

Adult Basic Education

Mathematics

Mathematics 3107A

Measurement Technology Design and Measurement

Curriculum Guide

Prerequisites: Mathematics 2105A, 2105B and 2105C

Credit Value: 1

Mathematics Courses [General College Profile]

Mathematics 2105A
Mathematics 2105B
Mathematics 2105C
Mathematics 3107A
Mathematics 3107B
Mathematics 3107C
Mathematics 3109A
Mathematics 3109B
Mathematics 3109C

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To the Instructor

I. Introduction to Mathematics 3107A

The intent of the first unit is to give students experience in determining measurements in metric (SI) and Imperial systems using different measuring devices. The instructor should provide a variety of measuring instruments (e.g. metre sticks, yard sticks, measuring tapes, calipers, micrometers). Students will also perform basic conversions within and between the Imperial and SI systems, using technology or conversion tables where appropriate.

In the second unit, students will explore components of design and measurement to create views of simple objects from several perspectives. Students will also solve problems involving estimation and costing for objects when a design is given.

II. Prerequisites

Students should be familiar with the metric system and be able to make conversions using a unit ratio. Students should be able to draw an object to scale and, given a scaled diagram, determine the actual measurements of the object.

III. Textbook

Essentials of Mathematics is designed to emphasize the skills needed in adult life as well as in the workplace. Students should appreciate that mathematics is practical and useful for accomplishing real-world activities. With this in mind, this resource has been developed with contents that are real and relevant to the lives of students.

Each chapter begins with an introduction which presents the key mathematical ideas that will be encountered. The following categories are in each chapter:

Chapter Goals: Located on the bottom of each introductory page, this section lists the major concepts to be learned.

Chapter Project and Project Activity: Each chapter contains a guided project. This type of group work is not well suited for the Adult Basic Education environment. Therefore, **these sections have been omitted from the course**. However, if there are several students working on the same chapter, instructors may use their discretion in assigning the **Chapter Project**, or some modification of it, for an assessment.

Exploration: Most of the concepts are introduced, developed and explained in these lessons. In this section, **Examples** and **Solutions** for typical problems are provided. The instructor should ensure that students carefully study and understand each **Example** before proceeding.

To the Instructor

Class Discussion, Small Group Discussion and Pairs Activities: As the titles imply, these activities are provided to give students an opportunity to work collaboratively. Some of these sections have been assigned in the Study Guide, especially if they can be completed by a student working alone.

Mental Math: The questions contained in these sections are often calculations that are similar to those required in the **Solutions** to the **Examples**. Although called **Mental Math**, students should not be required to complete these activities without pencil and paper. If students have difficulty with these problems, the instructor should provide practice worksheets. The solutions to **Mental Math** are found in the *Teacher Resource Book*.

Notebook Assignment: This section provides a series of problems similar to those in the **Exploration**. Students should attempt these problems only after the **Exploration** problems have been understood and all assigned **Mental Math** and practice worksheets have been completed. The textbook contains only answers to **Notebook Assignment**, but the *Teacher Resource Book* has solutions with workings and some explanations.

Chapter Review: This section contains a series of questions that review the chapter outcomes. Answers are in the textbook as well as the *Teacher Resource Book*.

Case Study: This part requires students to express their understanding of the skills they have learned. Answers are in the textbook as well as the *Teacher Resource Book*.

IV. Technology

The use of technology in our society is increasing and technological skills are becoming mandatory in the workplace. It is assumed that all students have a scientific calculator and its manual for their individual use. Ensure that the calculator used has “scientific” on it as there are calculators designed for business and statistics which would not have the functions needed for this course. Although students will sometimes use a calculator, they should first complete most problems using pencil and paper.

To the Instructor

V. Curriculum Guides

Each new ABE Mathematics course has a Curriculum Guide for the instructor and a Study Guide for the student. The Curriculum Guide includes the specific curriculum outcomes for the course. Suggestions for teaching, learning, and assessment are provided to support student achievement of the outcomes. Each course is divided into units. Each unit comprises a **two-page layout of four columns** as illustrated in the figure below. In some cases the four-column spread continues to the next two-page layout.

**Curriculum Guide Organization:
The Two-Page, Four-Column Spread**

Unit Number - Unit Title		Unit Number - Unit Title	
Outcomes Specific curriculum outcomes for the unit.	Notes for Teaching and Learning Suggested activities, elaboration of outcomes, and background information.	Suggestions for Assessment Suggestions for assessing students' achievement of outcomes.	Resources Authorized and recommended resources that address outcomes.

VI. Study Guides

The Study Guide provides the student with the name of the text(s) required for the course and specifies the sections and pages that the student will need to refer to in order to complete the required work for the course. It guides the student through the course by assigning relevant reading and providing questions and/or assigning questions from the text or some other resource. Sometimes it also provides important points for students to note. (See the *To the Student* section of the Study Guide for a more detailed explanation of the use of the Study Guides.) The Study Guides are designed to give students some degree of independence in their work. Instructors should note, however, that there is much material in the Curriculum Guides in the *Notes for Teaching and Learning* and *Suggestions for Assessment* columns that is not included in the Study Guide and instructors will need to review this information and decide how to include it.

