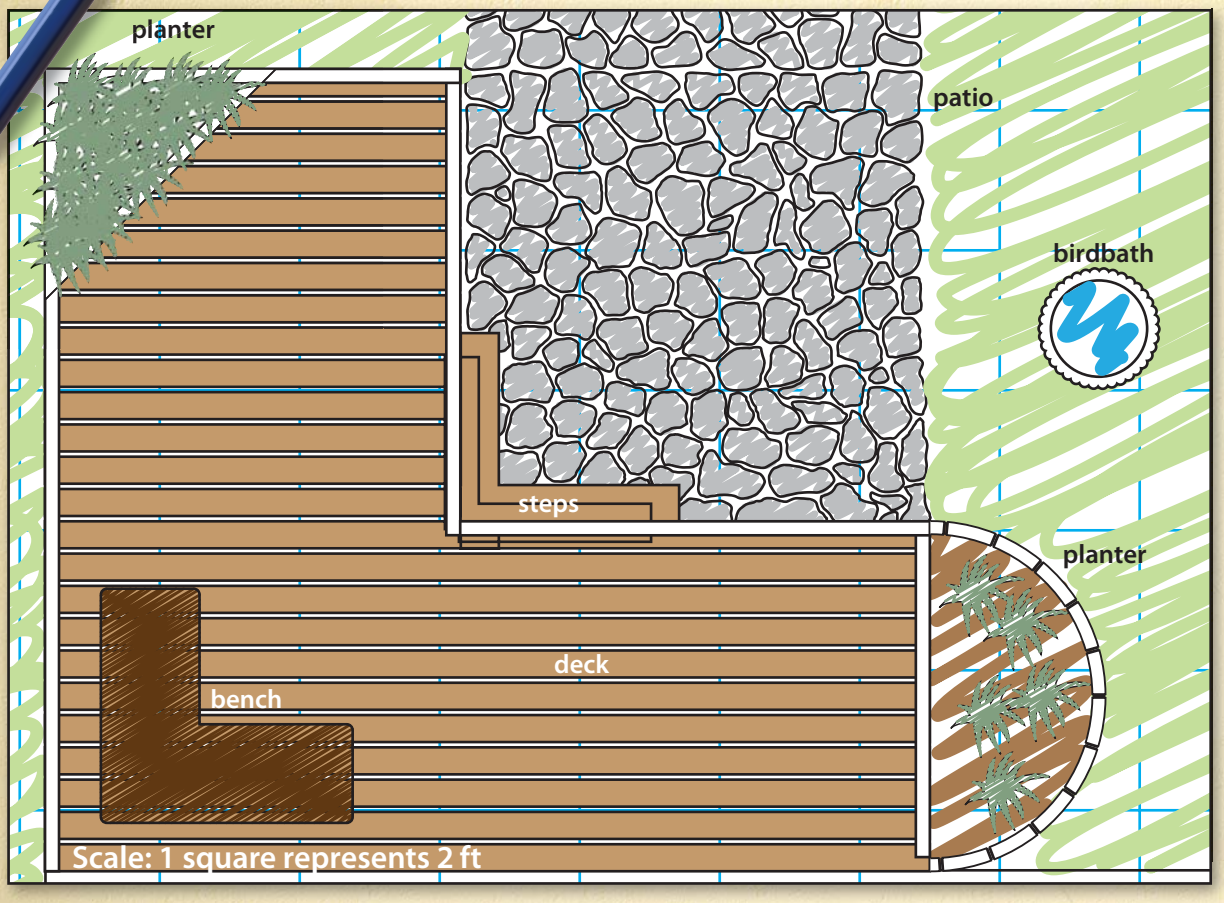
Math at Work 10: Chapter 3

February 24, 2011, 16:41

3 Measuring Area



Maria is helping her uncle design a new deck and patio. She drew this sketch to show the top of the items in her plan.

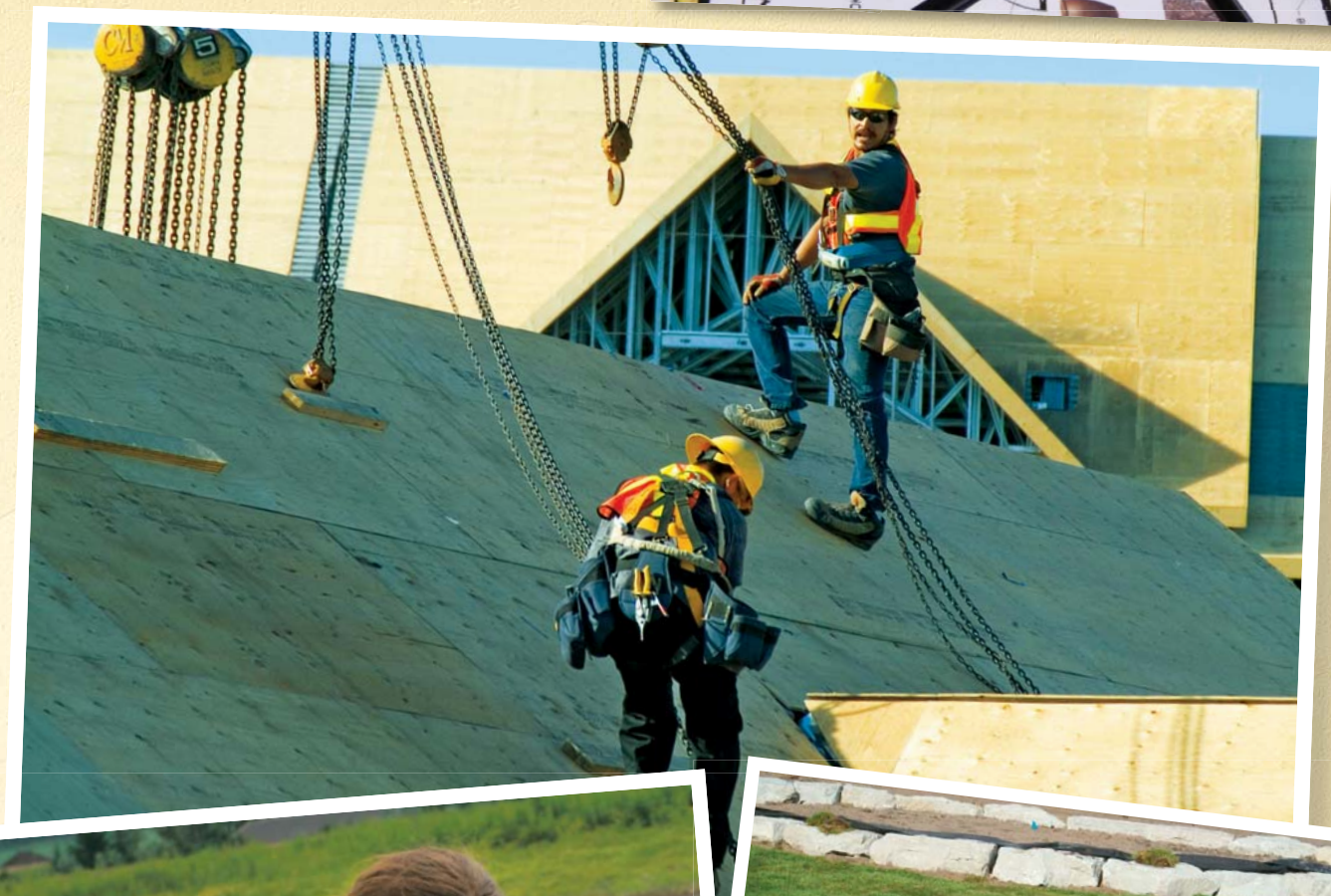
1. What shapes do you see?
2. What measurements will Maria need to make for each shape before she purchases any materials?
3. What does the scale mean?
4. What jobs or careers require these skills?

Key Words

area
composite shape
surface area
rectangular prism
right cylinder

Career Link

Dan works as a landscaper. He enjoys designing gardens, patios, and retaining walls. This is the creative part. He also likes building his designs. This is the hands-on part.



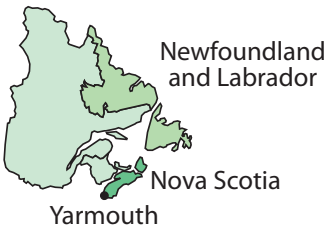
3 Get Ready

Length Measurements

1. a) List the four most commonly used SI measurements for length, from shortest to longest.

b) What SI unit would be best to measure each of the following items?

- your height
- the length of a soccer field
- the thickness of a dime
- the distance from Newfoundland and Labrador to Yarmouth



2. a) List the four most commonly used imperial measurements for length, from shortest to longest.

b) What imperial unit would be best to measure each of the following items?

