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ABSTRACT

Beginning in February 1994, twelfth-grade students who have passed the Ohio Ninth-grade Proficiency Tests in all areas will take the Twelfth-grade Proficiency Tests in writing, reading, mathematics, and citizenship. This fact sheet describes the Twelfth-grade Proficiency Test in mathematics, which is designed to measure a twelfth-grade level of mathematics literacy as defined by 19 learning outcomes developed by Ohio educators and adopted by the Board of Education in 1988. This fact sheet describes the mathematics test, which consists of 50 multiple-choice questions, divided among the 5 categories (strands) of arithmetic, measurement, data analysis, algebra and functions, and geometry. Each question has four answers. Students are permitted, but not required, to use a calculator in taking this test, although it is designed to be calculator neutral. The three types of questions students will encounter are those relating to knowledge and skills, conceptual understanding, and application and problem solving. Most students will be able to complete the test in 75 minutes; 2.5 hours are allowed. (SLD)

Fact Sheets

Twelfth-grade Mathematics

What are the Twelfth-grade Proficiency Tests?

Beginning in February 1994, twelfth-grade students who have passed the Ninth-grade Proficiency Tests in all areas will take the Twelfth-grade Proficiency Tests in writing, reading, mathematics, and citizenship. The twelfth-grade tests will be administered once annually in February; there will be a make-up period after the regular administration for any students missing the regular administration.

The purpose of the Twelfth-grade Proficiency Test in Mathematics is to measure a twelfth-grade level of literacy as defined by the nineteen learning outcomes. A committee of Ohio teachers and citizens went through a consensus-building process to develop these learning outcomes, which were adopted by the State Board of Education in 1988.

What can students expect on the Twelfth-grade Proficiency Test in Mathematics?

The mathematics test consists of 50 multiple-choice questions. These 50 questions are divided among 5 categories called strands: Arithmetic (5 questions), Measurement (5 questions), Data Analysis (8 questions), Algebra/Functions (19 questions), and Geometry (13 questions). This grouping is illustrated in the circle chart on page three and a full description of the test's content can be found in the next section.

Each question has four answer choices, one of which is correct. Answer choices such as *None correct*, *All correct*, or combinations of responses are not used. However, the answer choice *Cannot be determined* may be used. There is no penalty for guessing.

Students are permitted (but not required) to use a calculator when taking this test. A list of calculators acceptable for use with this test will be available after September 1993. No graphing calculators will be allowed. Because calculators are optional, no questions on the test are

significantly easier to solve with a calculator than without. In other words, the test is calculator-neutral. Students are not permitted rulers, compasses, or protractors. Rather than requiring much computation, questions on the test primarily require knowledge of basic facts and skills, understanding of concepts, and ability to apply knowledge and understanding to problem-solving situations. The three types of questions that can be expected are described below:

Knowledge and skills (30% of the questions on the test)

Questions of this type test students' knowledge of important basic terms, facts, methods, procedures, and skills. This may include the ability to recall important definitions, relationships, and formulas; choose and use procedures appropriately; read graphs and tables; and perform rounding, ordering, and estimating operations.

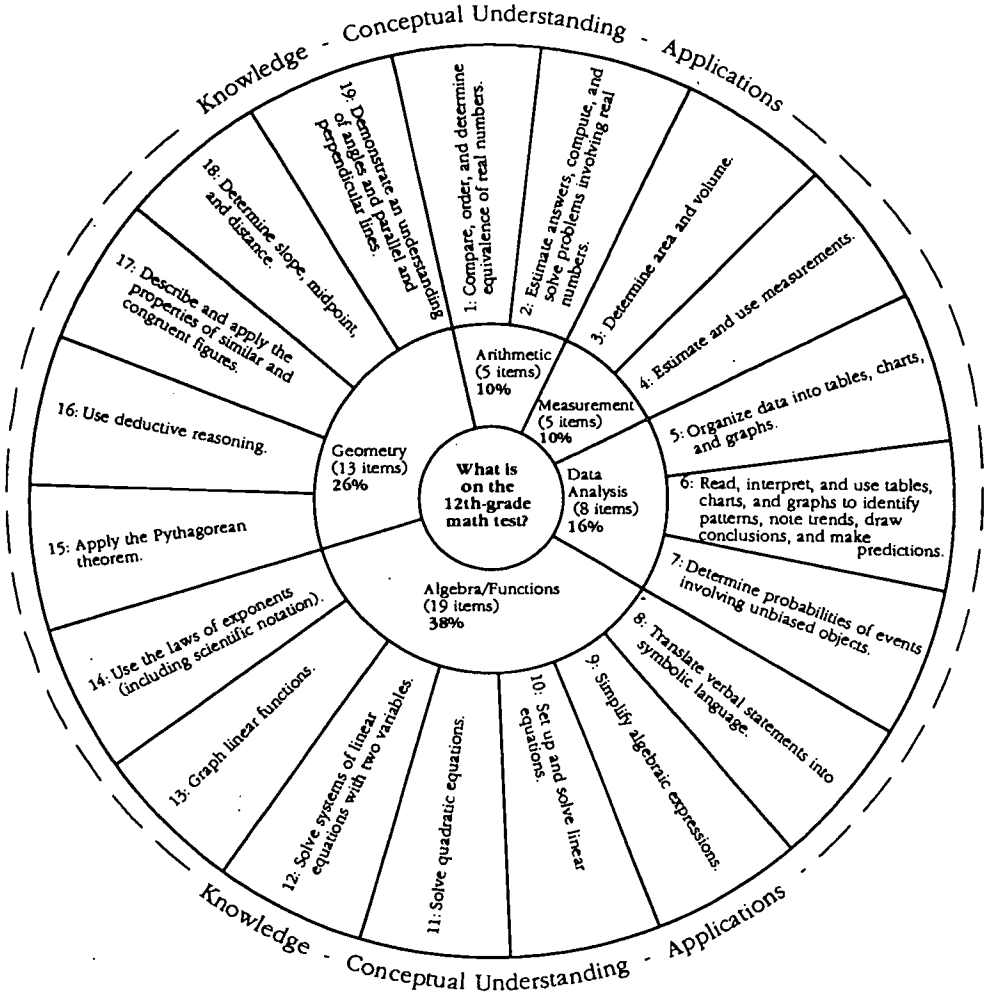
Conceptual understanding (30% of the questions on the test)

