Date: _____

CHAPTER 6

# Geometry in Design

## Get Set

Answer these questions to check your understanding of the Prerequisite Skills concepts on pages 294–295 of the *Foundations for College Mathematics 11* textbook.

### Geometric Shapes

**1.** Describe the shape of each object.

**a)** a CD

**b)** the Canadian flag

**c)** a soup can

**d)** a shoebox

### Perimeter and Area

**2.** Find the perimeter and the area of a disc with a 10-in. diameter.

### Surface Area and Volume

**3.** Fifi's fish tank is 30 cm tall, 40 cm long, and 25 cm deep.

**a)** If the bottom and sides of the tank are made of glass, what is the surface area of the glass?

**b)** How much water can the tank hold when filled to the top?

### Angles in a Polygon

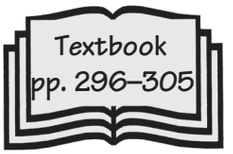
**4.** A pentagon contains two right angles, one 150° angle, and one 160° angle. Find the measure of the fifth angle.

### Scale Factors

**5.** Dexter is in a Victorian museum looking at a ship in a bottle. The ship is a scale model of an actual schooner. Each centimetre represents 2 m. The foremast on the model is 11 cm above the deck and the topmast is 16.5 cm above the deck. How tall are these masts on the original schooner?

Date: _____

# 6.1 Investigate Geometric Shapes and Figures




## Warm-Up

**1. Number Skills**

Match each decimal number with the equivalent fraction.

**a)** 0.3 **A** $\frac{16}{32}$

**b)** 0.85 **B** $\frac{15}{50}$

**c)** 0.5 **C** $\frac{4}{20}$

**d)** 0.2 **D** $\frac{85}{100}$

**2. Algebra**

Factor each trinomial fully.

**a)** $3x^2 + 24x + 45$

**b)** $3x^2 + 3x - 6$

**3. Relations**

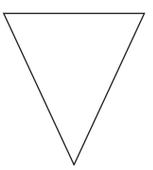
Determine $x$-intercepts of the quadratic relation $y = -7x^2 + 63x + 70$.

**4. Geometry/Measurement**

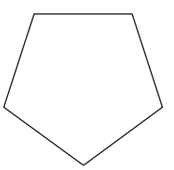
Circle the regular polygon.

**A**

**B**



**C**



**5. Data/Probability**

Find the mean, the median, and the mode of the set of data.

–10, –7, –3, –1, 0, 4, 4, 6, 17, 50

**6. Problem Solving**

What is the surface area of a cube with a volume of 512 $cm^3$?

**7. Math Literacy**

**a)** The name for a regular four-sided polygon is …

**b)** The name for an eight-sided polygon with congruent sides and angles is …

**8. Previous Section**

One of the angles in a parallelogram is 65°. What are the measures of the other angles?

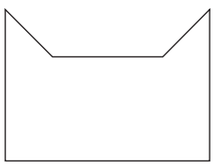
Date: _____

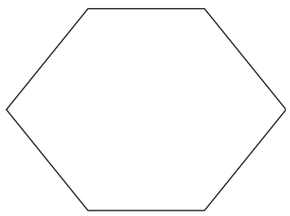
## Practise


**1.** Sketch a front view of your school. Identify as many geometric shapes as you can. Why do you think these shapes have been chosen?

**2.** Which of these polygons can be used to tile a plane?

**a)** 

**b)** 

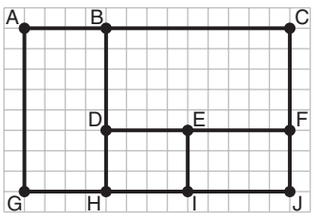
**c)** 

**3.** Photographs are often printed in standard sizes: $3 \times 5$, $4 \times 6$, $5 \times 7$, and $6 \times 8$. All dimensions are in inches. Which size of photograph is closest to being a golden rectangle? Remember, the golden ratio is approximately 1.618:1.