- the diameter of a bicycle wheel
- the length of a football field
- the length of your classroom
- the distance from Newfoundland and Labrador to Miami

Convert Units

3. Convert each length to the unit indicated. The first one has been done for you.

a) 4 yards → ■ feet

There are 3 feet in 1 yard, so 4 yards would be 4 × 3 = 12 feet.

b) 3 metres → ■ centimetres

c) 36 inches → ■ feet

d) 150 centimetres → ■ metres

e) 4 feet → ■ inches

f) 500 metres → ■ kilometres

g) 2 metres 65 centimetres → ■ centimetres

4. Estimate each length in the unit indicated. The first one has been done for you.

a) 4 inches → ■ centimetres

There are about 2.5 centimetres in 1 inch, so 4 inches would be 4 × 2.5 = about 10 centimetres.

b) 3 metres → ■ yards

c) 3 metres → ■ feet

d) 20 centimetres → ■ inches

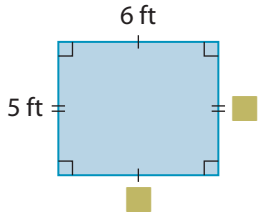
e) 40 kilometres → ■ miles

f) 500 miles → ■ kilometres

Perimeter

5. Sketch each figure. Determine the missing dimensions indicated by ■.

a)



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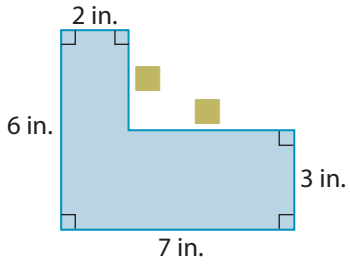

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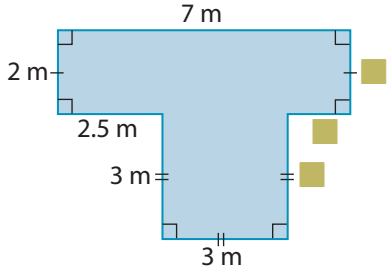


6. "Perimeter" is the distance around a figure. Calculate the perimeter of each figure in #5.

Area

7. Calculate.

a) 9×4 **b)** 8×5

c) 7×3 **d)** 12×10

e) 7×7 **f)** $8 \times 4\frac{1}{2}$

8. Round each length to the indicated unit.

a) 28.35 m to the nearest 0.1 metre

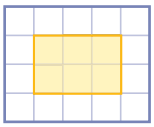
b) $24\frac{3}{4}$ in. to the nearest inch

c) 2 m 55 cm to the nearest metre

d) $3\frac{1}{2}$ ft to the nearest foot

9. Determine the number of squares that are shaded in each figure. **Hint:** Two half-shaded squares are equal to one full-shaded square.

a)



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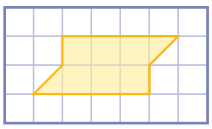

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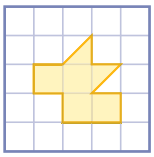
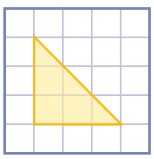


d)



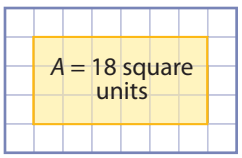
3.1 Imperial Area Measurements

Focus On . . .

- estimating and calculating area in imperial units
- identifying when to use an imperial unit of area
- solving problems that involve applying formulas
- determining whether a solution to a problem is reasonable

area

- the number of square units needed to cover a surface of a shape
- short form is *A*



What do the following projects have in common?

- ***waterproofing the boards of a deck***
- ***painting the walls in a room***
- ***installing a countertop in a kitchen***

Each project involves working with area.

Explore Imperial Areas

Materials

- ruler
- yardstick
- masking tape
- grid paper
- measuring tape

Calculating area is an important part of the job when you install flooring.

1. On the floor of your classroom, tape out an area 1 ft by 1 ft. This area is 1 square foot.

2. **a)** On the floor of your classroom, tape out an area 3 ft by 3 ft.

b) Since 3 feet equals 1 yard, what is the area inside the tape?

c) How many square feet are in 1 square yard?

3. a) Recall your personal reference for 1 foot.

b) Use this reference to estimate the dimensions of your classroom. Round your estimates to the nearest foot.

c) On grid paper, create a scale diagram of the classroom. Use the rounded dimensions from part b).

4. a) What is the approximate area of the classroom in square feet?

b) About how many square yards is this?

5. a) Using a measuring tape, measure the length and width of your classroom.

b) Calculate the area of the classroom to the nearest square foot.

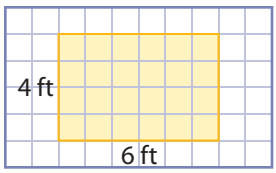
6. Reflect

a) How close was your estimate to the calculated area of the classroom?

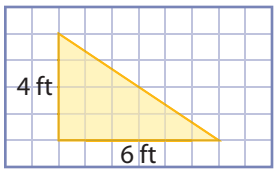
b) Was your estimate too high or too low? Explain why you think this was so.

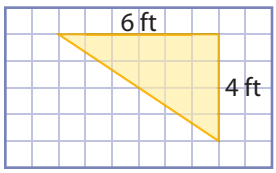
7. Extend Your Understanding Use your knowledge of the area of rectangles to determine the area of triangles.

a) What is the area of the rectangle?



b) How is the area of each triangle below related to the area of the rectangle above?





c) What is the area of each triangle?

Web Link

You can explore this relationship using dynamic geometry software. Go to www.mhrmathatwork10.ca and follow the links.

On the Job 1

Estimate and Calculate a Rectangular Area

The glass in Mackenzie's front door broke. She needs to call local glass companies to get estimates of the cost to replace the glass. Before she calls, Mackenzie needs to know the approximate area of the glass.

a) How can Mackenzie estimate the area? What is the estimated area of glass needed?

b) Mackenzie measures the dimensions of the opening in the door. The opening is 32 inches high and 20 inches wide. What is the area of the opening?

Tools of the Trade

Glaziers measure, cut, install, and repair all types of glass. Glaziers need special tools and knowledge of how glass breaks in different circumstances. To learn more about glaziers, go to www.mhrmathatwork10.ca and follow the links.

F.Y.I.

The term "square feet" can also be written ft^2.

Solution

a) Mackenzie uses a personal reference to estimate the height and width of the glass. She knows that 3 feet is about the distance from the ground to her waist.

She stands next to the door and estimates the height of the glass to be 3 feet.

She estimates the width of the glass to be about half of the height, or $1\frac{1}{2}$ feet.

Approximate area = estimated height × estimated width

$$= 3 \text{ ft} \times 1\frac{1}{2} \text{ ft}$$

$$= 4\frac{1}{2} \text{ ft}^2$$

$3 \times 1 = 3$

$3 \times \frac{1}{2} = 1\frac{1}{2}$

Mackenzie concludes that the area of the broken glass is approximately $4\frac{1}{2}$ ft^2.

b) Mackenzie measures the opening.

height = 32 in.
width = 20 in.

She calculates the area in square inches.

Area = height × width
= 32 in. × 20 in.
= 640 in.^{2}

The area of the glass needed is 640 square inches.

1 ft by 1 ft = 12 in. by 12 in.

So, 1 ft^2 = 144 in^2.

To convert square inches to square feet, divide by 144.

640 ÷ 144 = 4.444… ft^2

Mackenzie needs 4.44 square feet of glass. This is very close to her estimate of $4\frac{1}{2}$ square feet.

She knows that 4.44 ft^2 of glass will not be quite enough. The top of the door opening has a slot in which the glass fits. She will need to allow for this.

Mackenzie knows the dimensions of the opening in her door. She has an estimate of the area. Also, she has a calculation of the area in square feet and in square inches. Mackenzie feels ready to begin calling glass companies.

Your Turn

The base of a rectangular box measures 31 inches by 21 inches.

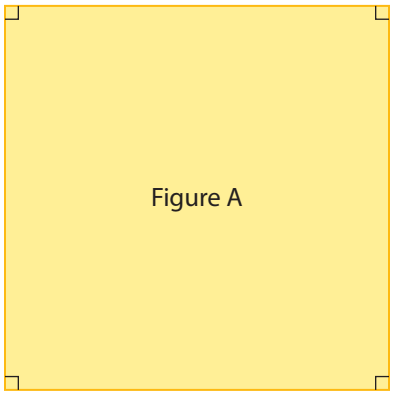
a) Estimate the area of the base of the box.

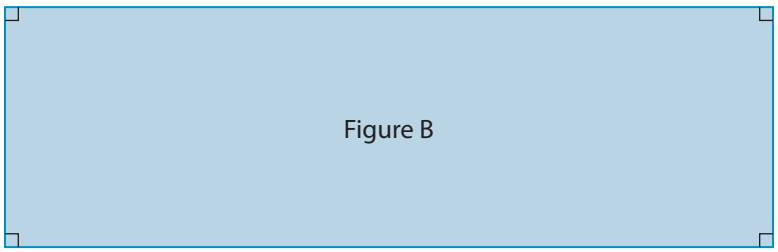
b) Calculate the area of the base of the box. What is the area in square inches? square feet? Round the answer to the nearest tenth of a square unit where necessary.

Check Your Understanding

Try It

1. a) Estimate the length and width of each figure in inches. Then, estimate each area in square inches.





b) Measure the actual length and width of each figure in part a). Then, calculate each area.