To the Instructor

VII. Resources

Essential Resources

Essentials of Mathematics 11, ISBN: 0-7726-4823-9

Essentials of Mathematics 12, ISBN: 0-7726-4997-9

Essentials of Mathematics 11, Teacher Resource Book 11, ISBN: 0-7726-4878-6

Essentials of Mathematics 12, Teacher Resource Book 12, ISBN: 0-7726-5049-7

Mathematics 3107A Study Guide

Resources

Math Link: <http://mathforum.org>
<http://edHelper.com>
<http://www.purplemath.com/index.htm>
<http://www.educationindex.com/math/>
<http://www.learner.org/exhibits/dailymath/resources.html>

VIII. Recommended Evaluation

Written Notes	10%
Assignments	10%
Test(s)	30%
Final Exam (<i>entire course</i>)	<u>50%</u>
	100%

Measurement Technology

Design and Measurement

Unit 1 - Measurement Technology

Outcomes

1.1 Explore the history of measurement systems.

1.1.1 Identify the most suitable units in both metric and imperial systems for measuring different items.

Notes for Teaching and Learning

The instructor should take time to discuss the development of measurement systems. Students should realize that there are more systems than the SI (metric) and imperial systems. This unit, however, will focus on these two. The imperial system may be new to students.

If possible, students should work in pairs or small groups for much of this chapter.

Unit 1 - Measurement Technology

Suggestions for Assessment

Study Guide questions 1.1 and 1.2 will meet the objectives of Outcome 1.1.

In the Study Guide, students have been assigned Practice Exercise 1, *Suitable Units of Linear Measure*. Copies of all worksheets are found in the Appendix contained in this Curriculum Guide.

Resources

Essentials of Mathematics 11,
The History of Measurement,
pages 193, 195 - 200

Teacher Resource Book 11,
pages 118 and 119

Blackline Master 13, Ruler

Appendix, Practice Exercise
1, *Suitable Units of Linear
Measure*

Unit 1 - Measurement Technology

Outcomes

1.2 Use appropriate metric and imperial rulers and tape measures to measure dimensions of given objects to solve problems.

1.2.1 Add, subtract and multiply fractions.

1.2.2 Use the [$A \frac{b}{c}$] key on a scientific calculator.

1.2.3 Given a figure, find its perimeter and area.

Notes for Teaching and Learning

Students may need some review of the basic units of measurement in both the SI and imperial systems. (The chart on page 209 of *Essentials of Mathematics 11* could be used as a guide.)

The instructor should provide a review worksheet, if necessary, on adding, subtracting, multiplying and dividing fractions. Although the text uses the [$A \frac{b}{c}$] key on a scientific calculator, students must develop the skills necessary to do these calculations with pencil and paper.

The opportunity is here for the instructor to review or introduce perimeter, area and volume of geometric shapes.

Unit 1 - Measurement Technology

Suggestions for Assessment

Study Guide questions 1.3 to 1.5 will meet the objectives of Outcome 1.2.

In the Study Guide, students have been assigned Practice Exercise 2, *Imperial and SI Measure* and Practice Exercise 3, *Word Problems*. The instructor may choose to use these worksheets as a homework assignment.

Resources

Essentials of Mathematics 11,
Measurement in the Metric
and Imperial Systems, pages
201 - 208

Teacher Resource Book 11,
pages 120 - 123

Appendix, Practice Exercise
2, *Imperial and SI Measure*
Practice Exercise 3, *Word
Problems*

Unit 1 - Measurement Technology

Outcomes

1.3 Make basic conversions within the imperial and metric systems.

1.3.1 Identify the unit conversion ratio required to solve a problem.

Notes for Teaching and Learning

The instructor should ensure that students know how to convert from one unit to another by using a unit conversion ratio. Students will need extra guidance in this area.

The instructor should advise students to check the website www.onlineconversion.com/.

Unit 1 - Measurement Technology

Suggestions for Assessment

Study Guide questions 1.6 and 1.7 will meet the objectives of Outcome 1.3.

In the Study Guide, students have been assigned Practice Exercise 4, *Metric Prefixes*.

The instructor could assign the problems below for extra practice.