5:3 $\doteq$ _____:1 6:4 $\doteq$ _____:1

7:5 $\doteq$ _____:1 8:6 $\doteq$ _____:1

**4.** Which rectangle is closest to being a golden rectangle?



Date: _____


**5.** Hannah made a blanket of 40 granny squares to donate to a homeless shelter. The blanket measures 120 cm by 195 cm, which is close to a 5-by-8 array of squares. Hannah claims that the blanket is a golden rectangle, and that it can be divided into a square with 120-cm long sides and another golden rectangle. Use calculations to check her claims.

**6.** A hardcover book is 10.5 in. tall. What should be the width of the book to form a golden rectangle?

1.618:1 = 10.5:_____

**7.** Two common ratios of height to width of television screens are 3:4 and 9:16. Which screen ratio is closer to the golden ratio?

**8.** Create a shape with five sides that can tile a plane. Draw your tessellation on the grid.

Date: _____

# 6.2 Perspective and Orthographic Drawings

Textbook pp. 306–317

## Warm-Up

**1. Number Skills**

Round each number to two decimal places.

**a)** 3.4082

**b)** 411.0545

**c)** 88.697

**d)** 64.705

**2. Algebra**

Write each relation in standard form.

**a)** $3(x - 7)^2 + 44$

**b)** $(x + 13)^2 - 209$

**3. Relations**

Find the $x$-intercepts and the $y$-intercept of the quadratic relation.

$$y = 0.5(x - 2)(x + 4)$$

**4. Geometry/Measurement**

**a)** What is the sum of the angles around a point where vertices meet in a tessellation?

**b)** What is the sum of the interior angles of a quadrilateral?

**5. Data/Probability**

The faces of a triangular-based prism are numbered from 1 to 5. What is the theoretical probability of choosing a number that is written on a rectangular face?

**6. Modelling**

Write an equation to model the area of a rectangle with one pair of parallel sides 2 cm longer than the other pair.

**7. Math Literacy**

Rearrange the letters to spell an adjective meaning "the same length".

I SORT MICE

**8. Previous Section**

A printing company can make greeting cards 20 cm tall. How wide should the cards be to form a golden rectangle?

Date: _____

## Practise

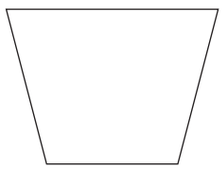
Section 6.2

**1.** Which representation would be the most useful for presenting a concept for a new statue outside an office tower? Explain your reasoning.

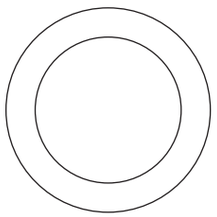
**A** a scale model
**B** isometric perspective drawings
**C** blueprints showing top views
**D** orthographic drawings