2. Complete each of the following conversions.

a) $2\ \text{ft}^2 = \blacksquare\ \text{in.}^2$

b) $\frac{1}{2}\ \text{ft}^2 = \blacksquare\ \text{in.}^2$

c) $\frac{1}{4}\ \text{ft}^2 = \blacksquare\ \text{in.}^2$

d) $2\ \text{yd}^2 = \blacksquare\ \text{ft}^2$

e) $\frac{1}{2}\ \text{yd}^2 = \blacksquare\ \text{ft}^2$

f) $9\ \text{ft}^2 = \blacksquare\ \text{yd}^2$

g) $288\ \text{in.}^2 = \blacksquare\ \text{ft}^2$

h) $1296\ \text{in.}^2 = \blacksquare\ \text{yd}^2$

3. Which imperial unit would be best to express the area of each item? Prepare to explain your reasoning.

a) a hallway in the school

b) a computer screen

c) the top of a desk

d) the bottom of your shoe

e) the screen on a calculator

f) a football field

4. a) Use personal references for imperial lengths to estimate the area of any two items from #3.

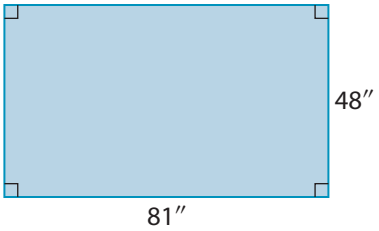
b) Compare the references you used with those used by a classmate.

c) Measure, and then calculate the area of the two items from part a). Express each area to the nearest square unit.

5. a) Calculate the area of the rectangle in square inches.

b) Convert the area to square feet.

c) Convert the area to square yards.



Apply It

6. a) Use a personal reference to estimate the dimensions of this page.

b) Estimate the area in square inches.

c) Measure the length and width of the page. Then, calculate its area, rounded to the nearest square inch.

d) Is the area of the page greater or less than 1 ft^2? Explain how you know.

F.Y.I.

Sometimes you need to round numbers up to ensure that you have enough material.

Think of times when you might need to do this.

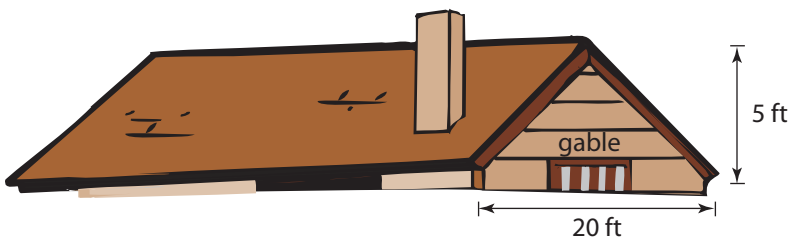
7. Derek wants to seed his front yard with grass. His yard measures approximately 45 ft by 60 ft. The instructions on a bag of grass seed indicate that it will cover 75 yd^2. How many bags of grass seed does Derek need? Explain your answer.

F.Y.I.

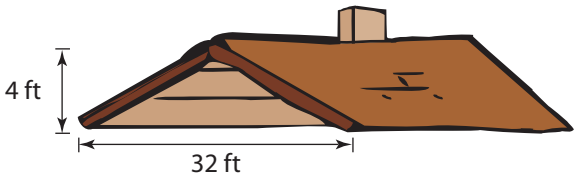
Area of triangle $= \frac{1}{2} \times$ base $\times$ height

8. House gables are in the shape of a triangle. Calculate the area of each gable shown below.

a)



b)



On the Job 2

Estimate and Calculate a Circular Area

Jason and two friends, Vicki and Kelly, decide to paint Jason's team crest at centre ice of his rink in Clarenville. They place the outside edge of the circular crest 10 feet from centre ice.

a) Estimate the area that must be painted.

b) Calculate the area to be painted, to the nearest square foot.

Solution

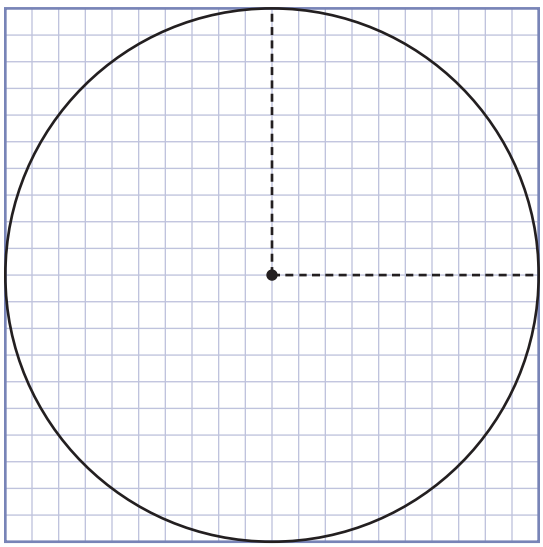
a) ***Method 1: Estimate Using a Grid***

Vicki draws a circle with a radius of 10 units on grid paper.

She counts the number of whole squares inside one quarter of the circle. There are 71.

She estimates the area of the partial squares to equal 6 full squares.

The estimate for the area of one quarter of the circle is 77 squares.

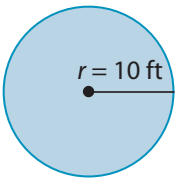


Each square represents 1 ft^2. Vicki estimates that the total area to be painted is $77\ ft^2 \times 4 = 308\ ft^2$.

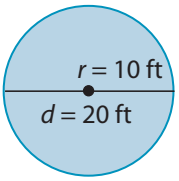
Method 2: Estimate Using a Square

Jason makes the following sketch on paper.

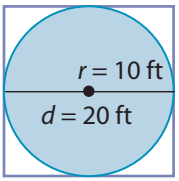
First he draws a circle and labels the radius as 10 feet.



Then, he labels the diameter as 20 feet.



He draws a square around the outside of the circle.
The width of the square is also 20 ft.



The area of the square is 20 ft × 20 ft, which is 400 ft^2. Jason says that the area of the circle has to be less than 400 ft^2. He looks at his drawing and thinks that the area of the circle will be about 320 ft^2.

b) Kelly knows that the formula for the area of a circle is $A = \pi r^2$, where r is the radius.

$A = \pi r^2$

$A = \pi(10 \text{ ft})^2$

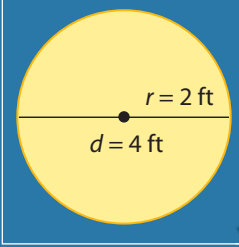
$A = 314.159\ldots \text{ ft}^2$ 314.1592654

Kelly calculates that the area of the circle, rounded to the nearest square foot, is about 314 ft^2.

Jason and his friends will need to paint an area at centre ice of about 314 square feet.

F.Y.I.

The length of the radius of a circle is half the length of the diameter.



F.Y.I.

π is read as pi. If your calculator does not have a π key, use 3.14. This is a good approximation of pi.

Tech Link

Follow the steps to use the pi button.

Press C π × 10 × 10 =

Your calculator may have slightly different key strokes. Experiment or check with a classmate to find out which ones work.

Your Turn

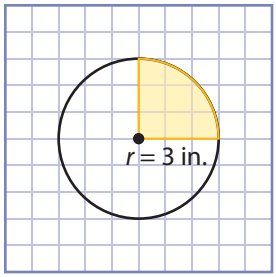
A circular wading pool has a radius of 5 feet. Estimate and then calculate the area. Round your answer to the nearest tenth of a square foot.

Check Your Understanding

Try It

1. Estimate the area of each shaded quarter circle.

a)



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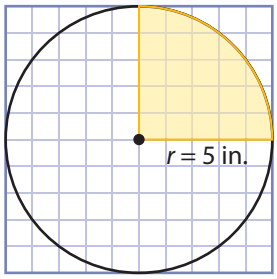
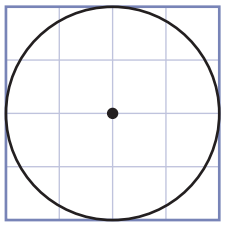


2. Estimate the total area of each circle in #1.

3. What is the area of each large square?

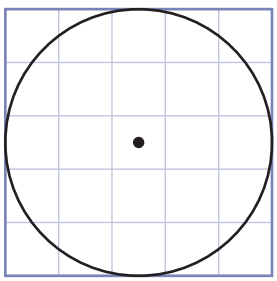
a)



Scale: 1 square represents 1 $in.^2$

This means that the length of one side of one square on a diagram represents 1 in. of actual length.

b)



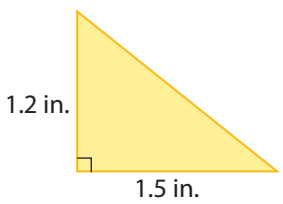
Scale: 1 square represents 1 $in.^2$

4. Estimate the area of each circle in #3.

5. Calculate the area of each circle in #1 and #3. Round all answers to the nearest square inch.

6. a) Estimate the area of the triangle.

b) Calculate the area of the triangle. Round the answer to the nearest tenth of a square inch.



Tools of the Trade

Sprinkler system installers build, install, test, and maintain and repair sprinkler systems. Sprinkler systems are often installed in buildings for fire protection. To learn more about sprinkler system installers, go to www.mhrmathatwork10.ca and follow the links.

Apply It

7. A sprinkler on a golf course can spray a distance of about 80 feet. The sprinkler head travels in a circle. What is the area of the grass that the sprinkler can soak? Express your answer to the nearest square foot.

F.Y.I.

Each year, Canada loses millions of dollars worth of lumber to forest fires.

8. Allison works in forestry in Labrador, watching for fires. From her observation tower, she can see a distance of about 20 mi in all directions. What is the total area she can see from the tower, to the nearest square mile?

