gulls have a DDT concentration 30 times that of plankton-feeding fish.
C DDT accumulates in the bodies of organisms.
D those organisms at greatest risk are higher order consumers.

8e-18 The atmosphere today contains more carbon dioxide than it did in the 1850s.
–
Co
4
(i)
D

This increase is probably due to

A extra use of fossil fuels.
B overgrazing by animals.
C clearing of forests.
D slightly higher atmospheric temperature.

8e-19 Eutrophication in streams is caused by high concentrations of nutrients.
–
Ap
4
(i)
B
*

Eutrophication usually involves

A increased growth by producers.
B large amounts of oxygen dissolved in water as a result of photosynthesis.
C carbon dioxide being used for photosynthesis.
D competition for oxygen supplies during the night.

8f—Understanding and managing the biosphere

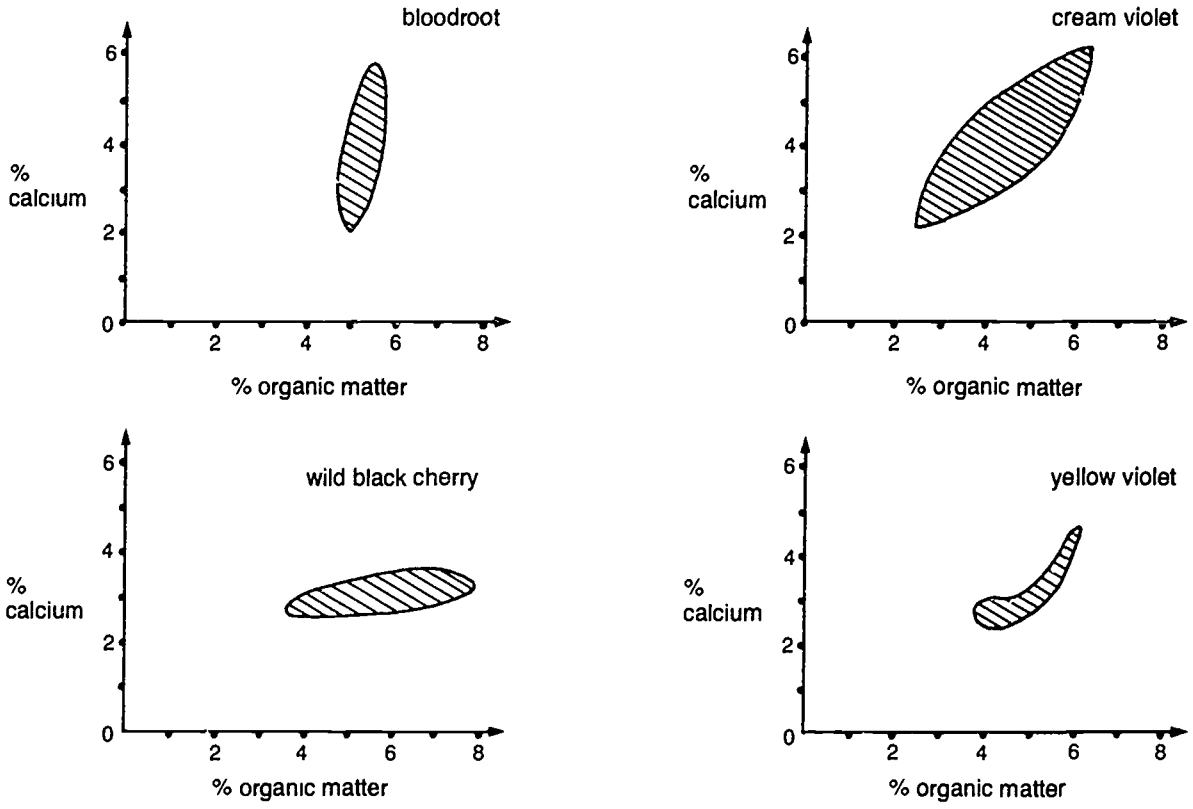
CORRECT response items

8f-1 Shortly after myxomatosis was introduced into Australia to control rabbits it appeared in Europe and
8e drastically reduced native rabbit populations. Many areas that had supported a grassland ecosystem
Ap throughout recorded history began to develop into forest ecosystems.
4
(c) Considering the above observations, which of the following conclusions is most valid?
A