**2.** **a)** Which of these diagrams could represent the top view of a typical cup?

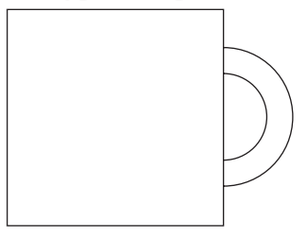
**A**



**B**

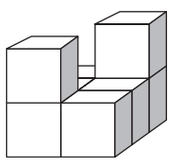


**C**

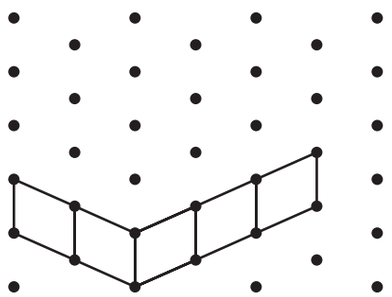


**b)** Which of the diagrams could represent the front view and the side view of a cup?

**3.** Max used eight linking cubes to make a model.



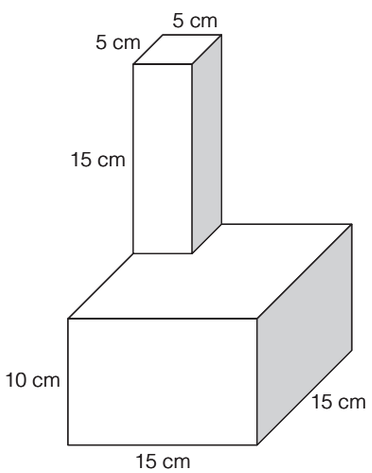
**a)** Complete the isometric perspective drawing of the object.



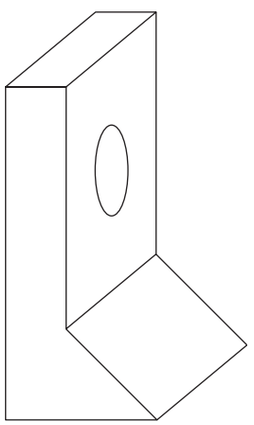
**b)** Draw orthographic drawings of the object.

Date: _____


**4.** Create the three orthographic drawings that could be used in the production of this object. Include the dimensions.

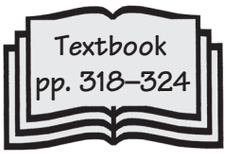



**5.** Create the three orthographic drawings that could be used in the production of this object.



Date: _____

# 6.3 Create Nets, Plans, and Patterns




## Warm-Up

**1. Number Skills**

Simplify each fraction, if possible.

**a)** $\frac{18}{62}$ **b)** $\frac{24}{31}$

**c)** $\frac{375}{1000}$ **d)** $\frac{365}{500}$

**2. Algebra**

Expand and simplify.

**a)** $(3x - 8)(4x - 8)$

**b)** $(10x + 7)(x - 11)$

**3. Relations**

How many $x$-intercepts does the quadratic relation $y = x^2 - 3$ have?

**4. Geometry/Measurement**

Four congruent squares each have an area of 36 $m^2$. The squares are arranged to form a larger square. What is the perimeter of the larger square?

**5. Data/Probability**

Francis recorded the height, in cubes, of several towers made of linking cubes.
4, 12, 9, 13, 15, 6, 5,
8, 11, 12, 16, 11, 7, 12

Find the mean, the median, and the mode heights.

**6. Problem Solving**

What are the dimensions of a rectangle with an area of 20 $mm^2$ and a perimeter of 24 mm?

**7. Math Literacy**

**a)** Name an everyday object in the shape of a cube.

**b)** Name an everyday object in the shape of a sphere.

**8. Previous Section**

Sketch orthographic drawings of a cone standing on its base.

Date: _____


## Practise

**1.** Would you use a net, a plan, or a pattern to show the design of a bookcase? Explain.

**2.** Sketch a pattern that could be used to make a baseball cap.

**3.** **a)** Sketch a net that could be used to make a hexagonal prism.

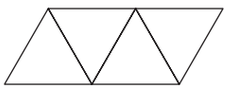
**b)** Sketch a net that could be used to make a pentagonal pyramid.

**4.** Sketch a net that could be used to construct a square-based prism that is twice as tall as it is wide. Label the dimensions.

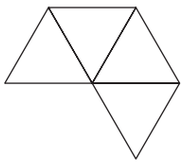
Date: _____


**5.** Which of these nets can be folded into a regular tetrahedron? Explain.

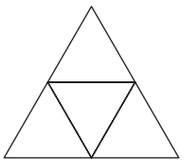
**A**



**B**

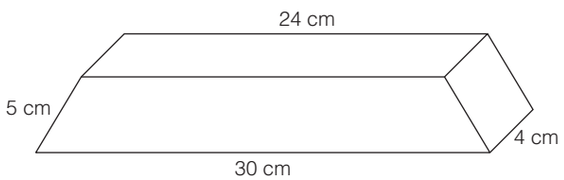


**C**



**6.** Draw a pattern that can be used to construct an open box that is 40 cm high, 30 cm long, and 15 cm wide. Label the dimensions.