F.Y.I.

Brad Gushue and teammates Russ Howard, Mark Nichols, Jamie Korab, and Mike Adam won the gold medal for curling at the 2006 Winter Olympics. The curlers became the first Newfoundlanders ever to win a gold medal.

9. In curling, "the house" is a set of different-sized circles with the same centre. The manager of a curling rink in St. John's needs to know the area of the house. The house has dimensions as shown in the table below.

Ring	Outside Diameter (ft)
White button	1
Red	4
White	8
Blue	12

Round each answer to the nearest tenth of a square foot.

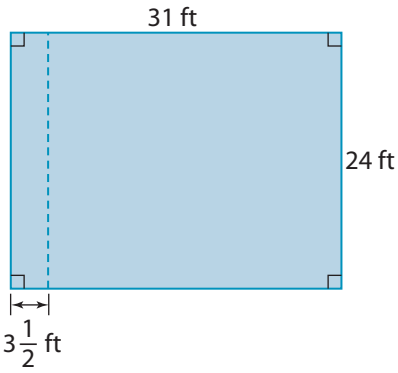
a) Calculate the area of the white button in the centre of the house.

b) Calculate the area of the house.

c) Calculate the area of the red ring.

Work With It

1. A math classroom is being remodelled to provide access for wheelchairs. The classroom currently measures 31 ft by 24 ft. The longer walls will be reduced in length by $3\frac{1}{2}$ ft. The new floor tiles measure 1 ft by 1 ft. Calculate the number of floor tiles needed for this classroom.



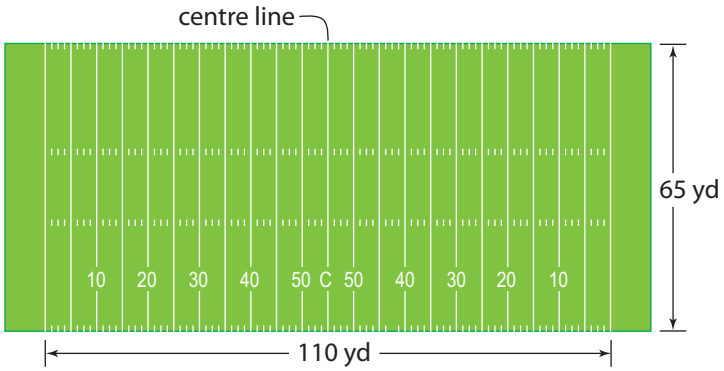
2. **a)** Calculate the area of the circular face of a hockey puck. Round your answer to the nearest tenth of a square inch.

b) Calculate the area of the face of the hockey puck in SI measurements. Round your answer to the nearest tenth of a square unit.

F.Y.I.

1 in. is about 2.5 cm.

3. Canadian football is usually played on a field 110 yards by 65 yards.



F.Y.I.

Commonwealth Stadium in Edmonton, AB, is the only Canadian Football League field with a natural grass turf.

a) Calculate the area of the field in square yards.

b) Suppose the turf between the two 40-yd lines is damaged and needs to be replaced. Calculate the area of new turf needed.

F.Y.I.

The slant height of a roof is the distance along the slope of the roof from the top of the roof to the bottom.

Tools of the Trade

Roofers and shinglers build and repair flat and sloped roofs using asphalt, shingles, and other waterproof materials. To learn more about roofing, go to www.mhrmathatwork10.ca and follow the links.

4. A gable roof consists of two rectangles. A bundle of shingles covers approximately 32 ft^2. Jake's roof is 44 ft wide and has a slant height of 18 ft. How many bundles will he need to shingle the roof?

5. Tasha works for a company that makes solar blankets for swimming pools. A customer in Grand Falls-Windsor orders a blanket to cover a pool. The circular pool has a diameter of 16 feet.

a) Using grid paper, make a scale diagram of the solar blanket.

b) Use the diagram to estimate the area of the blanket.

c) Calculate the area of the pool's surface, to the nearest square foot.

d) Solar blankets sell for $2.99 per square yard. Calculate the cost, before tax, of the blanket.

Discuss It

6. A round drum has a diameter of 12 in. Is the drum's area greater than, less than, or equal to 1 ft^2? You may wish to use a diagram to support your reasoning.

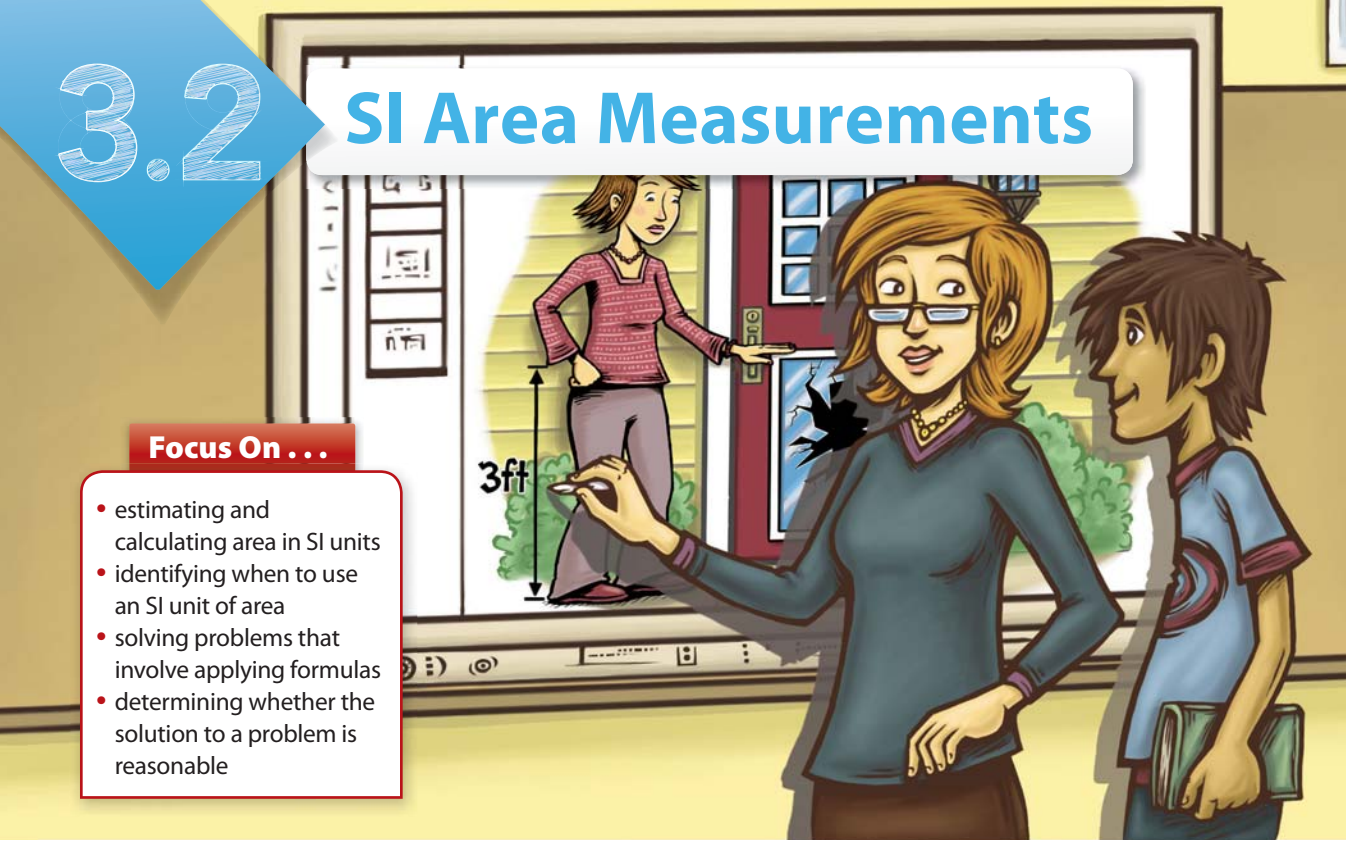
7. Do you think it is a good idea to estimate an answer to an area problem before calculating the answer? Prepare to explain.

8. Mark says that the area of the 8-ft ring in curling is double that of the 4-ft ring. Is he right? Explain why or why not.

9. a) Explain why someone who installs sprinkler systems needs to have a working knowledge of area.

b) State two other jobs or careers that involve working with area.

3.2 SI Area Measurements



Focus On . . .

- estimating and calculating area in SI units
- identifying when to use an SI unit of area
- solving problems that involve applying formulas
- determining whether the solution to a problem is reasonable

People who sell pull-down screens for multimedia presentations need to work with area. So do painters and masons.

Explore SI Areas

Materials

- metre sticks
- grid paper
- scissors
- measuring tape

People who sell screens are responsible for calculating area to determine the best size of screen for a wall.

1. On the floor of your classroom, lay out four metre sticks in the shape of a square. You want the area inside the square to be exactly 1 square metre.

2. a) Using a piece of grid paper, cut out one square that is 1 cm by 1 cm. Then, cut out a square that is 10 cm by 10 cm.

b) What is the area of the smaller square of paper? What is the area of the larger square of paper?

c) Place each square of paper inside the square on the floor. How many of the smaller squares would it take to cover the square metre? How many of the larger squares would it take to cover the square metre?

d) Explain your answers to part c).

