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ABSTRACT

This guide and the accompanying student workbook (separate document) comprise the Adult Basic Education Level II (grades 4, 5, and 6) package on the metric system. An introductory section provides background information on adult basic daily living skills, a discussion of the design and use of the student workbook, and information on what the teacher needs to know about the metric system (six pages). Five instructional sections are included: Linear, area, mass, capacity, and temperature. Each section includes learning activities and additional comments (both of which relate to specified pages in the student workbook) and lists of materials needed. Appended are sources of material (complete addresses and ERIC document numbers, where possible) on adult education and/or the metric system, instructions for using the student test booklets, two student test booklets (forms 1 and 2), and answers to student tests (forms 1 and 2). (SH)

Metrics for Good Measure

LEVEL II. INSTRUCTOR'S GUIDE.

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THE CENTER FOR VOCATIONAL EDUCATION

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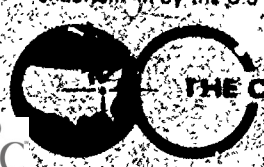

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CONTENTS

INTRODUCTION

The ability to use measurement tools and concepts is a basic necessity of adult life. The change to the metric system now taking place in the United States gives the Adult Basic Education student an opportunity to catch up to and even exceed the present measurement skills of the average adult.

Basically, ABE instructors are concerned with providing curriculum materials which have immediate application. ABE students are motivated by learning tasks which improve the quality of their lives now, whether on the job or at home. A chance to learn skills which their neighbors may not have can contribute to self-improvement and self-confidence.

The content of the LEVEL II STUDENT WORKBOOK is occupationally oriented. There are references to measurement tasks used within some thirty-one different occupations to which students can relate.

Pragmatic needs and goals have brought these adult students to the ABE program. They can emerge from the unit on metrics with measurement skills they can take home and immediately put to use.

The Adult Performance Level (APL) material here shows some of the everyday skills needed by LEVEL II ABE students:* After the students have finished this unit they should be able to use the metric system in these suggested ways.

LEVEL II

- Reading
- Writing
- Speaking and Listening
- Computation
- Problem Solving
- Interpersonal Relations

*Norvell W. Northcutt. ADULT FUNCTIONAL COMPETENCY: A SUMMARY. Austin, Texas: Adult Performance Level Project Staff, Division of Extension, The University of Texas at Austin. January, 1973.

Consumer Economics	Occupational Knowledge (Including Homemaking)	Health	Community Resources	Government and Law
Increase reading vocabulary to include: length — metre — m width — centimetre — cm height — litre — l scale — degree Celsius — °C mass-weight — gram — g measure — kilogram — kg millilitre — ml		1. Be able to read dosage on a medicine bottle. 2. Read a Celsius thermometer.	Be able to read temperature forecasts in newspaper and on television.	1. Look for price per litre of gasoline posted at gas stations. 2. Read highway signs.
Be able to write the metric symbols m, cm, kg, g, l, ml, and °C.		Be able to record own body measurements in metrics.	Assist community consumer organizations.	Able to read labels to see if they conform to packaging laws.
Ask for proper quantities and sizes needed in merchandise.	In service jobs, know and understand metric terms.	Say and understand readings of clinical thermometers, scales, and height measures.	Understand weather forecasts and temperature predictions.	Explain to others how metric system will affect government and laws.
Be aware of number of servings in commercial metric container sizes.	1. Use millilitre spoons and litre cups in food preparation. 2. Know correct utensil size for quantity prepared.	Relate °C to choice of clothing to wearer.	Keep daily and monthly rainfall records in centimetres.	
When purchasing, know large and small equipment sizes and size of space to be occupied by them.	Know general temperature--low, medium, high--for cooking.	Interpret clinical thermometer readings for person's temperature and take appropriate action.	Use weather reports, distances in km, and speed limits to help plan activities.	
Ask for correct sizes in talking to store clerks.	Teach a neighbor to use a metre stick, a metric ruler, and a metric tape measure.	Give the doctor a child's temperature over the phone.	Help others learn the basics of the metric system.	Give accurate estimates of metric measures to law enforcement officials.

DESIGN AND USE OF THE STUDENT WORKBOOK

These materials are designed for ABE students who are functioning at Grade levels 4, 5, or 6.

The STUDENT WORKBOOK is organized into six sections: Linear, Area, Mass, Capacity, and Temperature. Each of these sections introduces appropriate concepts, measurement words, and measurement devices. After a brief introduction to each section, students are sent to a resource table which you, the instructor, have organized. At this resource table students perform hands-on activities that are described throughout the STUDENT WORKBOOK in the sections headed Metric Activities.

As students complete the metric activities, they will acquire a feeling for the size of a metric unit. When they have internalized the concept (that is, when they are thinking metric), they go back to the STUDENT WORKBOOK for some examples of where people use these measurements at work and at home. These short vignettes not only give students some idea of the practical uses of metric measurements but can act as an impetus for further discussions of other occupations and situations where these metric units are used.

The ability to handle number concepts varies widely among ABE students. Therefore, it seemed prudent to plan the LEVEL II STUDENT WORKBOOK for grade 4.5 reading and mathematical levels. Instructors are encouraged to adapt the materials upward if they feel it is appropriate for their students.

The STUDENT WORKBOOK begins by using a problem solving approach to introducing metric measurement. Most people have had measurement problems--clothing that does not fit when we get it home; furniture that is too wide to be moved through doorways, and objects that are too big for their intended space. These experiences are often uncomfortable and frustrating. Yet, almost everyone has had them and by planning ahead and measuring, many of these situations can be avoided.

The role of the teacher is extremely important. Reading metric information will not provide LEVEL II ABE students with the measurement skills they need to know. It is essential that the instructor encourage students to become actively involved in the Metric Activities sections. These are laboratory activities which involve the student in learning in a personal way. They encourage a positive attitude toward discovery and inquiry, and they reduce fears and concerns about the metric system. In addition, these hands-on activities can easily be expanded as needed. You need to collect the materials for each segment and set up a resource table with measurement equipment before the students begin.

Students need to get their hands on measurement tools. As a result of working with the Metric Activities on the metre and the centimetre, the square metre, the gram and the kilogram, the litre and the millimetre, and the Celsius thermometer, your students will become familiar with the quantities they represent and will establish their own personal sets of physical references. Thus, the students may associate the width of a fingernail with a centimetre and the mass of a brick, a football, or an iron with a kilogram.

Experiences with metrication in other countries such as Australia, England, and Canada show that students learn better when metric units are compared to familiar objects. Students should learn to "think metric." It is difficult and confusing to learn the new system by constantly referring to the Customary system now in use. Even though we will be using Customary and metric measurements side by side for quite a while, students should learn them as separate measurement languages, not by translating from one to the other.

OBJECTIVES

The student will demonstrate the listed skills for each of the five measurement groups, using the terms and devices shown. Page numbers refer to pages in the STUDENT WORKBOOK.