**7.** Consider this design for a trapezoid-based prism.




**a)** Draw a net that can be folded into the shape of this prism. Label the side lengths.

**b)** Draw plans for the individual pieces. Label the side lengths.

Date: _____

# 6.4 Scale Models

Textbook pp. 327–334

## Warm-Up

### 1. Number Skills

Calculate.

**a)** 50% of 72

**b)** 70% of 60

**c)** 20% of 17

### 2. Algebra

Factor each trinomial fully.

**a)** $2x^2 + 20x + 48$

**b)** $-5x^2 + 70x + 160$

### 3. Relations

Determine the minimum value of the quadratic relation $v = 0.2t^2 - 10t + 15$.

### 4. Geometry/Measurement

Circle all the words that apply to a square.

| | |
|---|---|
| right angles | quadrilateral |
| four equal sides | regular |
| parallel sides | equal diagonals |

### 5. Data/Probability

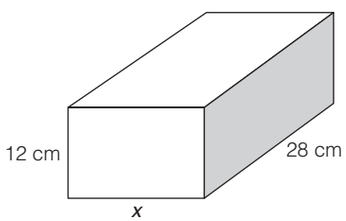
Abagail asked 10 people to choose their favourite season. Her results are shown:

fall, spring, spring, summer, fall, summer, winter, spring, summer, fall

What is the experimental probability of someone from this group choosing fall?

### 6. Problem Solving

The volume of this prism is 5376 $cm^3$. Solve for $x$.




### 7. Math Literacy

Which term means a form, template, or model from which an object can be created?

**A** a net
**B** a plan
**C** a pattern
**D** a scale model

### 8. Previous Section

Sketch two different nets of a cube.

Date: _____


## Practise

**1.** A building is in the shape of an isosceles triangular prism. The base is an isosceles triangle with two sides 30 m long and one side 20 m long. The height of the building is 10 m. A model is made using a scale of 1 cm represnts 10 m.

**a)** Find the height and the side lengths of the base of the model.

**b)** Draw a scale diagram of the model.

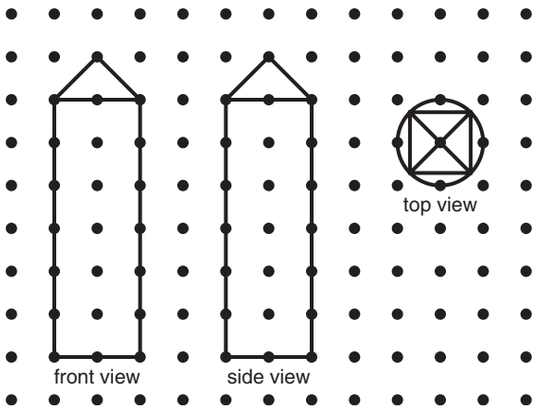
**2.** Frida is building a scale model of a storage shed. The shed is 20 ft long, 10 ft wide, and 9 ft tall. She plans to use the scale 2 in. represents 1 ft. Find the dimensions of the model.

**3.** Create a scale diagram of a container that could hold a tray of cut vegetables and two different dips. Include dimensions in your diagram.

Date: _____

Section 6.4

**4.** While on a visit to France, Araldo sketched orthographic drawings of the Tour du Crédit Lyonnais in Lyon. The distance between pairs of horizontal or vertical dots represents 20 m.