1. Convert each of the following units of linear measure as indicated.

- a) 3 m = _____ cm b) 53 cm = _____ mm
c) 25 mm = _____ cm d) 450 cm = _____ m
e) 0.65 m = _____ mm f) 7.4 mm = _____ cm
g) 3.5 km = _____ m h) 560 m = _____ km

Solutions

- a) 300 cm b) 530 mm c) 2.5 cm d) 4.50 m
e) 650 mm f) 0.74 cm g) 3500 m h) 0.560 km

2. Convert each of the following units of linear measure as indicated.

- a) 5 ft. = _____ in. b) 3 yd. = _____ ft.
c) $2\frac{1}{2}$ ft. = _____ in. d) 36 in. = _____ ft.
e) 18 in. = _____ ft. f) 27 in. = ___ ft. + ___ in.
g) 4 ft. 4 in. = _____ in. h) 2 yd. 8 in = _____ in.

Solutions

- a) 60 in. b) 9 ft. c) 30 in. d) 3 ft.
e) 1.5 ft. f) 2 ft. + 3 in. g) 52 in. h) 80 in.

Resources

Essentials of Mathematics 11,
Conversions Within Systems,
pages 209 - 214

Teacher Resource Book 11,
pages 124 and 125

www.onlineconversion.com

www.think-metric.com

Appendix, Practice
Exercise 4, *Metric Prefixes*

Unit 1 - Measurement Technology

Outcomes

1.4 Make basic conversions between the imperial and SI (metric) systems.

Notes for Teaching and Learning

Conversion between the SI and imperial systems are extremely important for students interested in a trades career.

Use of the conversion table on page 216 is a must. The instructor should provide students with the conversion table in Blackline Master 14.

Students do not have to memorize the conversions, but, given a chart of conversions, they should know how to use it.

For introducing the need in Trades careers to understand conversion between the systems, the instructor should provide the sheet, *Changing Units Between the Metric and Customary Systems*. The instructor should spend some time discussing this chart and giving help in conversions.

Unit 1 - Measurement Technology

Suggestions for Assessment

Study Guide question 1.8 will meet the objectives of Outcome 1.4.

Resources

Essentials of Mathematics 11,
Conversions Between
Systems, pages 215 - 219

Teacher Resource Book 11,
pages 126 and 127

Blackline Master 14,
Conversion Table

Appendix, *Changing Units
Between the Metric and
Customary Systems*

Unit 1 - Measurement Technology

Outcomes

1.5 Use Vernier calipers to find inside and outside measurements of given objects.

Notes for Teaching and Learning

It takes practice to become efficient in using Vernier calipers.

The instructor should ensure that students have Vernier calipers for this entire **Exploration**.

The Vernier caliper applet (see Resources column) is an excellent resource for learning how to read the various scales on the caliper.

Although the **Class Activity**, page 225, is best suited for working in pairs, students can complete it individually. The instructor should provide students with a list which suggests objects that could be measured.

Unit 1 - Measurement Technology

Suggestions for Assessment

Study Guide questions 1.9 and 1.10 will meet the objectives of Outcome 1.5.

Resources

Essentials of Mathematics 11,
Measuring with Vernier
Calipers, pages 222 - 229

Teacher Resource Book 11,
pages 131 and 132

Blackline Master 17, Vernier
caliper

[www.ronblond.com/M10/
Vern.APPLET/index.html](http://www.ronblond.com/M10/Vern.APPLET/index.html)

Unit 1 - Measurement Technology

Outcomes

1.6 Use a micrometer to find the outside measurements of given objects.

Notes for Teaching and Learning

Micrometers are more precise than Vernier calipers because they measure to a smaller unit (one hundredth of a mm). The instructor should ensure that students have access to a micrometer for this entire **Exploration**.

The instructor should have students use the suggested website which shows an applet of the measurement scale of a micrometer.(See Resources column.)

Unit 1 - Measurement Technology

Suggestions for Assessment

Study Guide question 1.11 will meet the objectives of Outcome 1.6.

In the Study Guide, students have been assigned **Chapter Review**, questions 1 - 10. The instructor may choose to use these questions as an assessment.

Resources

Essentials of Mathematics 11,
Measuring with Micrometers,
pages 230 - 237

Teacher Resource Book 11,
pages 133 - 136

Blackline Master 18,
Micrometer

www.ronblond.com/M10/Micrometer.APPLET/index.html

Unit 2 - Design and Measurement

Outcomes

2.1 Draw simple objects using a one-point and two-point perspective.

Notes for Teaching and Learning

The instructor should ensure that students have grid paper during this entire unit.

Students should be advised to make accurate drawings and to label vertices.

The solutions to **Notebook Assignment**, page 77, are given in detail in the *Teacher Resource Book*. The textbook solutions give the drawings, but do not indicate the order in which lines should be drawn.

Unit 2 - Design and Measurement

Suggestions for Assessment

Study Guide question 2.1 will meet the objectives of Outcome 2.1.

Resources

Essential of Mathematics 12,
One-point and Two-point
Perspectives, pages 71 and
73 - 77

Teacher Resource Book 12,
pages 53 - 58

Unit 2 - Design and Measurement

Outcomes

2.2 Draw simple objects from:

- a) eye-level perspective
- b) a perspective where the horizon is above the object
- c) a perspective where the horizon is below the object.