SKILLS	MEASUREMENT GROUPS				
	Linear (pp. 4-22)	Area (pp. 23-29)	Mass (pp. 30-39)	Capacity (pp. 40-53)	Temperature (pp. 54-59)
1. Recognize and use the unit and its symbol 2. State or show a physical reference for	millimetre (mm) centimetre (cm) metre (m) kilometre (km)	square centimetre (cm^2) square metre (m^2)	gram (g) kilogram (kg)	litre (l) millilitre (ml)	degree Celsius (°C)
3. Read correctly	metre stick, metric tape measure, and metric rulers		a kilogram scale, gram scale	measurements on litre cups and millilitre spoons	Celsius thermometer, Celsius clinical thermometer
4. Calculate or determine (includes selecting and using any appropriate measuring instruments) 5. Estimate within 25% of the actual measure	height, width, or length of objects	the area of a given space	the mass of objects	capacity of containers	the temperature of the air, a liquid, or a person
6. Convert a metric quantity in one of these units to its equivalent in another of these units			gram kilogram	litre millilitre	

WHAT THE INSTRUCTOR NEEDS TO KNOW

Linear

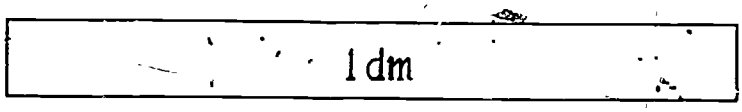
The first section is about linear measurement. Linear measure refers to the length, depth, width, or height of an object. Students are asked to estimate and measure the length, width, depth, or height of various objects.

The base unit of linear measure in the SI, or metric system, is the metre. (SI is an abbreviation for Système International d'Unités, or International System of Units.) The basic tool for measuring metres is the metre stick. The symbol m is used to denote metre or metres. Notice that no period is placed after the m unless it is at the end of a sentence.

- If you place one end of a metre stick on the floor and hold the stick against your leg, you will find that the other end of the metre stick is near your waist. You may want to take a metre stick and work Metric Activities 1 and 2. These two learning activities are designed to give you and your students a feeling for the length of a metre and a metre stick.

Because a metre is too long to measure many things, it has been divided into smaller units. All of these units have the word metre in them. A different prefix is used to differentiate between these subunits. The three most commonly used subunits all have prefixes that end in the letter i. See the list on the bottom of the next page.

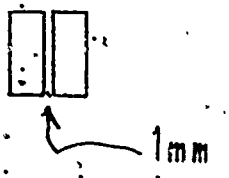
The first subunit is a decimetre. It is one tenth of a metre. The rectangle here is one decimetre long. There are 10 decimetres in one metre. The decimetre is a unit that is seldom used; but you, the instructor, should be aware of this unit so that you will have a better understanding of the metric system. The symbol for decimetre is dm.



If a decimetre is divided into 10 equal subunits, each of these subunits is called a centimetre. There are 10 centimetres in a decimetre or 100 centimetres in a metre. At the right is a rectangle that is one centimetre long. Remember that since there are 100 centimetres in one metre, each centimetre is one hundredth of a metre. Most centimetre rulers are 20 or 30 centimetres long. The symbol cm is used for centimetre.

- Measure the width of a paper clip and a penny. A paper clip is about one centimetre wide and a penny is about two centimetres wide. You may want to work through Metric Activity 7 to get a better understanding of the length of a centimetre.

If a centimetre is divided into 10 equal parts, each part is called a millimetre. There are 10 millimetres in a centimetre and 1 000 millimetres in a metre. At the right are two small rectangles. The distance between these rectangles is one millimetre. The symbol mm is used to represent millimetres.



- Many students are used to millimetres because they smoke cigarettes that are 100 mm or 120 mm long. Note that a 100 mm cigarette is also 10 cm, or 1 dm, long. A dime is about one millimetre thick.

There are times when it is not convenient to refer to large linear measures in metres. When this happens larger units are used. The names of these larger units all have a prefix plus the word "metre." For the larger units the prefixes do not end in the letter i.

The first of these larger units is 10 metres long. It is called dekametre and the symbol dam is used. Ten dekametres is a hectometre (hm). There are 100 metres in one hectometre. Ten hectometres is a kilometre (km). There are 1 000 metres in one kilometre. Dekametres and hectometres are not used in the LEVEL II materials. In fact, they will seldom be used. Kilometres are used to designate distances such as the distance between two cities. Many signs on the interstate highways now give the distance to major cities in kilometres. Speed and velocity are given in kilometres per hour (km/h).

The table below shows the relationship between the base unit (metre) and the other linear units.

Unit	Symbol	Value in Metres	Read as
*kilometre	km	1 000 metres	one thousand metres
hectometre	hm	100 metres	one hundred metres
dekametre	dam	10 metres	ten metres
*metre (base unit)	m	1 metre	one metre
decimetre	dm	0.1 metre	one tenth of a metre
*centimetre	cm	0.01 metre	one hundredth of a metre
*millimetre	mm	0.001 metre	one thousandth of a metre

*Units commonly used.

Area

The second section discusses area. Area refers to the number of units it takes to cover a surface completely. An SI unit of area is the square metre. The symbol for a square metre is m^2. Notice that the symbol is m^2 and not sq. m.

> Take four metre sticks and place them on the floor in the shape of a square. If you do this carefully, the area inside this square is a square metre. You might want to work Metric Activities 18 and 19. These two activities are designed to give you and your students a feeling for the area of a square metre.

There are smaller and larger units than a square metre. In fact, any of the linear units can be used for deriving a unit for area. For example, the instructional material in the STUDENT WORKBOOK uses square centimetres (cm^2) to explain area to the students. You may also use square millimetres (mm^2). Notice that there are 100 mm^2 in one cm^2.

Larger units can also be used. For example, a square dekametre (dam^2) is 100 m^2. Another name that is often used for a dam^2 is are and the symbol for are is a. An even larger unit is the square hectometre (hm^2). This is 10 000 m^2. A more common name for the hm^2 is the hectare and the symbol ha is used for hectare. Land measure is often in hectares. The only larger unit of area that will be used is the square kilometre (km^2). This will be used primarily for very large land areas.

Mass

The third section is about measuring weight or mass. The mass of an object refers to a measure of the amount of matter contained in the object. This amount always remains constant so long as something is not added to or subtracted from the object. Weight is the term that most people use when they mean mass. Weight, however, is affected by gravity while mass is not. Thus, the weight of an object on the moon is one sixth its weight on earth. The mass of that same object is the same whether the object is on the moon or on the earth. The word mass is used in the LEVEL II materials.

The SI base unit of mass is the kilogram and the symbol kg is used to designate kilogram or kilograms. A kilogram scale is used to measure kilograms. Kilogram scales come in many shapes and sizes. A bathroom scale and a scale in a doctor's office are two different types of kilogram scales.

- Find your mass on a kilogram scale. Measure the mass of other heavy objects such as a sack of potatoes, a bag of sugar, and a pet. Work through Metric Activities 21, 22, and 23. Guess the mass of a friend and various objects before you measure them. Keep trying until you are able to make fairly accurate guesses.

A kilogram is a rather heavy unit. Because of this it is often necessary to use subunits for expressing the mass of light objects. The most common subunit is the gram. There are one thousand grams in one kilogram. Thus, each gram represents one thousandth of a kilogram. The symbol g is used to represent grams. The units dekagram and hectogram are very seldom used. There are 10 hectograms in one kilogram and 100 dekagrams in one kilogram.