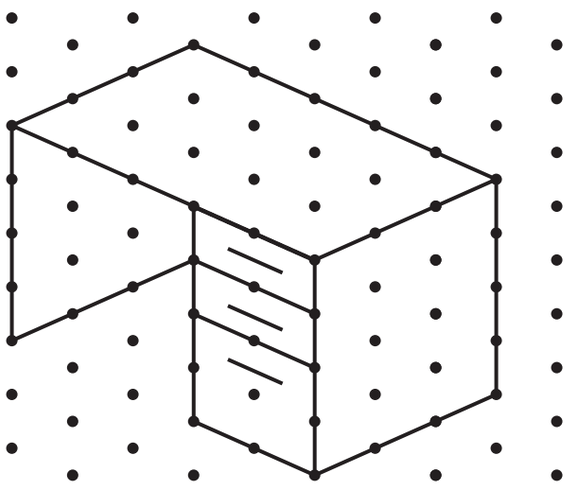



**a)** Which description best fits the tower? Explain.

**A** a rectangular prism 120 m tall, with a 20-m tall pyramid on top
**B** a cylinder 120 m tall, with a 20-m tall cone on top
**C** a pencil 7 cm tall
**D** a cylinder 120 m tall, with a 20-m tall pyramid on top
**E** a rectangular prism 120 m tall, with a 20-m tall cone on top

**b)** What other details about the tower can you add to the description?

**5.** Aurelia is using this isometric perspective drawing of a desk to draw plans. The distance between a pair of dots represents 20 cm. Draw plans to show each piece of wood required for the desk only. Do not include the three drawers. Include dimensions in your plans.



Date: _____

# 6.5 Solve Problems With Given Constraints

Textbook pp. 335–343

## Warm-Up

**1. Number Skills**

Estimate.

**a)** $6.8^2 - 15$

**b)** $2.92 \times 8.97 + 40$

**c)** $181 \div 9 - 50$

**2. Algebra**

Write each quadratic relation in standard form.

**a)** $-(x - 3)^2 + 17$

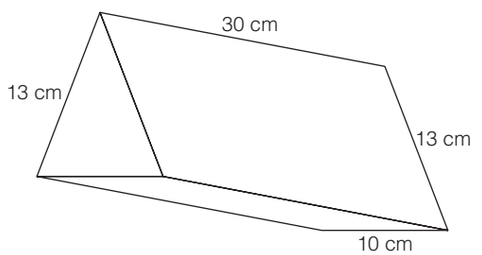
**b)** $-12(x + 1.5)^2 + 2.3$

**3. Relations**

Write an equation for a parabola with vertex at (–2, 8) and that passes through point (0, 0).

**4. Geometry/Measurement**

Find the volume of the prism.




**5. Data/Probability**

A bag contains 5 cubes: one red, one yellow, and three blue. What is the probability of randomly selecting a blue cube?

**6. Problem Solving**

An isosceles triangle has two 20-cm long sides and one 10-cm long side. What is the area of a triangle?

**7. Math Literacy**

What is the name of a triangle with one right angle and two equal angles?

**8. Previous Section**

A rectangular prism is 280 cm tall, 50 cm wide, and 170 cm long. A model of the prism uses the scale 1 cm represents 20 cm. What are the dimensions of the model?

Date: _____

## Practise


**1.** Turloch is building a square-based prism storage bin with a lid to hold DVDs. He has 3 $m^2$ of plywood available to make the bin.

**a)** Find the dimensions of the bin with the greatest possible volume, to the nearest tenth of a metre.

**b)** Find the maximum volume of the bin, to the nearest tenth of a cubic metre.

**2.** Ari has 450 $cm^2$ of tin to make a cylindrical pencil tin with an open top.

**a)** Find the dimensions of the cylinder with the greatest volume, to the nearest hundredth of a centimetre.

**b)** Find the maximum volume of the cylinder to the nearest tenth of a cubic centimetre.

**3.** Levy makes round pizzas with diameters of 34 cm, 40 cm, and 45 cm.

**a)** Find the area of each pizza.

**b)** Find the side length of the smallest square box needed for each pizza. Assume the dimensions of each box must be 2 cm greater than the diameter of the pizza that goes in it.