Notes for Teaching and Learning

The instructor should point out some simple objects in the classroom students could draw from three perspectives; eye level, horizon above the object and horizon below the object.

This is the first time most students have seen and drawn objects in perspective. Students may need extra guidance on the three possibilities for perspective drawings.

- a) eye-level horizon as shown in Figure A

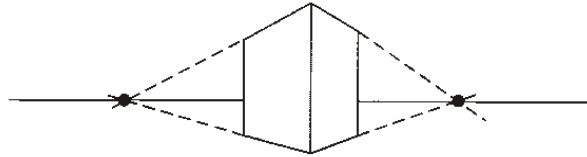


Figure A: Eye-Level

- b) horizon above the object as shown in Figure B

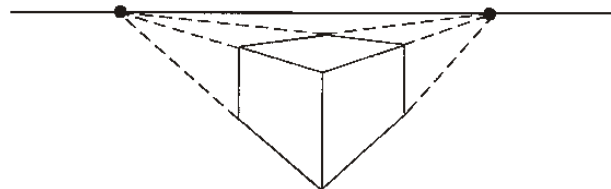


Figure B: Upper Horizon

- c) Horizon below the object as shown in Figure C

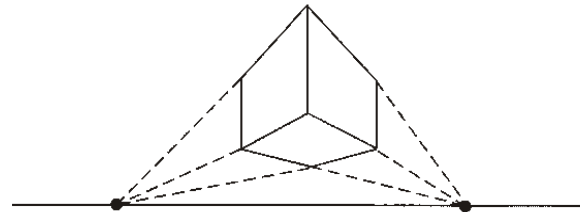


Figure C: Lower Horizon

Unit 2 - Design and Measurement

Suggestions for Assessment

Study Guide questions 2.2 and 2.3 will meet the objectives of Outcome 2.2.

Resources

Essential of Mathematics 12,
Drawing a Box, pages 78 - 81

Teacher Resource Book 12,
pages 59 - 61

Unit 2 - Design and Measurement

Outcomes

2.3 Draw exploded diagrams and constituent parts diagram for objects.

Notes for Teaching and Learning

When creating an oblique drawing, students should be reminded that the face of the object is directly in front and is drawn to scale. The oblique, or slanted lines are drawn at half scale or another suitable scale. Oblique lines are best drawn using grid paper, and moving diagonally from one corner to the opposite corner on a 45° angle. Students should place the actual measurements along the side, indicating exactly how long each measurement will be in the actual object.

Students should draw many examples of oblique views to ensure mastery of this concept before moving further into this unit.

The instructor should point out that oblique lines are always drawn at a 45° angle; whereas lines from a 1 or 2 point perspective could be at any angle.

The exploded view of an object is used to show how the constituent parts connect.

The instructor should point out to students that constituent parts should be drawn to scale and that each part needs to be drawn only once with the required number of that part included in the diagram.

Unit 2 - Design and Measurement

Suggestions for Assessment

Study Guide questions 2.4 to 2.6 will meet the objectives of Outcome 2.3.

In the Study Guide, students have been assigned Practice Exercise 5, *Exploded Views and Constituent Parts*. The instructor may wish to use this worksheet as a chapter review.

Questions similar to the following should be given for extra practice on scale drawings.

1. Given a scale of 1:20, how long would a line be drawn if it was actually
 - a) 60 cm long?
 - b) 230 cm long?
 - c) 10 cm long?
2. On a map, 3 inches represents 960 miles. What are the two ways to write this scale?
3. You are drawing the floor plan of a 12 ft. \times 15 ft. room. What scale could you use to fit the drawing on a piece of paper measuring $8\frac{1}{2} \times 11$ inches?

Resources

Essential of Mathematics 12, Exploded Views and Component Parts, pages 82 - 88

Teacher Resource Book 12, pages 62 - 64

Appendix, Practice Exercise 5, *Exploded Views and Constituent Parts*

Unit 2 - Design and Measurement

Outcomes

2.4 Create isometric and oblique drawings of objects.

2.4.1 Describe the differences among isometric, cavalier and cabinet drawings.

Notes for Teaching and Learning

The instructor should ensure that students have isometric dot paper before they begin this exploration.

The instructor should remind students that when creating an isometric drawing:

- i) all vertical lines are drawn to scale
- ii) the object is drawn from a corner
- iii) all lines that are not vertical are at a 30° angle to the vertical.

The instructor should provide students with the sheet *Oblique Cavalier Drawing and Oblique Cabinet Drawing*. This sheet shows the necessary steps to create each drawing.

Students should notice the similarities and differences between the two styles of oblique drawings, cavalier and cabinet. Both of these oblique drawings are shown face on with the face drawn to scale. Cavalier drawings will usually look distorted in shape because all dimensions are drawn to the same scale. Cabinet drawings have less distortion because receding lines are drawn at one-half scale.