- Pick up a raisin. Feel how light it is! It weighs about one gram. Pick up a nickel. A nickel weighs about 5 g. You may want to work through Metric Activities 24 and 25 to develop a better understanding of the mass of one gram.

A unit larger than a kilogram that is often used is the metric ton which is 1 000 kilograms. The metric ton is used for shipping corn, wheat, and other large quantities. The symbol t is used to represent the metric ton. This unit is spelled tonne in other English speaking countries; however, in the United States "metric ton" is preferred.

Capacity

The fourth section is about the measurement of capacity. Capacity refers to the amount of space enclosed by an object or container. The term capacity often is used to refer to either volume or capacity. Students are asked to estimate and measure the capacity of several containers and to use measures of capacity in preparing recipes.

The basic unit of capacity is the litre. A cube or box that is one decimetre long, one decimetre wide, and one decimetre high has a capacity of one cubic decimetre, or one litre. The symbol for a cubic decimetre is dm^3. The symbol for litre is l. Notice that this symbol is not the numeral one but a small, or lower case, letter "el." Because there can be some confusion when the last digit of a number is one, it is very important that a space be left between a numeral and the symbol for litre. If there is any possibility of confusion, use the whole word "litre."

- The litre will be a very common household unit. Milk, motor oil, gasoline, bleach, and soda pop are a few of the products that will be purchased in litres. You might want to do Metric Activities 28 and 29. These two learning activities are designed to give students a feeling for a litre.

The cubic decimetre, or litre, is often too large a unit for many uses. When this happens, the smaller unit that is used is the millilitre. There are one thousand millilitres in one litre. The symbol for millilitre is ml. Millilitre is another name for cubic centimetre. A box that is one centimetre long, one centimetre wide, and one centimetre high is a cubic centimetre. The symbol for cubic centimetre is cm^3. There are 1 000 cubic centimetres in one cubic decimetre.

- A teaspoon holds five millilitres. Metric Acitivity 31 gives people experience with millilitre spoons that will be used in cooking. Metric Activity 34 is designed to give experience using millilitre spoons and litre measuring cups. You might want to try these recipes at home so that you are sure that you understand all of the steps.

Units smaller or larger than a litre are often needed. When this is the case, these new units have names with the word litre preceded by a prefix. The following table shows the relationship between the base unit (litre) and the other units of capacity.

Unit	Symbol	Numerical Meaning	Read as
kilolitre	kl	1000 litres	one thousand litres
hectolitre	hl	100 litres	one hundred litres
dekalitre	dal	10 litres	ten litres
*litre (base unit)	l	1 litre	one litre
decilitre	dl	0.1 litre	one tenth of a litre
centilitre	cl	0.01 litre	one hundredth of a litre
*millilitre	ml	0.001 litre	one thousandth of a litre

*Units commonly used.

Temperature

The last section is about measuring temperatures. Students are asked to estimate how hot or cold something is.

The unit most people will use for measuring temperatures is degree Celsius. The tools for measuring temperatures are Celsius thermometers. The symbol for degree Celsius is °C. Usually no space is left between the numeral and the symbol. Thus, 53 degrees Celsius often is written 53°C and not 53 °C. Celsius and °C are both capitalized since they are in honor of Anders Celsius, the Swedish astronomer who developed the Celsius scale. The term degree centigrade has been replaced by degree Celsius.

- If you place a Celsius thermometer in ice water the reading should be 0°C; if you place it in boiling water the reading should be 100°C. Normal body temperature is 37°C. A comfortable room temperature is 21°C. Metric Activities 36, 37, and 38 give you a better feeling for Celsius temperatures. You may want to do these three activities before this material is studied in class.

METRIC NOTATION

When writing measures in metric notation there are a few rules that should be followed. To express a measure such as 15 metres you write 15 m. Notice that there is a space between the numeral 15 and the symbol m. Remember that no period is placed after the symbol unless it is at the end of a sentence.

When writing quantities of capacity in metric notation you must be very careful. A quantity such as 27 litres should be written as 27 l. Note that a space is left between the numeral 27 and the symbol l. This is important since a lower case el looks like a numeral one. Some early metric guides used a script el, ℓ, but this is discouraged since most typewriters do not have a script el key. When there is a possibility of confusion, the word litre should be written out.

Numbers that are one thousand and larger use a space instead of a comma to seperate groups of three digits. Thus, a quantity such as 25,683,927 centimetres should be written 25 683 297 cm. However, when there are four digits the space does not have to be used. Thus, 3957 and 3 957 are both correct.

When referring to quantities less than one unit in length, a zero (0) is placed to the left of the decimal point. Thus, 0.25 cm should be used not .25 cm. This is not necessary when there is a combination of whole units and partial units. For example, 2.35 dm is correct; 02.35 is not.

Another rule is that two different units are never mixed. It is not correct to write 6 m and 7 cm. Instead, this should be expressed entirely in metres, entirely in centimetres, or entirely in some other linear unit. Since there are 100 cm in 1 m, there are 600 cm in 6 m, hence this length of 6 m and 7 cm could be expressed as 607 cm. If you want to express this in metres rather than in centimetres, you must remember that 1 cm is the same as 0.01 m (1 centimetre is the same as one hundredth of a metre). so, 7 cm is 0.07 m and 6 m and 7 cm would be written 6.07 m.

COMMENTS AND MATERIALS NEEDED

	Comment	Student Workbook Page	Materials Needed
LINEAR			
Activity 1.	A METRE HIGH	4	
Activity 2.	A METRE LONG	4	
Activity 3.	A METRE WIDE	4	
	In these three Metric Activities students USE metre sticks and should get a feeling for the length of a metre or metre stick. Give each student enough time to fully understand the concept of metric length.		Metre stick for each student. (If possible, use unmarked metre sticks.)
Activity 4.	METRE ROOM	5	
	Again, in this activity students are getting experience in the use of metre sticks. Encourage them to write their answers and to use correct metric notation. They may want to write a result as 5½ m. This is acceptable. In fact, you might want to encourage them to use some rough measures such as this. Do not expect them to be precise.		Metre stick for each student. (If possible, use unmarked metre sticks.)
Activity 5.	STEPPING METRES	5	
	This can be fun. Encourage students to make the marks as far apart as possible, i.e., if there is room, they can put the marks 20, 30, or 40 metres apart. Ask them to try to make all their steps the same length.		Metre stick. Masking tape or chalk.
Activity 6.	METRES AROUND THE ROOM	5	
	Encourage the students to guess the height, width, or length of each of the objects and to write their guesses on a sheet of paper. Answers such as "almost two metres," "less than three metres," "two and a half metres," etc. are acceptable.		Metre stick for each student.