3. a) Estimate the dimensions of your classroom. Round your estimates to the nearest metre.

b) What is the approximate area of the classroom?

4. a) Estimate the dimensions of a desktop or a tabletop in your classroom. Round your estimates to the nearest centimetre.

b) What is the approximate area of the item in part a)?

c) Is this area greater than, less than, or equal to 1 m^2?

d) Explain how you know.

5. a) Use a measuring tape to measure the dimensions of your classroom to the nearest 0.1 metre.

b) Calculate the area of the floor to the nearest 0.1 m^2.

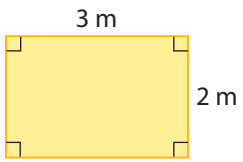
6. a) Measure the dimensions of your desktop or tabletop. Show the measurement to the nearest centimetre.

b) Calculate the area to the nearest square centimetre.

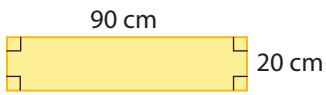
7. Reflect How close were your estimates to the calculated areas?

8. Extend Your Understanding Use your knowledge of the area of rectangles to determine the area of triangles.

a) Determine the area of each rectangle.

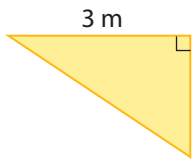


Rectangle A

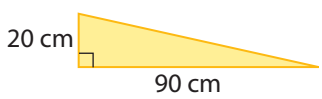


Rectangle B

b) How is the area of each triangle related to the area of the rectangle directly above it?



Triangle A



Triangle B

c) Calculate the area of each triangle.

On the Job 1

Estimate and Calculate a Rectangular Area

F.Y.I.

When asphalt is spread, it can be as hot as 300 °F. That's about 150 °C!

Mario's company owns a strip mall. A leaking water main has damaged a section of the parking lot. About 20 parking spaces need repaving. Mario needs to determine the area that must be resurfaced.

a) Describe a strategy for estimating the area that needs to be repaved. Then, estimate the area.

b) One parking space measures 4.8 metres by 2.4 metres. What is the total area that needs to be repaved?

Solution

a) Estimate the dimensions of one space.

Mario knows that one of his strides is approximately 1 metre in length. He takes 5 strides for the length of one parking space. He takes $2\frac{1}{2}$ strides for its width.

Estimate the area that needs to be repaved.

Method 1: Estimate the Area of One Parking Space

Approximate area = estimated length × estimated width

$= 5 \text{ m} \times 2.5 \text{ m}$

$= 12.5 \text{ m}^2$

Mario estimates that the area of one parking space is 12.5 square metres.

20 parking spaces were damaged.

$12.5 \text{ m}^2 \times 20 = 250 \text{ m}^2$

Mario estimates that the total area needing repaving is 250 m^2.

You can multiply by 12.5 without using a calculator.

$12 \times 2 = 24$

Therefore, $12 \times 20 = 240$.

0.5 is the same as $\frac{1}{2}$.

Half of 20 is 10.

$240 + 10 = 250$

Use mental math to multiply 12.5×20 using a different strategy.

F.Y.I.

How can you multiply a number by a power of 10?

Shift the decimal point one place to the right for each zero in the power.

$2.5 \times 10 = 25$
Shift 1 place.

$2.5 \times 100 = 250$
Shift 2 places.

$2.5 \times 1000 = 2500$
Shift 3 places.

Method 2: Estimate the Dimensions of All Damaged Parking Spaces

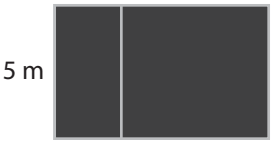
Each parking space has an estimated width of 2.5 m and a length of 5 m.

Twenty parking spaces form a large rectangle that is (20×2.5) m wide and 5 m long.

$2.5 \text{ m} \times 20 = 50 \text{ m}$

$\text{Approximate area} = 50 \text{ m} \times 5 \text{ m}$
$= 250 \text{ m}^2$

Mario estimates that the area of 20 parking spaces is 250 m^2.



b) ***Method 1: Calculate the Area of One Parking Space***

$\text{Area} = \text{length} \times \text{width}$
$= 4.8 \text{ m} \times 2.4 \text{ m}$
$= 11.52 \text{ m}^2$

Mario calculates the area of one parking space is 11.52 square metres.

20 parking spaces were damaged.

$11.52 \text{ m}^2 \times 20 = 230.4 \text{ m}^2$

The total area needing repaving is 230.4 m^2.

Method 2: Calculate the Dimensions of All Damaged Parking Spaces

The width of one parking space is 2.4 metres.

$\text{The width of 20 parking spaces} = 2.4 \text{ m} \times 20$
$= 48 \text{ m}$

The length of the entire row of parking spaces is 4.8 metres.

$\text{Approximate area} = 48 \text{ m} \times 4.8 \text{ m}$
$= 230.4 \text{ m}^2$

The area of the 20 parking spaces is 230.4 m^2.

Your Turn

A badminton court measures 13.4 metres in width and 6.1 metres in length.

a) Estimate the area of the badminton court.

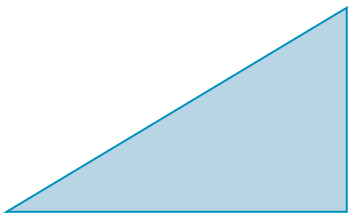
b) What is the area of the badminton court? Show your answer to the nearest 0.1 square metre.

Check Your Understanding

Try It

1. Estimate the width and height of each figure in centimetres. Then, estimate each area in square centimetres.

a) 

b) 

2. Measure the actual width and height of each figure in #1. Show your measurements to the nearest 0.1 cm. Then, calculate each area to the nearest 0.1 cm^2.

3. Complete each of the following conversions.

a) 1 m^2 = ■ cm^2

b) 0.5 m^2 = ■ cm^2

c) 0.1 m^2 = ■ cm^2

d) 50 cm × 50 cm = ■ cm^2 = ■ m^2

e) 50 cm × 100 cm = ■ cm^2 = ■ m^2

f) 25 m × 100 m = ■ m^2 = ■ km^2

4. What SI unit would be best to express the area of each item? Explain your reasoning to a classmate.

a) a parking space

b) the palm of your hand

c) the back of a chair

d) the face of a clock

e) a soccer field

f) a computer keyboard

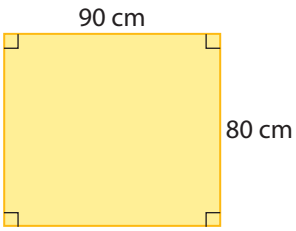
5. a) Use personal references for SI lengths to estimate the area of any two items from #4.

b) Compare the references you used with those used by a classmate.

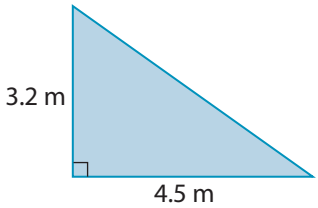
c) Measure, and then calculate the area of the two items from part a). Express each area to the nearest tenth of a square unit.

6. a) Without using a calculator, determine the area of the rectangle in square centimetres.

b) Convert the dimensions to metres. Then, calculate the area in square metres.



7. Determine the area of the triangle in square metres.



Apply It

8. a) Estimate the dimensions of a display board in your school.

b) Estimate the area in square centimetres and in square metres.

c) Measure the length and the height of the board to the nearest centimetre. Then, calculate the area. Round your answer to the nearest square centimetre.

d) Measure the length and the height of the same board to the nearest 0.1 m. Then, calculate the area. Round your answer to the nearest 0.1 m^2.

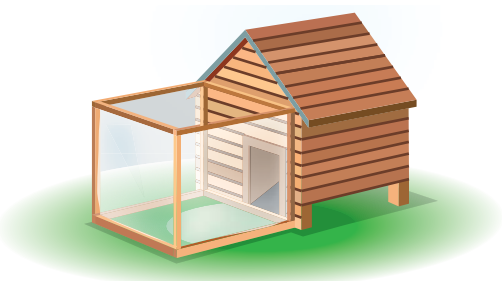
9. A litre of paint will cover approximately 10 m^2.

a) Use masking tape to mark an area on a wall approximately equal to 25 square metres.

b) Approximately how many litres of paint would you need to paint that part of the wall?

c) Approximately how many litres of paint would you need for two coats of paint on all of the walls in your classroom? Assume that each coat takes the same amount of paint.

10. Ruby has 30 m of fencing to make a yard for her chickens. She wants to make a rectangle with one side along the wall of the chicken coop. The chicken coop is 10 m wide. What is the largest area she can enclose?



On the Job 2

Determine a Circular Area Using SI Measures

Gayle's family installed a portable pool with a diameter of 4 m in their yard. They left the pool in the same place for so long that the grass underneath the pool died.

a) Estimate the area that needs grass seed.

b) Calculate the area to be seeded to the nearest tenth of a square metre.