Questions of this type test students' ability to recognize examples and counterexamples of concepts; use various representations of concepts; apply principles, facts, and definitions in new situations; compare and contrast related concepts and principles; judge the characteristics of solutions; and interpret assumptions.

Application and problem solving (40% of the questions on the test)

Questions of this type test students' ability to apply knowledge and/or conceptual understanding in new situations. This may include the ability to determine the sufficiency and consistency of data; translate between verbal and mathematical representations of a problem; use strategies and data to solve problems; generate, extend, modify, and interrelate procedures; and use critical thinking skills to solve problems.

What's on the Twelfth-grade Proficiency Test in Mathematics?



What are the twelfth-grade learning outcomes and what do they mean to the student?

These learning outcomes are mathematical abilities students are expected to possess and use by the time they complete their high school education. There are 19 outcomes grouped into five strands: Arithmetic, Measurement, Data Analysis, Algebra/Functions, and Geometry. The learning outcomes are numbered and in italics.

Strand 1 - Arithmetic (5 questions)

1. *Compare, order, and determine equivalence of real numbers.*

   This includes understanding of the relationships among integers, decimals, fractions, percents, and irrational numbers. Any combination of these types of numbers may appear in a question, testing the ability to translate from one form to another for the purpose of comparison. Items may include the use of negative numbers and small integer exponents.

2. *Estimate answers, compute, and solve problems involving real numbers.*

   This includes basic arithmetic operations and estimation using integers, decimals, fractions, percents, or irrational numbers. Items testing estimation will make clear that an exact computation is not desired.

Strand 2 - Measurement (5 questions)

3. *Determine area and volume.*

   This includes understanding the concepts of area and volume, and the ability to find the areas and volumes of simple geometric shapes or combinations of simple geometric shapes. Questions may require understanding of the relationships among length, area, and volume. Knowledge of the formulas for the areas of rectangles, circles, and triangles will be assumed, along with knowledge of the formula for the volume of a rectangular solid. Any other formulas needed will be provided as part of the question. Answers involving π will either be given in terms of π, or an approximation of π will be provided.

4. *Estimate and use measurements.*

   This includes understanding common measurement units of time, length, area, weight, velocity, etc., and the ability to choose the appropriate unit. Applications and estimations (including visual estimation) are included. The ability to determine the relative size of one measure with respect to another may also be included.

Strand 3 - Data Analysis (8 questions)

5. *Organize data into tables, charts, and graphs.*

   This includes all the skills and concepts needed to construct a table, chart, line graph, bar graph, or circle graph from numerical data. For example, this might involve selection of the proper type of graph, selection of proper scale, calculation of realistic distances between tick marks, or calculation of length of bars in a bar graph. Questions in this outcome focus on the process of putting information into visual form, rather than the process of extracting information from its visual representation.

6. *Read, interpret, and use tables, charts, and graphs to identify patterns, note trends, draw conclusions, and make predictions.*

   This includes all the skills and concepts needed to extract and interpret information obtained from line graphs, tables, bar graphs, histograms, circle graphs, or other visual representations of numerical information. This could include decoding symbols according to a given key, or making estimations. As part of drawing conclusions and making predictions, the student might be asked to make reasonable interpolations or extrapolations.