	Comment	Student Workbook Page	Materials Needed
Activity 7.	CENTIMETRES	9	
	This activity introduces the students to the centimetre by means of hands-on activities. In this Metric Activity students will USE the ruler to help them get an internal feeling about the length of a centimetre and how to use the ruler. Give each student enough time to fully understand the concept of the centimetre.		Metric ruler fo each student.
Activity 8.	GUESS AND MEASURE	9	
	Encourage the students to guess the measures of each of these objects. Ask them to write their guesses on a sheet of paper. Ask them to write the actual measures on a different sheet of paper and then compare the guess with the actual measure. Students could measure the length, width, and thickness of the book. You may want to include objects other than the ones listed here.		Metric ruler fo each student. Pencil. Chalkboard eraser. Coffee pot. Book.
Activity 9.	METRIC TAPE MEASURE	10	
	This activity helps students to relate further the metre to their body measurements. It introduces a new measuring tool--the metric tape measure. Before you begin this activity you might want to have students compare the length of their tape measure with the length of a metre stick. Note that many metric tape measures are 150 cm, or 1.5 m, long.		Metric tape measure for each student. "Figure it in Metrics" wall chart.
Activity 10.	BODY MEASUREMENTS	10	
	Here again the students get a chance to relate the metre to body measurements. As they work through this Metric Activity, students should be encouraged to compare their body measurements from Metric Activity 9 to the measurements of the three "models" in this activity.		Metric tape measure for each student.

Comment	Student Workbook Page	Materials Needed
Activity 11. MEASURING MILLIMETRES	14	
This is to help students learn to read a metric ruler in millimetres. You might want to duplicate some drawings or line segments for the students to measure in millimetres. The students can check these measurements against your answers of the measures of other students in the class. Give the students as many experiences as are needed for them to develop mastery.		Metric ruler for each student.
Activity 12. MILLIMETRES	15	
Students will develop a feeling for some everyday objects that measure about a millimetre. This will help them gain a better understanding of the size of a millimetre.		Metric ruler for each student. Paper clip (#1 size). Dime.
Activity 13. ME IN MILLIMETRES	15	
Once again encourage the students to guess before they measure. This also will help them associate some parts of their bodies with some millimetre measurements.		Metric ruler for each student.
Activity 14. MORE MILLIMETRES	15	
Encourage the students to first guess the measures of each of these objects, write their guesses on a sheet of paper, and then measure the object. Encourage them to keep guessing and measuring until they become proficient. You may want to include objects other than the ones listed here.		Paper clip. Button. Needle. Bolt. Stapler. Pencil. Book. Table. Desk.
Activity 15. UP IN SMOKE	16	
This activity gives further practice with measuring in millimetres. It provides an example of a metric product already in common use.		Metric ruler A number of cigarettes in each of several lengths: 100 mm, 120 mm, king size, regular.

Comment	Student Workbook Page	Materials Needed
Activity 16. MILLIMETRES AND CENTIMETRES	16	
In this Metric Activity students begin to convert from millimetres to centimetres. You may want to give the students some additional problems to convert. If these students are somewhat familiar with the customary system, you can point out how much easier it is to change metres to centimetres than to change feet to inches.		Metric ruler. Paper clip. Toothpick.
Activity 17. STEPPING KILOMETRES	20	
This is more of an after-school activity than an in-class activity. You may want to have the students get an idea of the length of a kilometre by asking each of them to take 1 000 steps back and forth in the hall. If you time them, they will get an idea of how long it takes to walk a kilometre.		
AREA		
Activity 18. SQUARE METRES	24	
Activity 19. LIVING METRES	24	
These two activities will help give students a feeling for the size of a square metre. If possible, measure off some parts of the room that are 2, 3, 4, etc. m^2. Have the students walk around these square metres and look at them to develop a feeling for the size of a square metre. This should help them to acquire the ability to estimate area in square metres.		
Activity 20. METRIC ROOM	25	
Use the newly acquired ability to estimate area in square metres by having students estimate the areas of the classroom floor and walls. After they have estimated these areas, they should measure them. Discuss with the students how the information about pattern repeating, width of the wallpaper, and height of the wall is used to determine how much wallpaper to buy.		Metre stick for each student.

MASS

Comment	Student Workbook Page	Materials Needed
Activity 21. FIND YOUR MASS This is a fun activity. Everyone will be surprised at how little they "weigh" in kilograms. You may want to place the scale in a corner of the room so that students can keep their metric mass a secret.	31	Metric bathroom scale.
Activity 22. KILOGRAMS Like some of the other Metric Activities, this one is designed to help the students get a feeling for the mass of a kilogram. The measurement unit for this activity is the kilogram. Students will lift some kilogram pieces to get an idea of their mass.	31	Several one-kilogram mass pieces.
Activity 23. WHAT'S ITS MASS? Again students are asked to guess, record their guess and then use the scales to find the mass. You may want to add several objects to the ones that are listed.	31	Kilogram scale. Apple. Brick. Box of rice.
Activity 24. GRAMS, GRAMS, GRAMS This activity gives students an opportunity to develop a feeling for the mass of a gram. Most students will find it difficult to differentiate between the mass of some of these pieces. Trying to guess the mass of a piece while blindfolded should, after several trials, improve the students' ability to distinguish the mass of a piece.	35	Set of mass pieces (1 g, 3 g, 5 g, and 20 g).

Comment	Student Workbook Page	Materials Needed
Activity 25. GUESS AND FIND THE MASS	36	
Now that students are beginning to feel comfortable with the concept of gram, have each student guess the mass of the light objects that have been placed on the table. DO NOT measure their masses--just GUESS! After they have guessed a mass, have each student measure the mass of each object they estimated and record the answer. It is excellent if students are within 25% of the correct measure.		Nickel. Sugar cube. Pencil eraser. Pencil. Sunglasses. Metric ruler.
Activity 26. WHAT WE EAT	39	
This is primarily a do-at-home activity. Ask students to examine various containers to find the mass of the contents. Soup, sugar, flour, rice, and other products have their metric masses printed on the label. You should point out that most labels give net weight, or the weight of the contents and not weight of the contents and the package. Also, manufacturers use the term weight, rather than mass, on labels. You may want to ask some students to bring in examples that they found. Empty some of the containers and have students find the mass of the contents. Do they get the same figure that is on the label?		
Activity 27. THINK MASS	39	
Here is a good opportunity for some class discussion. What jobs require people to find the mass of objects? What other measuring tasks are used in these jobs? Where will these students need to use the skills from this course?		

Comments	Student Workbook Page	Materials Needed
CAPACITY		
Activity 28. LOTS OF LITRES	41	
After the students fill their containers, have them lift them. How many kilograms are they holding? Guess and check! Do products that come in litre containers really hold a litre? Is the shape of the container deceiving so that some of the products look like they have more than some of the others? Measure and see.		Containers that hold a litre--one for each student, if possible. Products that come in litre containers. Rice, sand, sugar, water, etc. Litre measuring cup.
Activity 29. GUESS LITRES	41	
Students should be acquiring a feeling for a litre by now. See how well they can guess the capacity of each of these containers. Encourage students who were able to guess within 25% of the correct amount.		Paper or plastic coffee cup. Juice glass. Soft drink container. Casserole dish. Frying pan. Sauce pan. Litre measuring cup. Water or rice--enough to fill the largest of the above containers.
Activity 30. FILL THE BUCKET	41	
This is fun but it can be messy. If you think students will have difficulty seeing the water line after each litre is added, you may want to put a few drops of food coloring in the first couple of litres.		Large pail or bucket. Litre measuring cup. Waterproof marking crayon. Food coloring.