A In these ecosystems the physical factors of the environment were less important in determining the ecosystem structure than were the biotic factors.
B The competitive interaction between myxoma virus and the rabbit would result in the eventual extinction of one of the organisms.
C The seeds of tree species were dormant in the ground for very long periods.
D Prior to the introduction of myxomatosis the grass species were more effective competitors for space than the tree species.

The next 2 items refer to the following information:

The graphs below refer to an interaction between two environmental factors on four plants in a deciduous forest. The shaded area indicates the tolerance limits for organic matter and calcium for these species.



8f-2
6a
Co
4
(c)
C

Which of the following is **not** indicated by the data?

A Black cherry is found only within a narrow range of calcium, but is tolerant of wider variation in the percentage of organic matter.

B Bloodroot is narrowly restricted by the percentage of organic matter in the soil, but is less sensitive to variations in calcium.

C Yellow and cream violets can tolerate a wider variation in the levels of organic matter and calcium than can the other two species.

D Cream violets tolerate relatively higher calcium and lower organic matter than yellow violets.

8f-3
6a
An
3
(c)
B

An analysis of a flower grower's soil showed calcium content to be three per cent and organic matter five per cent.

If he wished to grow cream and yellow violets without any bloodroot or wild cherry the best way to manage his land would be to

A increase calcium content.

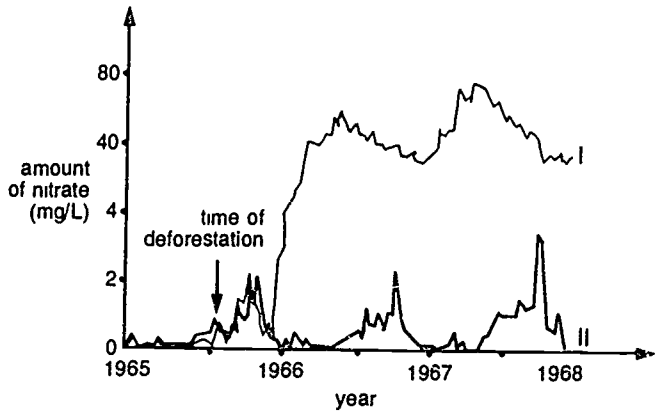
B increase both calcium and organic content.

C decrease calcium content.

D decrease both calcium and organic content.

8f-4
8e
Ap
3
(c)
D

The following graph shows the change in nitrate runoff as a result of deforestation in the Hubbard Brook experimental forest.



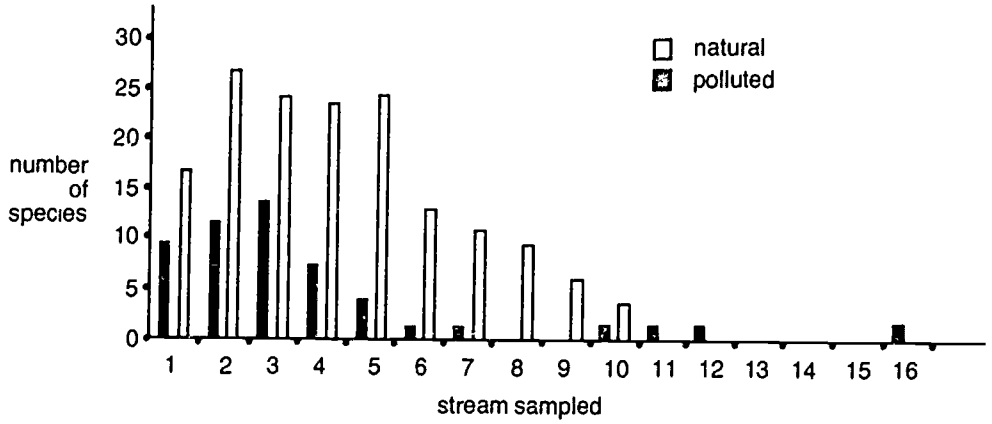
- curve I represents output of nitrate in stream water in the deforested area.
- curve II represents the output in a similar but undisturbed area.