7. *Determine probabilities of events involving unbiased objects.*

   This includes understanding of simple probability, complementary probabilities, and probabilities involving either dependent or independent events. Questions will require only simple arithmetic. Familiarity with decks of playing cards and dice will not be assumed. Probability will usually be given as a ratio in fractional form.

Strand 4 - Algebra/Functions (19 questions)

8. *Translate verbal statements into symbolic language.*

   This includes the ability to set up an appropriate algebraic expression or equation from an English description of a situation. Questions may also test the ability to identify the meaning of a given expression or equation in the context of a realistic problem.

9. *Simplify algebraic expressions.*

This includes simplifying algebraic expressions by factoring, adding, subtracting, multiplying, or dividing polynomials.

10. *Set up and solve linear equations.*

This includes the ability to solve linear equations which may be given or may have to be deduced from a problem description. Questions will be written so that the solution cannot be determined directly by substituting answer options into the equation.

11. *Solve quadratic equations.*

The student may use any method to solve the equation, but knowledge of the quadratic formula will not be necessary.

12. *Solve systems of linear equations with two variables.*

The system of equations might be given, or the student might be required to deduce it from a problem description. Computations will be calculator neutral. Conceptual understanding questions may include systems with no solutions or infinitely many solutions.

13. *Graph linear functions.*

This includes the ability to identify points and lines on a graph, graph linear equations, and translate a verbal description of a situation to a graph. Familiarity with functional notation ($f(x)$) will not be assumed.

14. *Use the laws of exponents (including scientific notation).*

This includes the ability to demonstrate knowledge and understanding of the following properties:

i) $(b^m)(b^n) = b^{m+n}$ ii) $(ab)^m = a^m b^m$ iii) $(b^m)^n = b^{mn}$

iv) $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$ v) $\frac{b^m}{b^n} = b^{m-n}$

The exponents and bases will usually be integers (positive, negative, or zero). Questions testing conceptual understanding might have a variable in the base or exponent. Questions focus on use of the above properties rather than computational skill.

Strand 5 - Geometry (13 questions)

15. *Apply the Pythagorean theorem.*

This includes knowledge of the Pythagorean theorem, which states that for any right triangle, $a^2 + b^2 = c^2$, where a and b are lengths of the legs (the two shorter sides) and c is the length of the hypotenuse (the longest side).

The ability to apply the Pythagorean theorem in realistic applications may be tested. No more than one application of the theorem will be required in any single problem. Knowledge of the decimal values of irrational numbers ($\sqrt{5}$, for example) will not be required.

16. *Use deductive reasoning.*

This includes the ability to draw logical conclusions from given facts in situations involving spatial, geometric, or subset relationships. Questions will not require knowledge of advanced geometric theorems, but may be based on common experience or simple geometric knowledge.

17. *Describe and apply the properties of similar and congruent figures.*

This includes understanding of the relationships between angle measures and side lengths in similar and congruent figures. The main emphasis will be on triangles, but other polygons of no more than six sides may also be used.

18. *Determine slope, midpoint, and distance.*

This includes understanding of the slopes, midpoints, and lengths of line segments. Use of the formulas for these may be required, but these formulas will not be provided as part of the question. Questions may include real-world applications of these concepts.

19. *Demonstrate an understanding of angles and parallel and perpendicular lines.*

This includes an understanding of the angular relationships between parallel and/or perpendicular lines. The focus is on plane geometry rather than coordinate geometry. Questions do not test the relationship between linear equations and parallel or perpendicular lines.

What else do students need to know?

- All work must be done in the test booklet. No additional paper is provided or permitted.
- Students may use calculators approved for this test but may not use other devices such as rulers, compasses, and protractors. A list of calculators approved for this test will be provided by the Ohio Department of Education after September 1993. Graphing calculators will not be permitted.
- Test questions have been constructed to emphasize knowledge, conceptual understanding, and problem-solving ability. Use of a calculator for computation does not provide a significant advantage.
- Each test question has four answer choices but only one answer is correct. There is no penalty for guessing.
- Answer choices such as *None correct*, *All correct*, or combinations of responses are not used.
- *Cannot be determined* could be an answer choice.
- Students should check their answers since answer choices often include frequently made mistakes.
- Students will have a maximum of two and one-half hours to finish the mathematics test. Most of them will be able to complete it within 75 minutes.
- To familiarize students with the types of questions found on this test, a practice test will be available after late spring 1993.

- There are 50 questions on the test. The following table shows the possible numbers of questions in each area.

Strands	Knowledge & Skills	Conceptual Understanding	Problem Solving	Totals	% of Test
Arithmetic	1-2	1-2	2-3	5	10%
Measurement	1-2	1-2	1-2	5	10%
Data Analysis	2-3	1-2	4-5	8	16%
Algebra/ Functions	5-6	6-7	7-8	19	38%
Geometry	4-5	3-4	4-5	13	26%
Totals	13-17	13-17	18-22	50	100%
% of Test	30%	30%	40%	100%	

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