Comment	Student Workbook Page	Materials Needed
Activity 31. SPOONS Let the students examine the spoons. How can they tell the number of millilitres each spoon holds? When would they use the spoons? Discuss. How many different uses can they think of for millilitre spoons?	44	Set of measuring spoons in 1 ml, 2 ml 5 ml, and 15 ml sizes. Medicine prescription bottles. Funnels.
Activity 32. COFFEE BREAK Let the students make coffee. This is a good opportunity for them to use litres and millilitres.	45	Large coffee pot or percolator--should hold about 36 cups Coffee--120 millilitres. Cream or cream substitute. Coffee cups. Water--2 litres.
Activity 33. CAN CAN You can have the students begin this activity by guessing the size of each can. Some cans will have metric units printed on the label so you may want to check before class and remove or cover up any of these units. You also may want to cover up or remove any units that are given in the customary system (such as pounds, ounces, pints, quarts) so that students do not compare the metric units with the customary ones. If a typical serving is 200 ml, how many servings does each container hold? Students can weigh the cans to gain more practice in using grams and kilograms.	45	Variety of empty fruit and vegetable cans. Litre measuring cup.

Comment	Student Workbook Page	Materials Needed
Activity 34. LET'S EAT!	45	
This is a tasty activity. Make sure you bring enough food and any utensils that will be needed, such as forks, bowls, salad bowls, mixing spoons, and so forth. Wherever the recipe says, or shows, "Chop 40 ml carrots" it should be understood that the students are to measure out the 40 ml of carrots after they are chopped. This lesson gives students a chance to use millilitres, litres, and grams. None of the recipes require cooking.		Measuring and cooking utensils as indicated in the recipes. Enough of each of the food items in the four recipes to serve your class.
TEMPERATURE		
Activity 35. READING DEGREES	54	
Set the demonstration thermometer at a certain setting and ask the students the temperature indicated. Repeat this with different temperatures as often as it takes for the students to feel comfortable reading the thermometer. Explain the significance of 0°C, 37°C, 100°C. Make sure you use some below-zero temperatures.		Celsius demonstration thermometer.
Whether something is hot or cold depends on the circumstances. 2°C would be a cold morning but it would be too warm for the freezer compartment of a refrigerator. 40°C would be a very hot summer day, but it would be too cold to cook something in the oven. Establish your frame of reference before you decide whether a temperature is hot or cold. What are good temperatures for cooking? . . . for going to the beach? . . . for freezing ice cream? . . . or having a snowball fight?		

Comment	Student Workbook Page	Materials Needed
Activity 36. TAKING TEMPERATURES	54	
Have several thermometers that can be dipped in the containers. Attempt to have the containers at different temperatures. Use insulated containers, if possible, to help maintain the temperature. Fill one container with ice and some water; another with boiling water (you could use a coffee pot to boil water); and so forth. For all except the very hot have the students first feel the water with their fingers and guess the temperature, then have them take the temperature. Ask them to read the temperature from the thermometer and then write the temperature.		4 or 5 Celsius thermometers. 5 or 6 containers of water at various temperatures. Electric coffee pot. Ice cubes.
Activity 37. AROUND AND ABOUT	55	
As the students move around the room, have them try to feel if the temperature has gone up or down. Ask them to guess the temperature in each of the places around the room. Is it warmer near the ceiling? Is it warmer or cooler near the windows? Do they think their answers would be the same during another season of the year?		Several Celsius thermometers.
Activity 38. IN AND OUT	55	
Again, have the students try to guess the temperature of each of the places outside. Is it really cooler in the shade? What difference does it make if they are near the building? If it is a sunny day they can check the temperature in a closed car.		Several Celsius thermometers.

Comment	Student Workbook Page	Materials Needed
Activity 39. FEVER	55	
Either make or obtain a demonstration Celsius clinical thermometer. Follow the design of the clinical thermometers you will be using in Activity 40. Take time to show how to read degrees in tenths then give the students as many experiences in reading and writing degrees as are needed to develop mastery.		Demonstration Celsius clinical thermometer.
Activity 40. BODY TEMP	55	
This will take some time. A clinical thermometer can be difficult to read. Make sure you use the alcohol to sterilize the thermometers after each use. After each student has taken his or her own temperature, ask the student to write it down. Then ask the student to tell you the temperature. Does the written answer agree with the oral answer, and do both answers agree with the thermometer?		Several Celsius clinical thermometers one for each student, if possible. Bottle of rubbing alcohol. Cotton balls.

RESOURCES AND MATERIALS

1. Make-a-Metre Packs: A roll of metre strips of heavy paper in variety of colors. Roll is $3.50 for 100 strips. Pads of decimetre strips and centimetre strips which may be cut apart and pasted or stapled to make a calibrated metre stick. Pads are approximately 70¢ and contain enough for 30 students.

   Available: Metric Supply International
   1906 Main Street
   Cedar Falls, IA 50613

   Improvised Material: Light weight cardboard or nonwoven fabric such as pellon cut into metre size strips. Draw in decimetre divisions with ballpoint pen.

2. Butterick Publishing Wall Chart: "Figure It In Metrics" an excellent chart for developing an understanding of metric clothing sizes. Cost for wall chart measuring 85 x 55 cm and showing 12 figure types is approximately $2.00.

   Available: Butterick Publishing Co.
   P. O. Box 1945
   Altoona, PA 16603

3. Balance Scale: Gram size available in a range of prices. Least costly is Ohaus, Model 1200 School Balance Scale. Cost approximately $17.50.

   Available: Ohaus Scale Corp.
   29 Hanover Road
   Florham Park, NJ 07932

   Improvised Material: A kitchen scale may be recalibrated to measure metrically. An improvised balance scale can be constructed as follows--

   Materials--a metre stick (thin wood), fish line or strong string, small plastic containers like butter containers, and large paper clip.

   Holes can be made in the metre stick with a drill or small screwdriver. The holes at end should be near the bottom. Use large paper clips, which are bent open, to provide hooks from which plastic containers may be hung. A loop of string in the center may be used to suspend the balance scale. Bring scale into balance by adding clay or plastic to the containers.

   To make weights, a square sugar cube is 1 gram, a rectangular one is 5 grams. Use clay balls or water to "make" weights needed.

4. Celsius Demonstration Thermometer: Can be purchased for approximately $6.75 from Ohaus (Ohaus Part No. 80570) or Dick Blick (Catalog No. 88283).