The instructor should discuss with students the differences among the following terms:

- i) oblique projections
- ii) exploded diagrams
- iii) constituent parts diagrams.

It may be helpful to have students draw an example of each in their notebooks using a relatively simple object.

Unit 2 - Design and Measurement

Suggestions for Assessment

Study Guide question 2.7 will meet the objectives of Outcome 2.4.

Resources

Essential of Mathematics 12,
Pictorial Drawings, pages
89 - 93

Teacher Resource Book 12,
pages 65 - 68

Appendix, *Oblique Cavalier
Drawing and Oblique
Cabinet Drawing*

Unit 2 - Design and Measurement

Outcomes

2.5 Solve problems involving estimation and costing for objects when a design is given.

Notes for Teaching and Learning

The instructor should supply recent advertisements and price lists from lumber yards and hardware stores.

The solutions in the student answer key to **Notebook Assignment**, question 1, on page 98 is incorrect.

The instructor should advise students of the correct answer which is given in the *Teacher Resource Book 12*, pages 72 and 73

Unit 2 - Design and Measurement

Suggestions for Assessment

Study Guide question 2.8 will meet the objectives of Outcome 2.5.

Resources

Essential of Mathematics 12,
Cost Estimates of Materials,
pages 96 - 98

Teacher Resource Book 12,
pages 71 - 73

Unit 2 - Design and Measurement

Outcomes

2.6 Plan the construction of an object while minimizing cost and waste.

Notes for Teaching and Learning

Students should have access to advertisements and price lists from lumberyards and hardware stores.

Unit 2 - Design and Measurement

Suggestions for Assessment

Study Guide question 2.9 will meet the objectives of Outcome 2.6.

In the Study Guide, students have been assigned **Chapter Review**, questions 1 - 5. The instructor may prefer to use these questions in an assessment.

The following could be used as an assessment for this chapter.

Student Project

Each student will design a 3-D object within a specified budget. Objects could be a picnic table, bird house, garbage box, roof truss or some other object approved by the instructor.

Part A

The following could be combined:

- labeled, scaled drawing of object
- 3-D drawing of object

Part B

- sketch an exploded view of how the pieces fit together
- draw each of the constituent parts to scale

Part C

- set a budget
- list all the materials needed to build this project
- perform a cost comparison by researching at least two suppliers
- calculate waste and cost of wasted materials
- provide pictures of object
- include an estimation of the costs of incidental supplies such as glue, nails, etc.
- if necessary, adjust materials to lower cost within the proposed budget

Creativity is encouraged! Neatness and accuracy in diagrams are important.

Resources

Essential of Mathematics 12, Building from Scratch, pages 100 - 106

Teacher Resource Book 12, pages 74 - 76

Appendix

Changing units between the Metric and Customary Systems

From Metric to Customary				From Customary to Metric			
Quantity	to change from	to	multiply by	Quantity	to change from	to	multiply by
Length	m	mil	0.039 37	Length	mil	m	25.4
	mm	in.	0.039 37		in.	mm	25.4
	cm	in.	0.393 7		in.	cm	2.54
	m	ft	3.280 8		ft	m	0.304 8
	km	mile	0.621 37		mile	km	1.609 3
Area	cm ²	sq in.	0.155	Area	sq in.	cm ²	6.451 6
	m ²	sq ft	10.736 9		sq ft	m ²	0.092 9
Volume	cm ³	cu in.	0.061	Volume	cu in.	cm ³	16.387
	m ³	cu yd	1.308		cu yd	m ³	0.764 6
	mL	fl oz	0.033 8		fl oz	mL	29.574 6
	L	fl oz	33.814		fl oz	L	0.029 6
	L	pt	2.113		pt	L	0.473 2
	L	qt	1.056 7		qt	L	0.946 4
	L	gal	0.264 2		gal	L	3.758 4
Mass or weight	g	oz	0.035 3	Mass or weight	oz	g	28.349 5
	kg	lb	2.205		lb	kg	0.453 6
	t	lb	2205		ton	kg	907.2
Bending moment, torque, moment of force	N-m	lbf-in.	8.850 7	Bending moment, torque, moment of force	lbf-in.	N-m	0.113
	N-m	lbf-ft	.737 6		lbf-ft	N-m	1.355 8
Pressure/ Vacuum	kPa	psi	0.145	Pressure/ Vacuum	psi	kPa	6.894 8
Velocity	km/h	mph	0.621 4	Velocity	mph	km/h	1.609 3
Force, thrust, drag	N	lbf	0.224 8	Force, thrust, drag	lbf	N	4.448 2
Power	W	W	1	Power	W	W	1
Temperature	C	F	$(1.8 \times C) + 32$	Temperature	F	C	$(F - 32) \div 1.8$

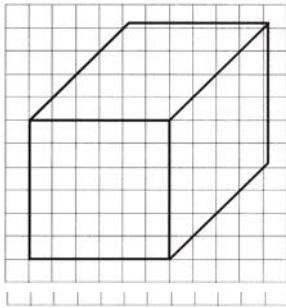
Oblique Cavalier and Oblique Cabinet Drawings

Example 1

Draw a cube measuring 6 inches on each side using an oblique cavalier drawing.