Which of the following statements is supported by the data in the graph?

A Deforestation does not affect the inorganic nutrient level of streams.
B Increased irrigation in certain land areas results in removal of nutrients from the soil.
C Destruction of vegetation increases the erosion of soil by wind.
D Loss of vegetation accelerates the leaching of minerals from soil.

8f-5
8e
An
4
(c)
B

The following graph shows the variation in the number of species of diatoms in samples taken from 16 freshwater streams before and after pollution.

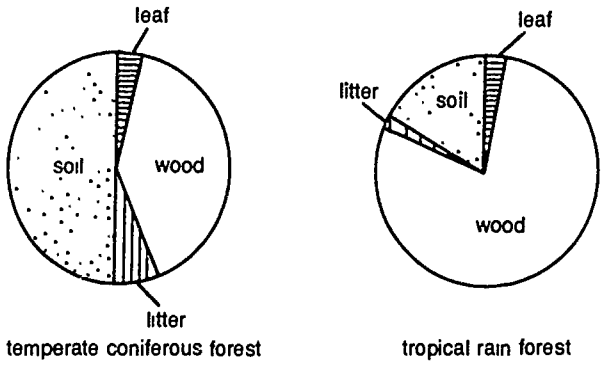


Which of the following is supported by these data?

A Some diatom species only occur in polluted streams.
B Polluted streams tend to have fewer diatom species than unpolluted streams.
C Water purity may be indicated by diatom population size.
D Diatom populations usually decrease when a stream becomes polluted.

8f-6 8e Ap 4 (c) A

The following diagram shows the distribution of organic carbon accumulated in non-living and living components of a temperate coniferous forest and a tropical rain forest. Both ecosystems contain about 250 tonnes of organic carbon per hectare.



Distribution of Organic Carbon

As a general rule, when these forests are cleared, temperate soils tend to retain fertility for longer periods than tropical soils.

Which of the following statements **best** accounts for these observations?

A When the temperate forest is removed the high soil humus content reduces the leaching of inorganic nutrients.

B Most of the organic carbon in the tropical rainforest is in the trees, this shows that the soils will be able to grow crops better than the soils in the temperate areas.

C The high rainfall in the tropical rain forest makes conventional fertilizing methods unsuitable.

D The temperate forest actually contains more organic carbon than the tropical rain forest and, therefore, can be farmed more successfully.

8f-7 – Kn 4 (c) C

The bacterium *Escherichia coli* is frequently used as an indicator organism by authorities monitoring environmental pollution.

Its presence in river water indicates

A the illegal dumping of household garbage in or near the river.

B inadequate aeration of the river.

C contamination of the water by human faeces.

D the beginning of the eutrophication process.

8f-8 – Ap 5 (c) D

Suppose that the supply of fossil fuels became exhausted and man came to rely predominantly on nuclear energy.

The **most** probable result would be that

A the level of thermal pollution of the biosphere would decrease.