Available: Ohaus Scale Corp.
29 Hanover Road
Florham Park, NJ 07932

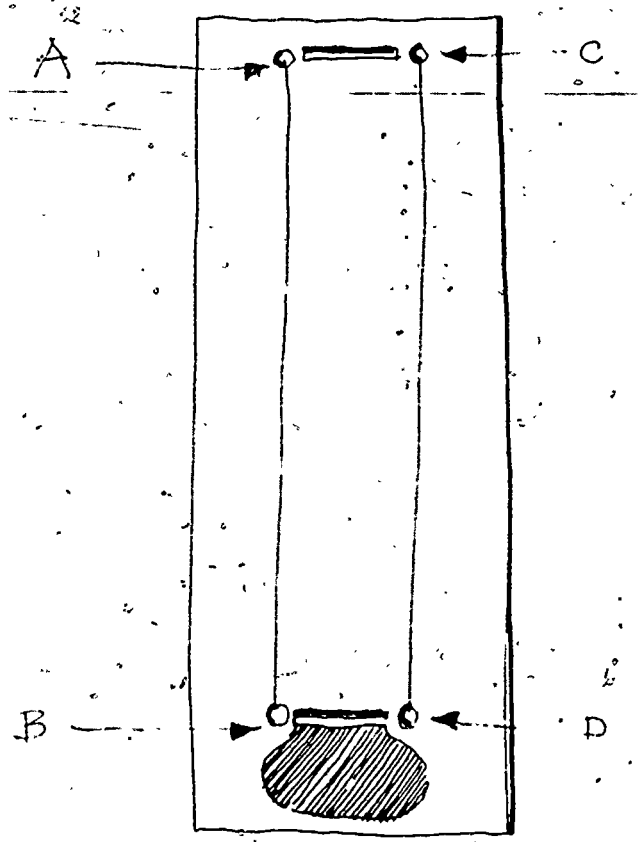
Dick Blick
Box 1267
Galesburg, IL 61401

Improvised Material: An improvised Celsius demonstration thermometer can be constructed as follows:

Materials--one sheet of white poster board 75 cm x 100 cm, a piece of red ribbon and a piece of white ribbon each measuring 2 cm x 95 cm, glue, black felt tip marker, red felt tip marker, knife or razor blade, metre stick, pencil.

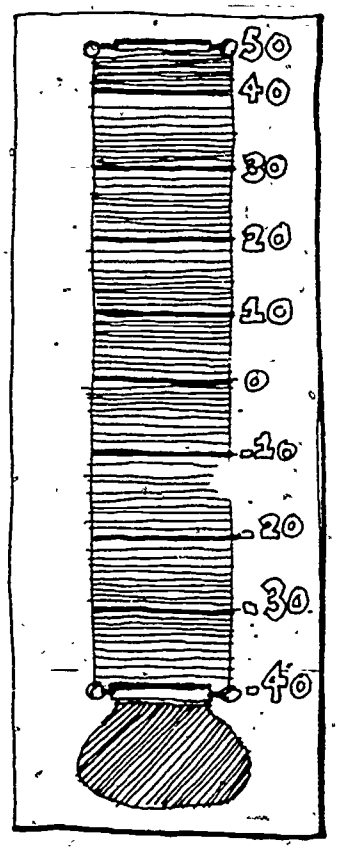
Cut the sheet of poster board in half so that each half measures about 37.5 cm x 100 cm. About 5 cm from the middle of the top of the board cut a slot about 2.5 cm x 0.2 cm. Cut another slot this same size about 5 cm from the middle of the bottom. Your board should now look something like the Drawing 1 here.

With the red felt tip marker draw and color in a circle below the bottom slot. With a pencil lightly mark point A about 1 cm to the left of the top slot, Point B 1 cm to the left of the bottom slot, point C 1 cm to the right of the top slot, and point D 1 cm to the right of the bottom slot. Draw a line from A to B and a line from C to D (see Drawing 1).



Drawing 1

Using your metre stick, mark each of these two lines off in centimetres. Connect the marks that are opposite each other. Your poster board should now look like Drawing 2. Label the bottom mark -40. Count up 10 marks and label this mark -30. Continue counting 10 marks and labeling: -20, -10, 0, 10, 20, 30, 40, and 50. Glue one end of the red ribbon to one end of the white ribbon. You now have one ribbon--red on one end and white on the other. After the glue has dried, insert the ribbon into one of the slots, pull one end of the ribbon through and insert the end into the other slot. Join and glue the two ends of the ribbon. Hold the poster board upright and arrange the ribbon so that the red part of the ribbon comes through the bottom slot. You now have a demonstration Celsius thermometer. By sliding the ribbon up and down you can get different temperature settings.



Drawing 2.

5. Clinical Celsius Demonstration Thermometer: This is an improvised thermometer. The materials and the directions will be the same as for the Celsius Demonstration Thermometer as described in the previous part, #4. If you made that thermometer, then use the other half of the poster board for this thermometer. If not, then you will need a piece of poster board 37.5 cm x 100 cm. Cut the slots 10 cm from the top and bottom instead of the 5 cm that was used in #4. The bottom reading on the thermometer should be 34. Count up ten spaces and label this line 35. Keep counting ten lines and labeling 36, 37, 38, 39, 40, 41, and 42. Insert the ribbon and use, as in the other demonstration. Remember, however, that on this thermometer each mark indicates 0.1°C (one-tenth of a degree Celsius).

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202 Extension Building
The University of Texas at Austin
Austin, Texas 78712

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U. S. Government Printing Office,
Washington, D.C. 20402
SD Catalog No. C13.10:330/3

Meiring, Steven P. LET'S MEASURE METRIC. A Teacher's Introduction to Metric Measurement. Ohio Department of Education, Columbus, Ohio. 1975, 80 p.

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Division of Educational Redesign and Renewal
Room 1004, 65 South Front Street
Columbus, Ohio 43215

De Simone, Daniel V. A METRIC AMERICA: A DECISION WHOSE TIME HAS COME. National Bureau of Standards, Washington, D.C. 1971, 170 p. $2.50 SD Catalog No. C13.10:345 Series: NBS Special Publication 345

Order from: Superintendent of Documents
U. S. Government Printing Office
Washington, D.C. 20402

Also from: ERIC/ED 055 884

LEVEL II

METRIC EDITORIAL GUIDE. SECOND EDITION. American National Metric Council, Washington, D.C. July 1975, 13 p. $1.50

Order From: American National Metric Council
1625 Massachusetts Avenue, N.W.
Washington, D.C. 20036

METRIC EDUCATION: AN ANNOTATED BIBLIOGRAPHY FOR VOCATIONAL, TECHNICAL AND ADULT EDUCATION. The Center for Vocational Education, The Ohio State University, 1960 Kenny Road, Columbus, Ohio 43210. December, 1974, 210p., $10.00

Order from: Product Utilization
The Center for Vocational Education
1960 Kenny Road
Columbus, Ohio 43210

Also from: ERIC/ED 115 953

Cooper, Gloria S.; Magisos, Joel H.; and others. METRIC EDUCATION. A POSITION PAPER FOR VOCATIONAL, TECHNICAL AND ADULT EDUCATION. The Center for Vocational Education, The Ohio State University, Columbus, Ohio. 1975, 46 p. $3.00

Order from: Product Utilization
The Center for Vocational Education
1960 Kenny Road
Columbus, Ohio 43210

Also from: ERIC/ED 112 064

SOME REFERENCES ON METRIC INFORMATION. U. S. Department of Commerce, National Bureau of Standards, Washington, D.C. Special Publication 389, December 1973, 8 p. CODEN: XNBSAV Library of Congress Catalog Card Number: 73-600344. 25 cents

Order from: Superintendent of Documents,
U. S. Government Printing Office,
Washington, D.C. 20402
SD Catalog No. C13.10:389
Stock No.: 0303-01219

Also from: ERIC/ED 090 025

USE OF STUDENT TEST BOOKLETS

The STUDENT TEST BOOKLETS can be used to evaluate how well your students are able to meet the objectives for these materials. The tests in this INSTRUCTOR'S GUIDE can be used as masters for duplicating additional copies.

There are two forms of the test. Form 1 can be used to evaluate a student's progress. Students who do not get at least 20 of the 25 questions correct may benefit from repeating parts of the LEVEL II materials. After a student has restudied the materials, Form 2 of the test can be used. Answers and a list of materials needed for each form are given on the page immediately following each form.