Scale: 1 square: 1 inch.

- Draw the face. (Note: Assume graph paper is one-quarter inch.)
- Draw the oblique lines to scale. (Note: Depth measurement $6 \times \frac{1}{4}'' = 1 \frac{1}{2}''$ for depth.)
- Complete the cube, measuring 6 inches on each side.

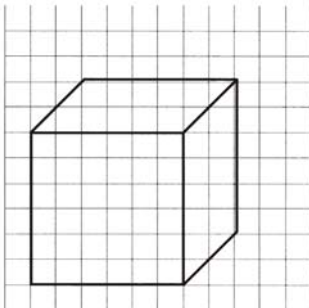


Example 2

Draw a cube measuring 6 inches on each side using an oblique cabinet drawing.

Scale: 1 square: 1 inch.

- Draw the face. (Note: Assume graph paper is one-quarter inch.)
- Draw the oblique line to scale. Oblique lines should be $1.5'' \div 2 = .75''$ (half-scale).
(Note: Actual dept in drawing: $6'' \div 2 = 3''$ (half-depth).)
- Complete the cube, measuring 6 inches on each side.



Practice Exercise 1
Suitable Units of Linear Measure

1. Identify suitable units of linear measure in the SI and Imperial systems.		
Item	Metric - SI	Imperial
a) distance from St. John's to Clarendville		
b) length of a pen		
c) thickness of a coin		
d) diameter of a car tire		
e) dimensions of a duotang		

2. Complete the following table with an appropriate estimate.		
Item	Metric - SI	Imperial
a) distance from Gander to Corner Brook		
b) length of ice surface in an arena		
c) width of a floor tile		
d) dimensions of a loonie		
e) diameter of a human hair		

3. Estimate, in both SI and imperial units, the length and width of each of the following objects. Use a metre stick, ruler, tape measure, or any other suitable device, to determine the actual measure of each object (rounded to the nearest mm or 1/16th of an inch).				
Item	Metric - SI Estimate	Imperial Estimate	Actual SI	Actual Imperial
a) desktop				
b) textbook				
c) classroom				
d) window				
e) door				

Practice Exercise 1

Solutions











Solutions: Example 1		
Item	Metric - SI	Imperial
a) distance from St. John's to Clarenville	km	miles
b) length of a pen	cm	inches
c) thickness of a coin	mm	fraction of an inch
d) diameter of a car tire	cm	inches
e) dimensions of a duotang	cm	inches

Solutions: Example 2		
Item	Metric - SI	Imperial
a) distance from Gander to Corner Brook	360 km	220 miles
b) length of ice surface in an arena	60 m	200 feet
c) width of a floor tile	30 cm	1 foot
d) dimensions of a loonie	2.5 cm	1 inch
e) diameter of a human hair	1 mm	1/16th of an inch













Practice Exercise 2

Imperial and SI Measure

1. Measure each of the following items to the nearest $\frac{1}{16}$ of an inch.

<p>a) diameter of nut</p> 	<p>f) length of small nail</p> 
<p>b) length of gyproc screw</p> 	<p>g) length of large nail</p> 
<p>c) length of wood screw</p> 	<p>h) diameter of steel drill bit</p> 
<p>d) size of wood bit</p> 	<p>i) length of bolt (exclude head)</p> 
<p>e) diameter of dowel</p> 	<p>j) length of wrench</p> 

2. Measure each of the following items to the nearest millimetre.

a) length of AAA battery 	g) length of small bolt 
b) diameter of loonie 	h) diameter of penny 
c) diameter of bolt head 	i) inside and outside diameter of washer 
d) length of paper clip 	j) length of large bolt 
e) length of small wrench 	k) length of nail 
f) length of large wrench 	l) length of pen 

Practice Exercise 3

Word Problems

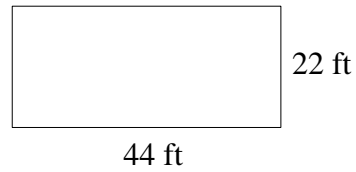
Solve the following problems. Draw and label a sketch for each.