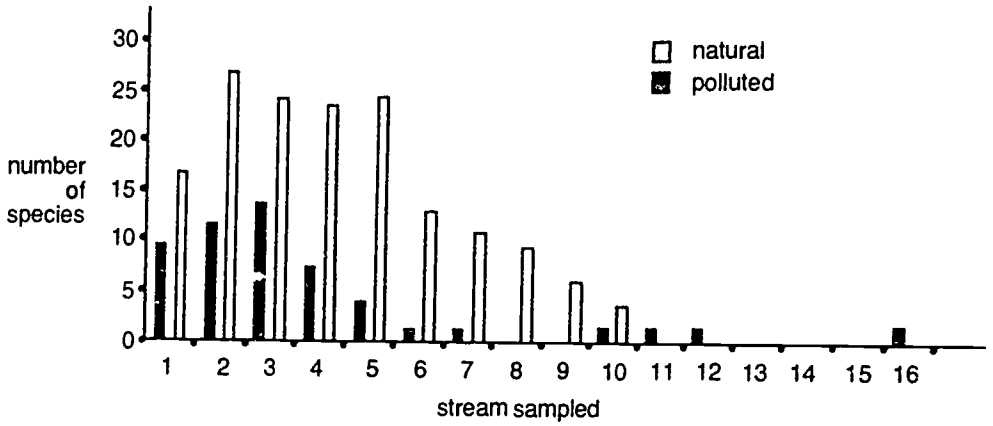
B the concentration of oxides of nitrogen in the atmosphere would remain relatively constant.

C the 'greenhouse effect' would cease.

D more solar energy would reach the earth's surface.

8f-9
8e
An
4
(c)
B

The following graph shows the variation in the number of species of diatoms in samples taken from 16 freshwater streams before and after pollution.



Each of the following is supported by these data.

A Some diatom species only occur in polluted streams.
B Polluted streams tend to have fewer diatom species than unpolluted streams.
C Some streams are unable to support diatom populations.
D The number of diatom species usually decreases when a stream becomes polluted.

Appendix 1

Acknowledgments

- Australian Academy of Science, Canberra, for the extract from *Biology in Action*, No. 4, June 1982, and illustrations from *Biological Science: The Web of Life*, 3rd Edition, 1981.
- Australian Government Publishing Service, Canberra, for the table from *Metric Tables of Composition of Australian Foods* by Thomas and Corden, 1977; and the table adapted from *Charts and Tables of Heights, Masses and Head Circumferences of Infants and Children* by the National Health and Medical Research Council, 1975.
- Cambridge University Press, for the illustration adapted from *The Animal and the Environment*, by F.J. & W.B. Vernberg, 1970.
- Chiron Press Inc., New York, for illustrations from *Ecology*, 2nd Edition, by R.E. Ricklefs.
- Commonwealth Scientific and Industrial Research Organization, for the extract from *Ecos*, Spring 1982, No. 33.
- Ecological Society of America, for the diagram from *Ecology*, Volume 142, 1961, by J.H. Connell.
- Professor D.W. Edington, Department of Physical Education, University of Michigan, for the graph from *The Biology of Physical Activity*, by D.W. Edington and V.K. Edgerton, 1976.
- Holt, Rinehart & Winston, New York, for the illustration from *The Animal and the Environment*, by F.J. & W.B. Vernberg, 1970.
- Methuen Publishers, London, for the illustration adapted from *The Principles of Insect Physiology*, by V.B. Wigglesworth, 1947.
- Thomas Nelson and Sons Ltd., Surrey, for the table from *Biology. A Functional Approach—Students' Manual*, by M.B.V. Roberts, 1974.
- Oxford University Press, London, for the table and graph adapted from *Discovering Biology* by J.J. Head, 1972.
- Pergamon Press (Aust.) Pty Ltd., Rushcutters Bay, NSW, for illustrations from *Australian Animals and Their Environments*, by Messel and Butter (eds.), 1977.
- W.B. Saunders Publishers, Philadelphia, for illustrations from *Biology*, 6th Edition, by C. Villee, 1977.

Examples of Item Uses

Essay framework

Item 1

Consider the following statement:

> Scientific research cannot be considered complete until it has been published or otherwise made available for appraisal by the scientific community.

Write an essay in which you critically examine this claim. Include an appraisal of each of the following statements, indicating whether you agree or disagree, and setting out clearly the basis of your agreement or disagreement.

A results of scientific work need to be made public to overcome the bias and distortion of individual judgment.
B any objections to a hypothesis are overcome once it has the support of other scientists.
C new discoveries, no matter how controversial, ought to be published in order to stimulate further research and scientific debate.
D the existing climate of scientific opinion is able to influence the direction of future research.