Form 1

STUDENT TEST BOOKLET

for

METRICS FOR GOOD MEASURE

LEVEL II

Directions

This test has 25 questions. Read each question carefully. There are three kinds of questions on this test.

One type of question is a multiple-choice question. Read each of the possible answers below the question. Pick the number of the answer you think is best. Write the number of this answer in the blank in the question.

Example:

0. There are (3) metres in one kilometre.

(1) 10
(2) 100
(3) 1 000
(4) 10 000

There are 1 000 metres in one kilometre. The correct answer is number (3). So, the number (3) is written in the blank.

A second type of question asks you to fill in the blank. You are to put what you think is the correct answer in the blank.

The third type of question also asks you to fill in the blank. But, before you fill in the blank you have to measure an object that is on the resource table. Each object on the resource table has been given a letter. Make sure you measure the correct object. If you do not see it someone else may be measuring it. Please wait until they are through; then measure the object and write your answer in the blank.

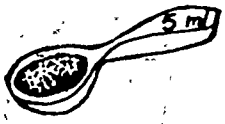
1. A millimetre is about the size of _____.

   (1) the thickness of a paper clip wire.
   (2) the top of a card table.
   (3) a bathroom scale.
   (4) the length of your little finger.

2. A box has a mass of 57 kilograms. Using metric symbols, this can also be written as 57 _____.

3. Measure the length of the resource table. It is _____ metres long.

4. How much salt is in this spoon? _____.

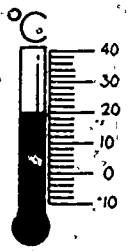


5. A measure that is the same as 43 litres is _____.

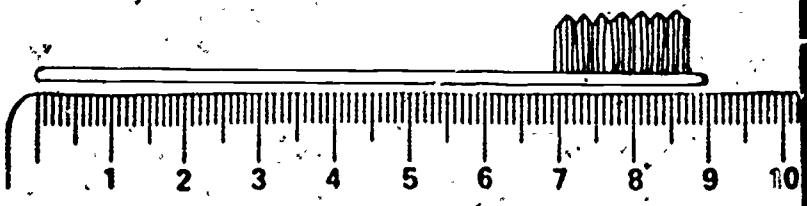
   (1) 0.043 ml
   (2) 4 300 ml
   (3) 43 000 ml
   (4) 0.43 ml

6. The distance between New York City and Boston is about 369 kilometres. If you write this using the symbol for kilometres you would write 369 _____.

7. The temperature shown on this thermometer is _____.



8. This toothbrush is _____ cm long.

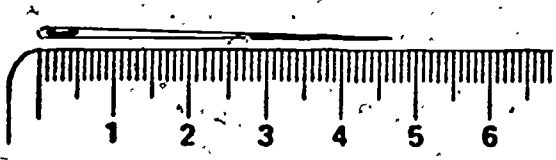


9. On the resource table is block D. ESTIMATE its mass in kilograms. _____ kg.

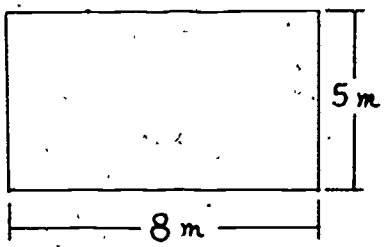
10. On the resource table is a red cardboard square, B. ESTIMATE the length of one side of this square in centimetres. _____ cm

11. If you use the symbol for millilitres, 28 millilitres can be written as 28 _____.

12. This needle is _____ mm long.



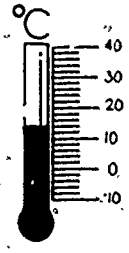
13. The area of this rectangle is _____ m^2



14. On the resource table is a ball, K. Its mass is _____.

15. If you use metric symbols, 47 millimetres can also be written as 47 _____.

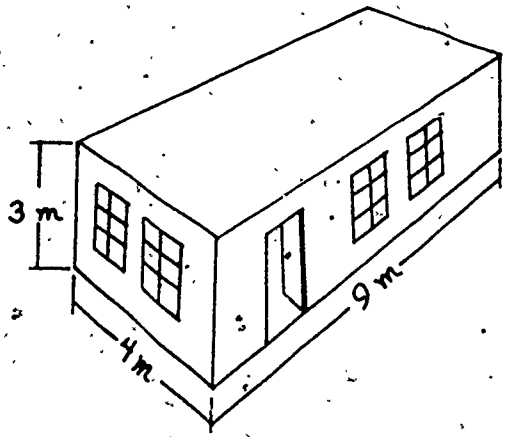
16. The temperature shown on this thermometer is _____ °C.



17. Using metric symbols, 273 square metres can also be written as 273 _____.

18. On the resource table is a can, G. Measure its capacity. It is _____ millilitres.

19. The area of the floor of the house in this picture is _____.

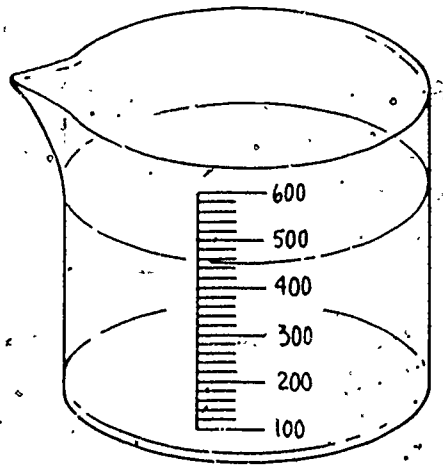


20. A measure that is the same as 934 kilograms is _____.

(1) 0.934 g
(2) 934 000 g
(3) 9.34 g
(4) 93 400 g

21. On the resource table is a can, C. ESTIMATE how many litres can C will hold. _____

22. How much water is in this cup?
_____ ml



23. A square metre is about the size of _____.

(1) a card table top.
(2) your thumbnail.
(3) the floor of the classroom.
(4) a 25¢ coin (quarter).

24. A metre is about _____.

(1) the distance you can walk in 12 minutes
(2) the width of a brick.
(3) the height of the ceiling of this room.
(4) the height of a doorknob from the floor.

25. Measure the temperature of the liquid in can N. It is _____.

MATERIALS NEEDED

Exercise number	Letter designation	Description
9	D	Block of wood--37 mm x 86 mm x 475 mm
10	B	Large red cardboard square 23 cm on each side
14	K	Solid rubber ball--something like a "Super Ball"
18	G	Large empty frozen orange juice can
21	C	Small empty coffee can
25	N	Any size can, e.g. a soup can (this is used only for holding water)

ANSWERS

1. (1)
2. kg
3. Answer depends on length of table used
4. 5 ml
5. (3)
6. km
7. 20°C
8. 9
9. Answer depends on density of block used--allow 25% error in estimates
10. 23--accept answers from 18 cm to 28 cm
11. ml
12. 47
13. 40
14. Answer depends on mass of ball used
15. mm
16. 14
17. m^2
18. Answer depends on size of can used
19. 38 m^2
20. (2)
21. Answer depends on size of can used--allow 25% error in estimates
22. 450
23. (1)
24. (4)
25. Answer depends on temperature of water used

Form 2

STUDENT TEST BOOKLET

for

METRICS FOR GOOD MEASURE

LEVEL II

Directions

This test has 25 questions. Read each question carefully. There are three kinds of questions on this test.