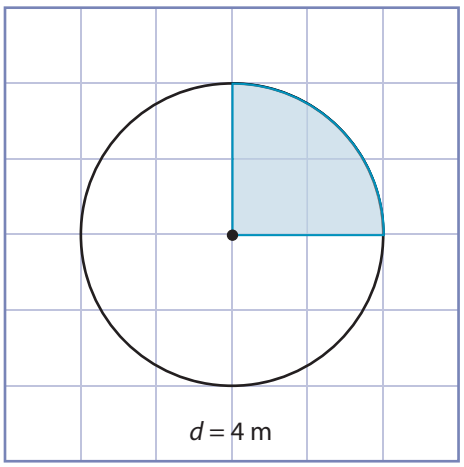
Solution

a) Gayle knows that the pool has a diameter of 4 metres.

$4 \text{ m} \times 4 = 16 \text{ m}^2$

The area of a square around the outside of the circle is 16 square metres.

The edge length of each grid square is 1 m.



She knows that the area of the circle will be less than 16 m^2. She estimates the area to be approximately 14 m^2.

b) Gayle could use pi $= 3$ to estimate the area of the circle.

$4 \text{ m} \times 3 = 12 \text{ m}^2$

So the area of the circle should be about 12 m^2.

To calculate the area to be seeded, Gayle uses the formula for the area of a circle.

$A = \pi r^2$

$A = \pi(2 \text{ m})^2$

$A = \pi \times 4 \text{ m}$

$A = 12.566\ldots \text{ m}^2$

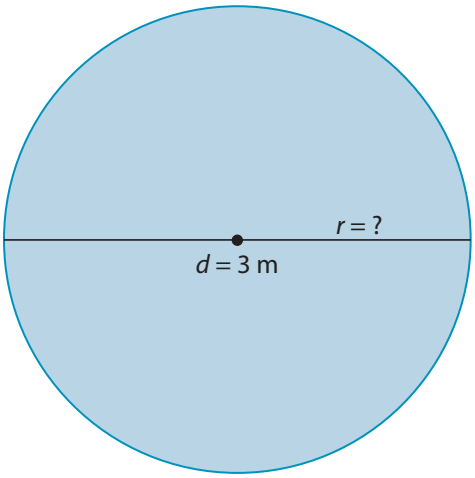
12.56637061

The formula is $A = \pi r^2$.
In the formula, r stands for the radius of the pool.

The area to be seeded is about 12.6 square metres.

Your Turn

A circular solar blanket has a diameter of 3 metres. Estimate and then calculate its area. Round your answers to the nearest tenth of a square metre.

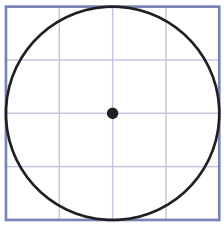


Check Your Understanding

Try It

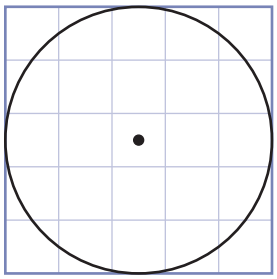
1. What is the area of each large square?

a)



Scale: 1 square represents 1 cm^2

b)



Scale: 1 square represents 1 m^2

2. Estimate the area of each circle in #1.

3. Calculate the area of each circle in #1. Round all answers to the nearest square unit.

Apply It

4. Harold drilled an ice-fishing hole. The diameter of the hole is about 25 cm.

a) Use grid paper and make a scale diagram of the fishing hole.

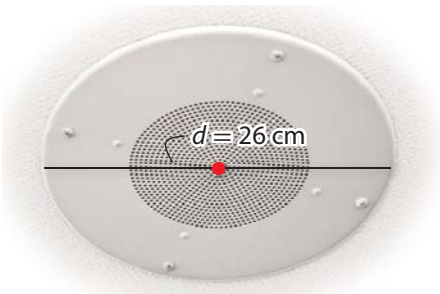
b) Use your diagram to help estimate the area of the hole.

c) Calculate the area of the hole to the nearest square centimetre.

F.Y.I.

If the temperature stays above freezing for more than 24 hours, ice begins to lose strength.

5. Many stores have speakers mounted into the ceiling. The holes in the ceiling are often covered with circular plastic or metal grills that match the ceiling colour. Calculate the area of a plastic grill that has a diameter of 26 cm. Round your answer to the nearest square centimetre.



F.Y.I.

A round access cover cannot fall into the sewer through its opening. But a square cover *can* fall through the opening if it is dropped diagonally.

F.Y.I.

The puffin is the provincial bird of Newfoundland and Labrador. About 95% of all North America's puffins breed around the coasts of Newfoundland and Labrador.

6. Workers can enter a sewer through an access such as this. What is the area of this circular access cover if the diameter is 26.5 in.? Express your answer to the nearest square inch.

7. Bonnie makes stained glass designs that she sells at craft shows. Part of this design has a circle with a 10-cm diameter.

a) Using centimetre grid paper, draw a circle with a diameter of 10 cm.

b) Estimate the area of one of Bonnie's designs.

c) Calculate the area of one of Bonnie's designs to the nearest 0.1 cm^2.

8. The Mi'kmaq drum shown is handmade from deer or moose hide, with a handle made from deer or moose hide. It has a diameter of 12 in. What is the area of the drum head, to the nearest tenth of a square inch?

Work With It

Tools of the Trade

Tilers install and repair tiled surfaces. Tiles can be ceramic, porcelain, stone, or even glass. Different tiles require different adhesives. Grout is often applied after the tiles are set. To learn more about tiling, go to www.mhrmathatwork10.ca and follow the links.

1. The floor of the cold storage room in Dylan's basement measures 3.3 m by 3.0 m.

a) What is the area of the floor, in square metres?

b) Convert the dimensions of the floor to centimetres.

c) Ceramic tiles measure 30 cm by 30 cm. How many tiles will Dylan need to cover the floor of the storage room?

2. Nick and Caitlin plan to expand two rooms in their home. They want to remove a wall and build an addition. The dotted line represents the wall they want to remove.

a) Convert the given dimensions to metres.

b) Calculate the area of each room to the nearest 0.1 m^2.

c) Suppose the new wall extends each room by 2 metres. What will the dimensions of each room be?

d) Draw a scale diagram of the two rooms after the renovation.

e) What is the area of each expanded room?

F.Y.I.

1 cm is about 0.4 in.

3. a) An electric hot plate has a diameter of 15 cm. What is the area of the top of the hot plate? Give your answer to the nearest square centimetre.

b) What is this area in imperial measurements?

4. The Clarke family's asphalt driveway is 30 years old and has many cracks. They plan to remove the asphalt and rebuild the driveway using paving stones.

a) Describe a strategy for estimating the area of a rectangular driveway.

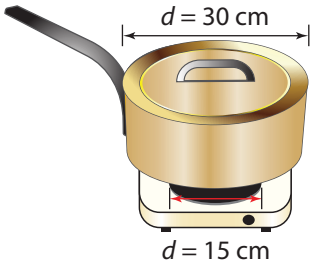
b) The dimensions of the driveway are 3.7 m wide by 10.2 m long. Estimate the area of the driveway.

c) Calculate the area of the driveway.

d) How close was your estimate to the calculated area? Compare your estimate with the one of a classmate.

Discuss It

5. Jennifer places a pot with a diameter of 30 cm on a 15-cm diameter hot plate.



Jennifer says: "The diameter of the burner is half the diameter of the pot. Therefore, half of the pot is on the burner."

Do you agree with Jennifer's thinking? Justify your answer.

6. Many people find it easier to convert linear measurements from one unit to another in the SI system than in the imperial system. Explain why.

7. Work with a partner. List as many different length and width dimensions as possible that give an area of 36 m^2.

8. a) What personal reference could you use to help you estimate the width of your classroom in SI units? in imperial units?

b) Which reference do you find more useful for this purpose? Explain.

3.3 Working With Area

Focus On . . .

- estimating the area of a composite 2-D shape using a grid
- solving problems that involve the area of composite 2-D shapes
- explaining how changing one or more dimensions affects the area of a rectangle

What do the following projects have in common?

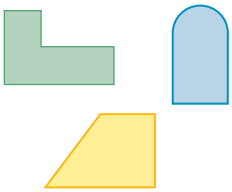
- ***covering a couch with fabric***
- ***laying hardwood in a bedroom with an adjoining closet***
- ***creating a parking lot along two walls of a building***

Each of these involves the area of at least one composite shape.

Look around your classroom or home. What composite shapes do you see?

composite shape

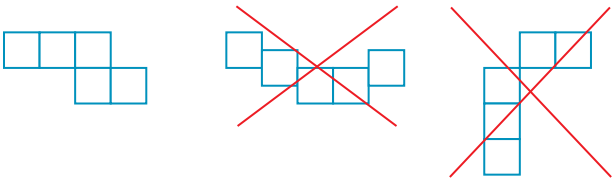
- a shape made of two or more shapes



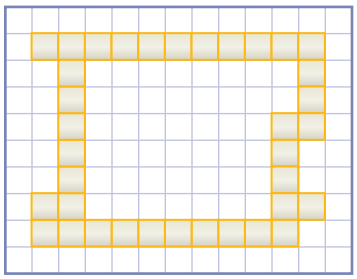
Explore Areas of Composite Shapes

Materials
- square tiles
- grid paper
- ruler

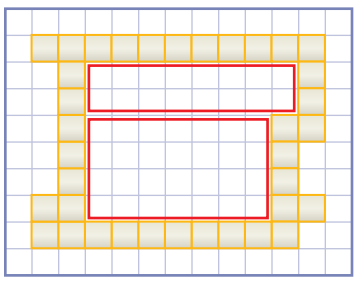
Design an enclosed space that is bordered by 28 patio stones. Each stone measures 0.5 m by 0.5 m. The stones must be laid side by side along whole edges. You need to form a continuous band around the space.