*[Compare this item with item **17j-1**]*

Extended response

Item 2a

Races are sometimes described as a stage in the development of new species.

Discuss this statement by explaining how each of the following would or would not facilitate the formation of two new species from two existing races.

A reproductive isolation of members of one race from the other
B interbreeding between members of each race to produce fertile hybrid offspring
C increasing differences between members of each race leading to differing gene pools
D each race tending to be confined to geographical areas with differing environmental factors operating

*[Compare this item with item **15j-5**]*

The table shows a comparison of the levels of oxygen, carbon dioxide and nitrogen in blood. It also gives experimentally determined levels for the amount of each gas which can dissolve in the blood under body conditions.

	Oxygen (mL / 100 mL)	Carbon dioxide (mL / 100 mL)	Nitrogen (mL / 100 mL)
Amount present in arterial blood	20.0	50.0	1.70
Amount present in venous blood	14.0	56.0	1.70
Amount which could dissolve in blood under body conditions	0.40	2.96	1.04

From your understanding of the above information, and your knowledge of the blood transport system, write True (T) or False (F) after each statement.

The following statements are consistent with the information set out in the table above.

A Most of the oxygen and carbon dioxide carried in the blood is not in the form of dissolved gas molecules.

B Nitrogen is more soluble in blood than oxygen.

C Most of the oxygen in the blood is used up when the blood comes into close contact with the tissue cells.

D Tissue cells absorb oxygen and release an equivalent amount of carbon dioxide.

*[Compare this item with item **11e-15**]*

In the space below **explain** why you judged each statement as True or False.

A

B

C

D

True/False

Item 3

Write True (T) or False (F) at the end of each of these statements.

The following statements are consistent with the cell theory.

A The cell is the unit of structure and function.

B Some structures are not cellular in form.

C All organisms consist of many cell types.

D All cells derive from pre-existing cells.

*[Compare this item with item **9f-3**]*

Debates

Item 4

It has often been said that the development of science, and the growth of scientific knowledge, over the past 300 years, has led to achievements which in many cases have been to the detriment of society and, in some cases, have threatened human existence. Out of concern for the issues raised by the results of scientific enterprise, several British scientists in 1969 formed a group known as the *British Society for Social Responsibility in Science*. This group argues that 'the development of science is not predetermined but should depend on the social choice of the community'.

Evaluate the following by discussing whether each statement is consistent or inconsistent with this argument.

A The development of science is affected more by political, economic and social pressures than by the aims and objectives of individual scientists.
B The development of science should depend more on recent discoveries and achievements than on the theories and principles established in the past 300 years.
C Scientists should become aware of the social significance of science and of their social responsibilities.
D The public should be made more aware of the implications and consequences of scientific development.

*[Compare this item with item **16f-3**]*

Research stimulus

Item 5

The next 2 items refer to the following information:

The salt balance in the blood is controlled by anti-diuretic hormone (ADH). This hormone acts on the cells of the collecting ducts of the kidney making them more permeable to water and thereby allowing water to pass from the ducts into the surrounding blood supply. ADH is released in increasing quantities by the pituitary in response to changes in the salt balance of the blood.

One might expect ADH secretion to increase from the pituitary if there is

A dehydration.
B a drop in the salt to water ratio in the blood.
C blood loss.
D a rise in the osmotic pressure of the blood.

An increased output of urine could be expected from the following treatments.

A Injection into the blood of a substance that inhibits the action of ADH on the collecting ducts.
B Surgical removal of the pituitary.
C Injection of a strong salt solution into the blood supply of the pituitary.
D Constriction of the blood vessels leaving the pituitary.

Thoroughly research the above information and items, then (i) explain, and (ii) give evidence for, the acceptance or rejection of each alternative.

*[Compare this item with items **12b-16** and **12b-17**]*

TOPIC INDEX OF CONCEPT AREAS*

* Concept areas from sections 1 to 8 are in Volume I. Concept areas from sections 9 to 17 are in Volume II.