One type of question is a multiple-choice question. Read each of the possible answers below the question. Pick the number of the answer you think is best. Write the number of this answer in the blank in the question.

Example:

0. There are (3) metres in one kilometre.

(1) 10
(2) 100
(3) 1 000
(4) 10 000

There are 1 000 metres in one kilometre. The correct answer is number (3). So, the number (3) is written in the blank.

A second type of question asks you to fill in the blank. You are to put what you think is the correct answer in the blank.

The third type of question also asks you to fill in the blank. But, before you fill in the blank you have to measure an object that is on the resource table. Each object on the resource table has been given a letter. Make sure you measure the correct object. If you do not see it someone else may be measuring it. Please wait until they are through; then measure the object and write your answer in the blank.

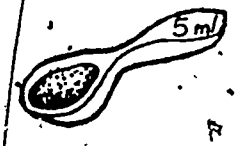
1. A centimetre is about _____.

   (1) the width of a fingernail.
   (2) the thickness of a dime.
   (3) the capacity of a spoon.
   (4) the length of this room.

2. A rock has a mass of 128 grams. Using metric symbols, this can also be written as 128_____.

3. On the resource table is a block A. Measure the length of this block. It is _____ millimetres long.

4. How much salt is in this spoon?

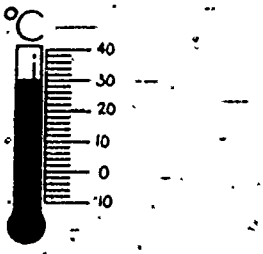


5. A measure that is the same as 52 ml is _____.

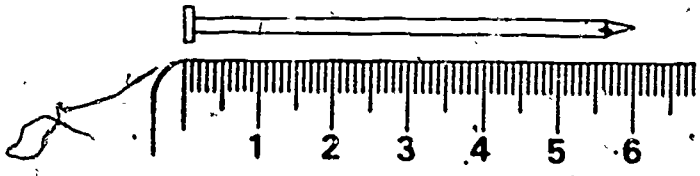
   (1) 52 000 litres
   (2) 5 200 litres
   (3) 0.052 litre
   (4) 0.52 litre

6. The distance between New York City and Boston is about 369 kilometres. If you write this using the symbol for kilometres you would write 369 _____.

7. The temperature shown on this thermometer is _____.



8. This nail is _____cm long.

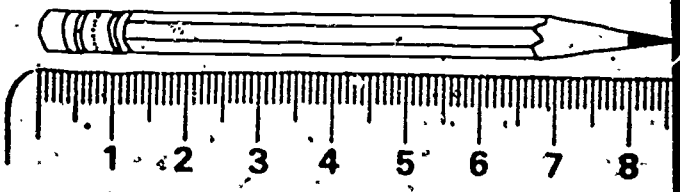


9. On the resource table is a box, H. ESTIMATE its mass in grams. _____g.

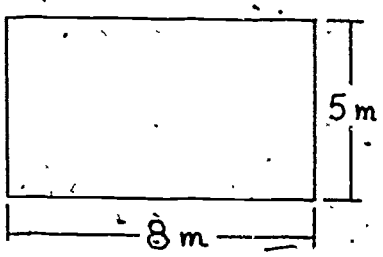
10. On the resource table is a yellow cardboard square, M. ESTIMATE the length of one side of this square in millimetres. _____mm

11. If you use the symbol for millilitres, 28 millilitres can be written as 28_____.

12. This pencil is _____mm long.



13. The area of this rectangle is _____m².



14. On the resource table is a brick, J. Its mass is _____.

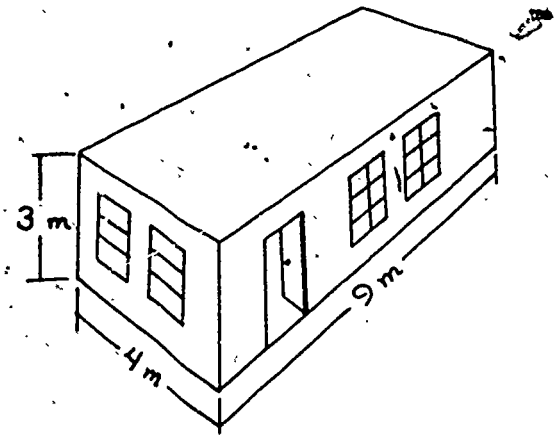
15. If you use metric symbols, 47 millimetres can also be written as 47_____.

16. The temperature shown on this thermometer is _____ °C.

17. Using metric symbols, 48 square metres can also be written as 48_____.

18. On the resource table is a can, F. Measure its capacity. It is _____ litres.

19. The area of the floor of the house in this picture is _____.

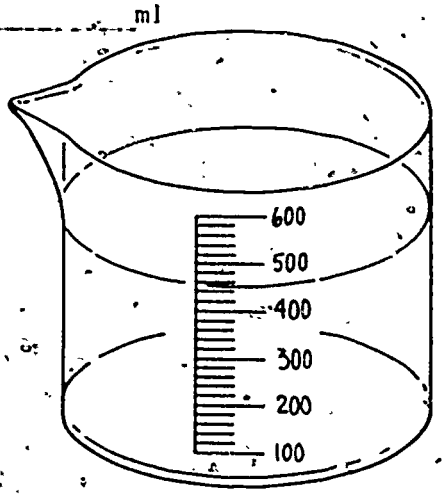


20. A measure that is the same as 187 grams is _____.

(1) 187 000 kg
(2) 0.187 kg
(3) 1.87 kg
(4) 18 700 kg

21. On the resource table is a can, P. ESTIMATE how many litres it holds. _____

22. How much water is in this cup? _____ ml



23. A square metre is about the size of _____.

(1) a card table top.
(2) your thumbnail.
(3) the floor of the classroom.
(4) a 25c coin (quarter).

24. A metre is about _____.

(1) the distance you can walk in 12 minutes.
(2) the width of a brick.
(3) the height of the ceiling of this room.
(4) the height of a doorknob from the floor.

25. Measure the temperature of this room. It is _____.

MATERIALS NEEDED

Form 2

Exercise number	Letter designation	Description
3	A	Block of wood--37 mm x 86 mm x 475 mm
9	H	Small box that is not empty
10	M	Yellow cardboard square 134 mm on each side
14	J	Brick
18	F	Large empty coffee can
21	P	Can--different size from F (should also be different size from C, G, and N used in Form 1)

ANSWERS

1. (1)
2. g
3. 475 mm--or whatever length of block used
4. 5 ml
5. (3)
6. km
7. 30°C
8. 6
9. Answer depends on mass of box used--allow 25% error in estimates
10. 134--accept answers from 100 mm to 168 mm.
11. ml
12. 86
13. 40
14. Answer depends on mass of brick used
15. mm
16. 6
17. m^2
18. Answer depends on size of can used
19. 36 m^2
20. (2)
21. Answer depends on size of can used--allow 25% error in estimates
22. 450
23. (1)
24. (4)
25. Answer depends on temperature of room