1. Using 28 square tiles, design at least four composite shapes. Sketch each design by shading squares on grid paper.
2. Determine the area of each space that you enclosed, in square metres.
3. **Reflect** Compare your designs with the designs of other students. Which design has the greatest area?
4. **Extend Your Understanding**
   - **a)** Suppose you have 36 square tiles. What would be the area of the inside of this shape?



   - **b)** Describe the strategy used to find the area of the shape in part a).

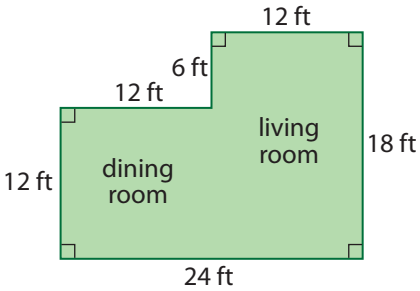


   - **c)** What other strategy might you use to find the area of this shape?

On the Job 1

Determine the Area of a Composite Shape

Felicity recently moved into a house in Mt. Pearl. She plans to install a hardwood floor in her dining room and living room. Below is a sketch of the area. Calculate the area of the floor to be covered in hardwood.



Tools of the Trade

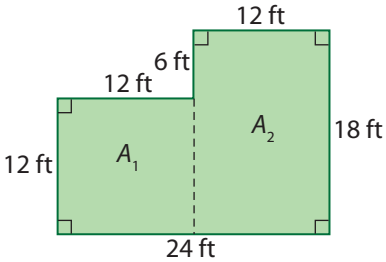
Floor covering installers prepare surfaces, measure areas to be covered, and install new flooring. Floor coverings include carpet, vinyl, tiles, and hardwood. To learn more about floor covering installers, go to www.mhrmathatwork10.ca and follow the links.

Solution

Method 1: Add Two Areas

You could divide the diagram into two areas.

One Way

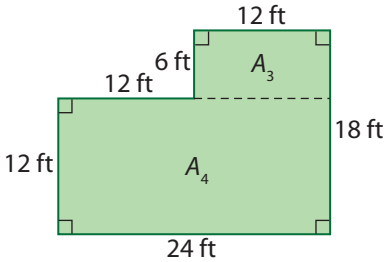


$A_1 = l \times w$
$A_1 = 12 \text{ ft} \times 12 \text{ ft}$
$A_1 = 144 \text{ ft}^2$

$A_2 = l \times w$
$A_2 = 12 \text{ ft} \times 18 \text{ ft}$
$A_2 = 216 \text{ ft}^2$

$\text{Total area} = A_1 + A_2$
$= 144 \text{ ft}^2 + 216 \text{ ft}^2$
$= 360 \text{ ft}^2$

Another Way



$A_3 = l \times w$
$A_3 = 12 \text{ ft} \times 6 \text{ ft}$
$A_3 = 72 \text{ ft}^2$

$A_4 = l \times w$
$A_4 = 24 \text{ ft} \times 12 \text{ ft}$
$A_4 = 288 \text{ ft}^2$

$\text{Total area} = A_3 + A_4$
$= 72 \text{ ft}^2 + 288 \text{ ft}^2$
$= 360 \text{ ft}^2$

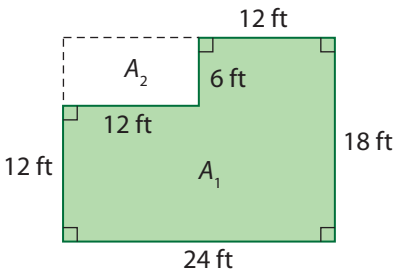
Use mental math to determine each product.
Example:
$24 \times 10 = 240$
$24 \times 2 = 48$
$240 + 48 = 288$

The total area of the two rooms is 360 ft^2.

Method 2: Subtract One Area From Another

Show the shape as one large rectangle.
This large rectangle is 18 ft by 24 ft.

Call the new rectangle in the upper corner A_2.
Call the original rectangle area A_1.



$A_1 = l \times w$
$A_1 = 24 \text{ ft} \times 18 \text{ ft}$
$A_1 = 432 \text{ ft}^2$

$A_2 = l \times w$
$A_2 = 12 \text{ ft} \times 6 \text{ ft}$
$A_2 = 72 \text{ ft}^2$

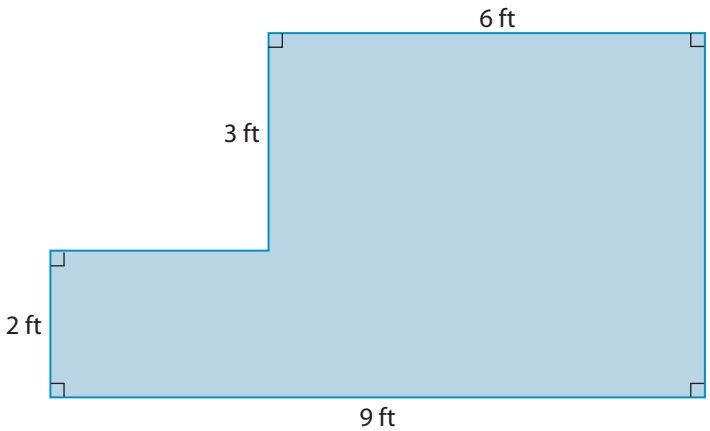
The total area of the floor is $A_1 - A_2$.

$\text{Total area} = 432 \text{ ft}^2 - 72 \text{ ft}^2$
$= 360 \text{ ft}^2$

The total area of the two rooms is 360 ft^2.

Your Turn

a) Calculate the area of the composite shape.



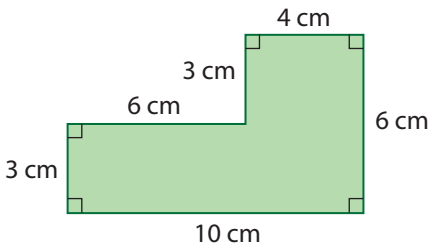
b) Use a second strategy to verify your answer in part a).

Check Your Understanding

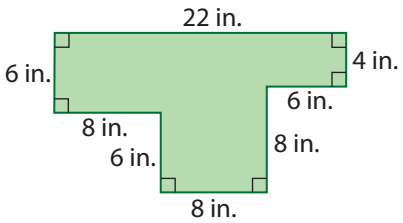
Try It

1. Determine the area of each composite shape.

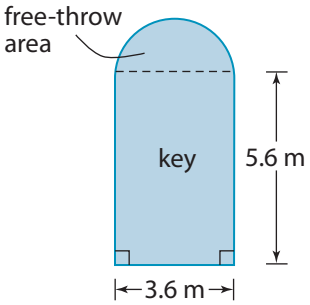
a)

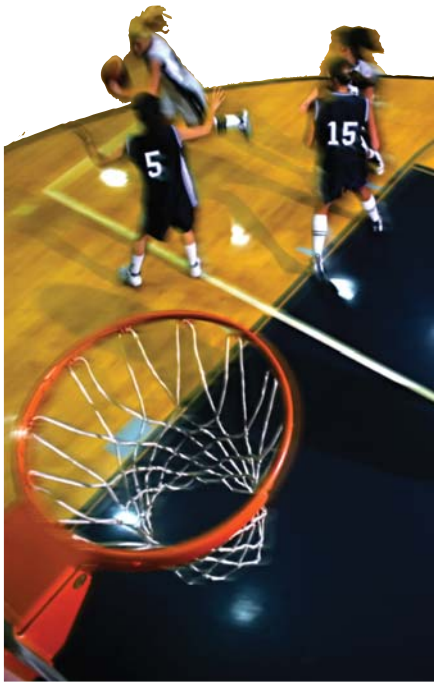


b)



2. Each of the two keys on a basketball court is in the shape of a rectangle. Each key also includes a free-throw area. Each of the two free-throw areas is in the shape of a semicircle. These areas can be painted so that they stand out from the rest of the court.





a) Calculate the area of one key. Express the answer to the nearest tenth of a square metre.

b) Calculate the area of one free-throw area. Express the answer to the nearest tenth of a square metre.

c) Calculate the total area to be painted for one basketball court.

F.Y.I.

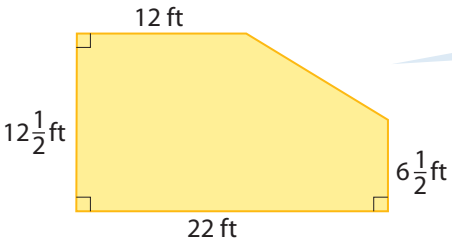
3.78 L is equivalent to 1 U.S. gallon.

Web Link

To explore composite shapes, go to www.mhrmathatwork10.ca and follow the links.