**c)** If each pizza box is 6 cm tall, find the total surface area of each box.

Date: _____


**4.** A flexible floating pipe capable of containing oil to a depth of 20 in. is to be placed around a leaking oil tanker containing 25 000 $ft^3$ of oil. The pipe will form a circular shape around the tanker. Remember, 1 ft = 12 in.

**a)** What length of pipe is needed if the leak is stopped when 25% of the oil escaped?

**b)** What length of pipe is needed if the leak is stopped when 50% of the oil escaped?

**c)** Why is your answer to part b) not double your answer to part a)?

**5.** Fatima is preparing to sew a denim bag using a pattern she bought. The dimensions of the three main panels are 30 in. by 36 in., 18 in. by 24 in., and 18 in. by 12 in.

**a)** The denim is available at the local fabric store in 50-ft bolts that are 2 ft, 3 ft, or 4 ft wide. Which width should Fatima purchase? Explain.

**b)** Piping to go along the edge of each rectangular panel is available in 4 ft, 6 ft, and 8 ft lengths. What lengths of piping should she purchase to minimize waste?

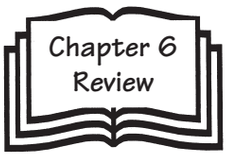
**6.** Yul is asked to build a metal box. The sides and base will be tin and the lid will be brass. The box must be large enough to hold four cubes, each with a side length of 10 cm. Sheet metal costs \$1/100 $cm^2$ for tin and \$2.50/100 $cm^2$ for brass. Yul also needs two hinges for the lid. Hinges cost \$3 each.

**a)** What dimension should Yul use for the box to minimize the total cost?

**b)** Calculate the total cost of the box.

Date: _____

# Chapter 6 Review



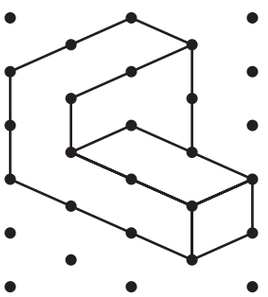

## 6.1 Revisit the Primary Trigonometric Ratios, textbook pages 296–305

**1.** A credit card is 85 mm long and 55 mm wide. How could you change the width of the card so that it is a golden rectangle?

**2.** Create a shape with four sides and only one right angle that can tile a plane. Draw your tessellation on the grid.

## 6.2 Perspective and Orthographic Drawings, textbook pages 306–317

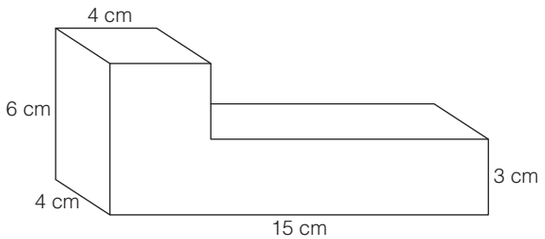
**3.** For the isometric perspective drawing, draw the orthographic projections of the top view, side view, and front view.



Date: _____


### 6.3 Create Nets, Plans, and Patterns, textbook pages 318–324

**4.** Consider this design for an L-shaped prism.




**a)** Draw a net that can be folded into the shape of the prism.

**b)** Draw plans for the individual pieces of the prism.

### 6.4 Scale Models, textbook pages 327–334

**5.** A scale model of a mail box is 7 cm tall and has a 2 cm by 2.5 cm base. The actual mail box is 1.4 m tall.

**a)** What is the scale of the model?

**b)** What are the dimensions of the base of the actual mail box?

### 6.5 Solve Problems With Given Constraints, textbook pages 335–343

**6.** A farmer wants to fence in one hectare (10 000 $m^2$) of pasture for his animals. The local hardware store charges \$6.50/m for rigid fencing that cannot form curves and \$7.25/m for flexible fencing that can form curves.

**a)** What shape of fence will minimize the total cost?

**b)** Find the minimum cost of constructing the fence.