1. A gable roof composed of two rectangles is to be covered with asphalt shingles. Each rectangle is 44 ft. by 22 ft. A bundle of shingles contains 27 shingles and will cover $33\frac{1}{3}$ sq. ft.
 - a) Find the area of the roof.
 - b) How many complete bundles of shingles are needed to cover the roof?
2. The inside dimensions of an aquarium are: 60 cm long, 30 cm wide and 40 cm deep.
 - a) Find the volume of the aquarium in cubic centimetres.
 - b) If 1 cubic centimetre equals 1 millilitre, find the volume of the tank in millilitres and litres.
 - c) If 1 litre of water has a mass of 1 kilogram, what is the mass of the water in the filled aquarium?
3. A contractor intends to pour a concrete pad for a shed that measures 24 ft. by 48 ft. If the floor is to be 6 inches thick, find the number of cubic yards of concrete that are required.
4. A room measures 12' 6" and has a ceiling height of 96".
 - a) Ignoring any openings such as doors or windows, find the total square footage of wall area to be painted.
 - b) If the ceiling area is to be tiled, how many tiles measuring 12 " by 12" will it take to tile the ceiling?

Practice Exercise 3

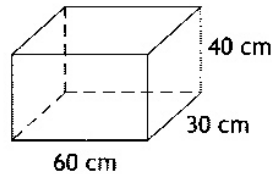
Solutions

1a) total square footage of roof
 $= 2 (44 \text{ ft.})(22 \text{ ft.})$
 $= 1936 \text{ square feet}$



1b) one bundle covers $33 \frac{1}{3}$ square feet
 total # of bundles needed
 $= 1936 \div 33 \frac{1}{3}$
 $= 58.08$
 $\rightarrow 59$ bundles are needed

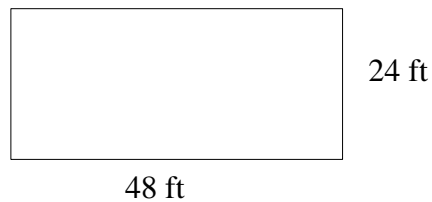
2a) volume = $(60 \text{ cm})(30 \text{ cm})(40 \text{ cm})$
 $= 72\,000 \text{ cm}^3$



2b) volume in mL = 72 000 mL
 volume in L = $72\,000 \div 1000 = 72 \text{ L}$

2c) mass of water = 72 kg

3.
 volume = $l \times w \times h$
 $24 \text{ ft.} = 8 \text{ yds.}$
 $48 \text{ ft.} = 16 \text{ yds.}$
 $6 \text{ in.} = 0.5 \text{ ft.} = \frac{1}{6} \text{ yd.}$
 so volume = $(8)(16)\left(\frac{1}{6}\right)$
 $= 21 \frac{1}{3} \text{ cubic yards}$



OR
 volume = $24 \times 48 \times 0.5$
 $= 576 \text{ ft}^3$

$1 \text{ yd}^3 = 27 \text{ ft}^3$

$\therefore \frac{576}{27} = 21 \frac{1}{3} \text{ yd}^3$

4a) total square footage of wall = ?

$$12' 6'' = 12.5'$$

$$96'' = 8'$$

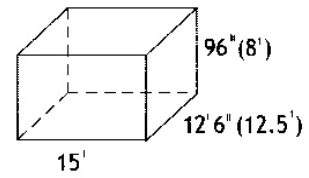
$$\text{two narrower walls} = 2(12.5 \text{ ft.})(8) = 200 \text{ square feet}$$

$$\text{two longer walls} = 2(15 \text{ ft.})(8) = 240 \text{ square feet}$$

$$\text{total} = 200 + 240 = 440 \text{ square feet}$$

4b) area of ceiling = $15' \times 12.5' = 187.5 \text{ ft}^2$

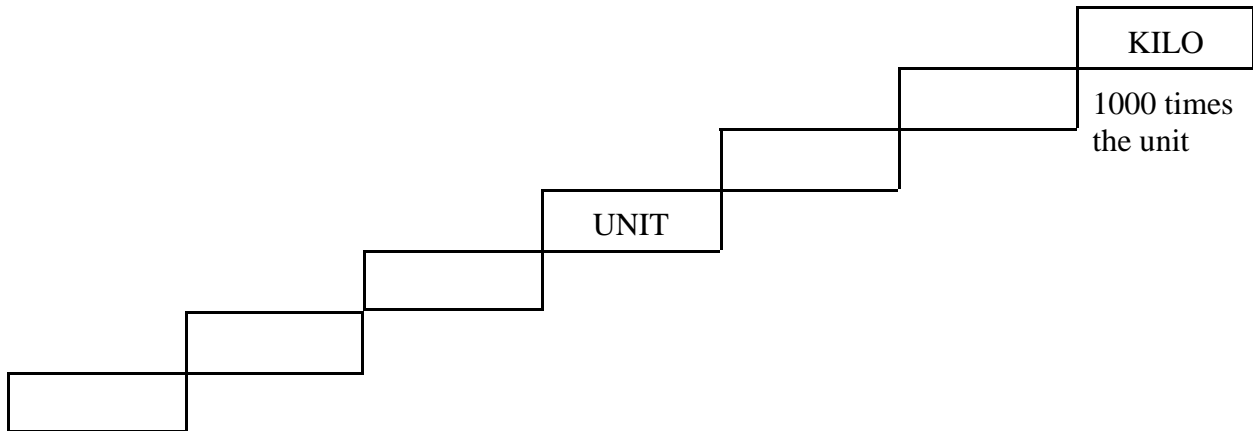
$$\text{minimum number of tiles} = 188$$



Practice Exercise 4

Metric Prefixes

Record the *Metric Prefixes* in the spaces provided. Below each, describe what the prefix means. One prefix is done for you.



Now use the *Metric Steps* to make these conversions: (Remember to count the steps.)

500 cm	<input type="text"/> m
2 km	<input type="text"/> m
<input type="text"/> mL	5.5 liters
220 mm	<input type="text"/> cm
<input type="text"/> kg	20 000 g

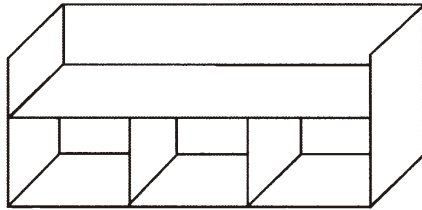
Practice Exercise 5

Exploded Views and Constituent Parts

1. When given a diagram of a 3-D object, you should be able to draw an exploded view of the object. This view is used to show how the constituent parts connect.

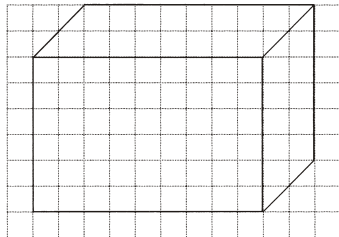
The following is a diagram of a desk organizer. “Pull apart” the various pieces, creating an exploded view.

The use of graph paper is recommended! You may, but do not need to, provide a scale for exploded views.

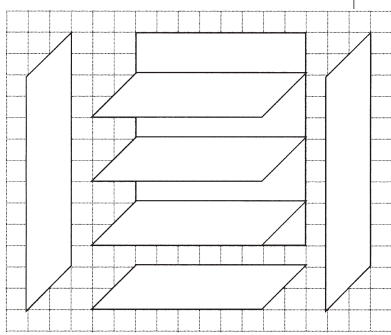


2. The measurements of this box are: length 36", width 24", and depth 12" (1 square = 4"). Draw the constituent parts.

Note: a) constituent parts should be drawn to scale
b) each part needs to be drawn only once with the number of that part included in the diagram.



3. The drawing below is in exploded format.
- What does it represent?
 - Make a drawing of the object in “built” form.
 - Suggest an appropriate scale for this diagram that would indicate its actual measurements. Hint: The object is 33 inches tall and about 24 inches wide.

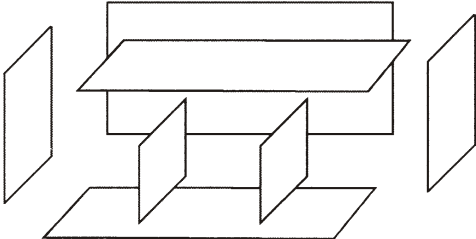


4. Set an appropriate scale and draw on graph paper the constituent parts for boxes measuring:
- 36" height, 24" width, and 18" depth
 - 6' height, 4' width, and 2' depth
 - 20' height, 15' width, and 10' width

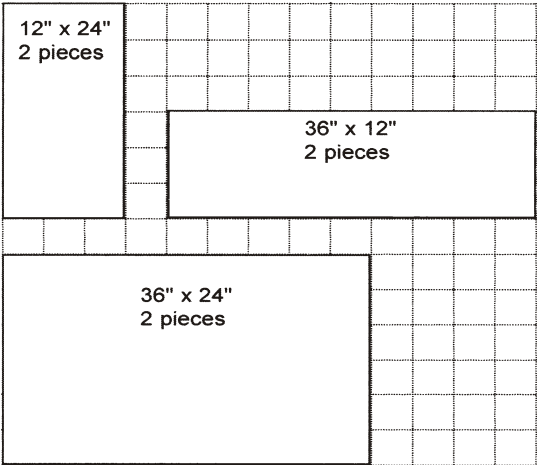
Practice Exercise 5

Solutions

1.

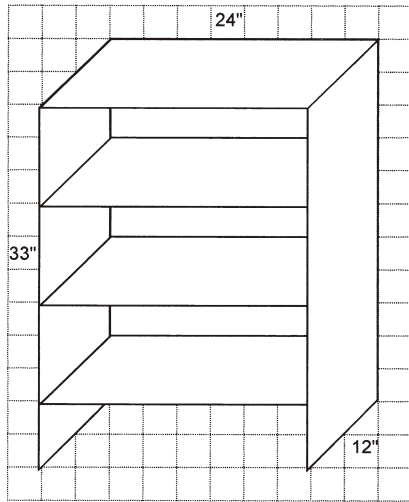


2.



3.a) bookshelf

b)



c) 1 square: 3" or 1":12"

4. Scales may vary: 1 square: 4"