Apply It

3. Ray was hired to stain a wooden deck. He needs to estimate the cost of the stain needed.



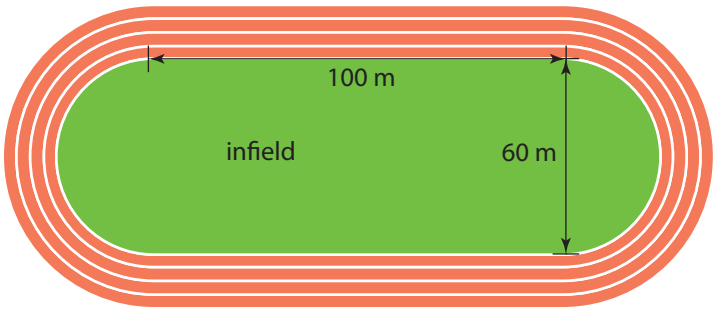
Recall how the area of a triangle relates to the area of a rectangle. See page 129.

a) Estimate, and then calculate the area of the deck.

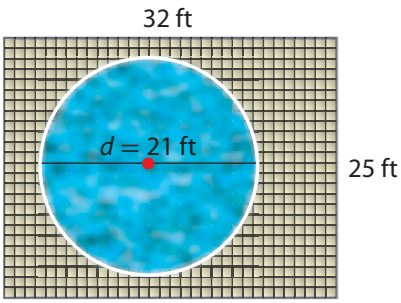
b) A 3.78-L can of wood stain covers about 300 ft^2. How many cans of stain does Ray need to cover the deck with one coat of stain?

4. Jon is a self-employed tiler. He is tiling 3 walls surrounding a 5-ft by 3-ft bathtub to a height of 2 ft. The tiles are 4 inches by 4 inches. What is the minimum number of tiles Jon needs?

5. The infield of a new running track will be covered with sod. Each end of the running track forms a semicircle. Calculate the area of the infield. Round your answer to the nearest square metre.



6. A patio made of concrete patio stones surrounds a circular pool. Helen wants to paint the concrete with a sealant to protect it. One can of sealant covers 175 ft^2.



a) What is the area of the patio, to the nearest square foot?

b) How many cans of sealant does she need?

On the Job 2

Determine the Effect of Changing Dimensions

At the soccer tournament, Ryan had his picture taken for the newspaper. The photo measures 20 cm wide by 10 cm high.

a) What is the area of the photo?

b) His parents decide to have the photo enlarged and mounted on a plaque. They ask the enlarger to double both the width and the height of the photo. What is the new area?

c) How many times as large as the area of the original photo is the area of the enlargement?

d) Suppose the dimensions were multiplied by 4 instead of by 2. How would the area of the plaque be affected?

Solution

a) The dimensions of the photo are 20 cm by 10 cm.

$A = l \times w$
$A = 20 \text{ cm} \times 10 \text{ cm}$
$A = 200 \text{ cm}^2$

The area of the photo is 200 cm^2.

b) The enlargement will have dimensions 40 cm by 20 cm.

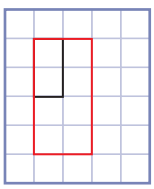
$A = l \times w$
$A = 40 \text{ cm} \times 20 \text{ cm}$
$A = 800 \text{ cm}^2$

The area of the enlargement will be 800 cm^2.

c) ***Method 1: Use a Scale Diagram***

Use grid paper and draw a scale diagram of the 20-cm by 10-cm dimensions.

Use a different colour to draw the 40-cm by 20-cm dimensions.



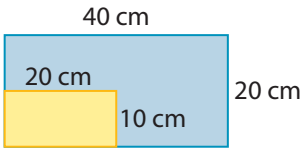
I can fit four small photos inside the large photo.

The large photo is four times the size of the small one.

Method 2: Divide the Larger Area by the Smaller Area

$800 \text{ cm}^2 \div 200 \text{ cm}^2 = 4$

Doubling each of the two dimensions makes the area four times the size of the original photo.



d) Multiply each dimension by 4.

The dimensions become 80 cm by 40 cm.

$A = l \times w$

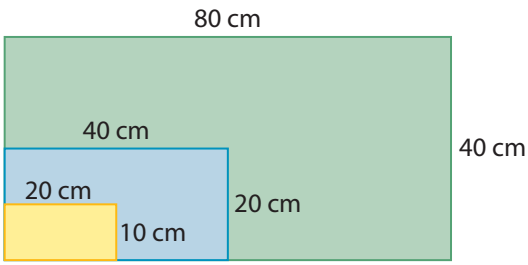
$A = 80 \text{ cm} \times 40 \text{ cm}$

$A = 3200 \text{ cm}^2$

The area increases to 3200 cm^2.

$3200 \text{ cm}^2 \div 200 \text{ cm}^2 = 16$

The area of the large photo is 16 times the area of the original.



Your Turn

a) Ryan suggests tripling the dimensions of the original photo. What is the area of the plaque then? Show your thinking.

b) Suppose Ryan had to reduce the dimensions of the original photo by half for the school newspaper. What is the area of this photo? Show your work.

Check Your Understanding

Try It

1. a) On grid paper, sketch a rectangle 5 cm wide and 6 cm long.

b) What is the area of the rectangle?

c) Sketch a rectangle with the width of the original rectangle doubled and the same length.

d) How many times as great is the area of the new rectangle than the area of the original rectangle?

e) Sketch a rectangle with the original width and double the length.

f) How does the area of this rectangle relate to the rectangle that you sketched in part c)?

g) Sketch a rectangle with double the original width and double the original length.

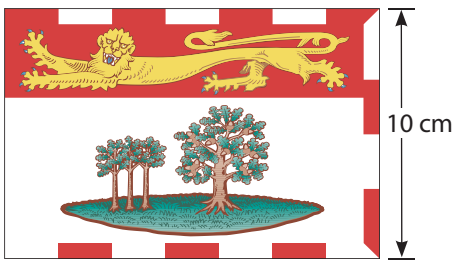
h) How many times greater is the area of this rectangle than the area of the original rectangle?

F.Y.I.

The flag of Prince Edward Island features a gold lion and an island. The oak tree is the official tree. The smaller trees represent the three counties that the island is divided into. The bands of red and white on three sides of the flag represent the official colours of Canada.

Apply It

2. The ratio of the length to the width of the flag of Prince Edward Island is 3 : 2. Assume that you have a flag that is 10 cm wide.



a) How long is the flag?

b) What are the dimensions of a flag in which the length and width are tripled?

c) What are the dimensions of a flag in which the length and the width are halved?

3. To answer the following questions, you will need the dimensions of your classroom, rounded to the nearest metre.

a) Create a scale diagram of the classroom on centimetre grid paper. Use a scale of 1 cm represents 1 m.

b) How many times greater is the length of the actual classroom than the length of the classroom on the diagram?

c) How many times greater is the width of the actual classroom than the width of the classroom on the diagram?

d) How many times greater is the area of the classroom than the area of the classroom on the diagram?

4. Chloe needs to triple the dimensions of a photo of the Newfoundland tartan for a display wall at school.

6 cm x 3 = 18 cm
Each side of the photo will be 18 cm long.

Is Chloe correct? If so, explain how you know. If she is incorrect, explain her mistake.

F.Y.I.

The Newfoundland Tartan uses colour to represent cultural and historic symbols: green for hills, gold for sun, white for winter, brown for iron ore, and red for the province's ties to England.

5. Brian lives in Labrador City. He likes spending some long summer days in his garden. He wants to expand his garden by lengthening one or both of its sides.

a) Calculate the area of Brian's garden if it measures 25 ft by 40 ft.

b) Which gives the larger area, doubling the length or doubling the width? Explain your reasoning.

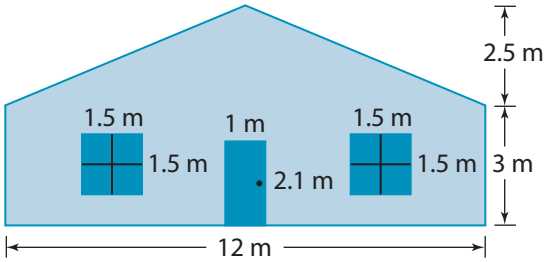
c) Suppose Brian doubles both dimensions of the garden. How many times as large is the area of the expanded garden compared to the original garden?

F.Y.I.

In June, Labrador City has about 17 hours of daylight.

Work With It

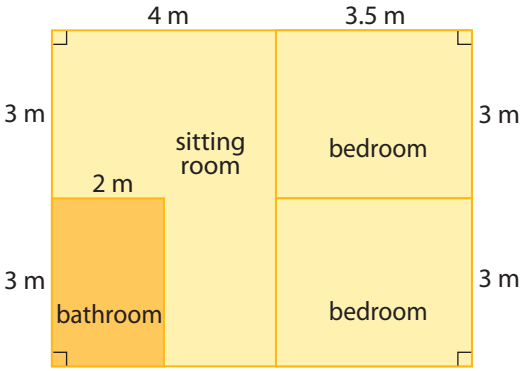
1. Michelle is painting the front of a neighbour's house. This does not include painting the front door or the windows.



a) Calculate the area to be painted.

b) One litre of paint will cover about 10 m^2. A 4-L can costs $37.99, plus HST. A 1-L can costs $12.99, plus HST. What is the minimum amount that Michelle will spend if she uses two coats of paint on the front of the house? Assume that each coat uses the same amount of paint.

2. A small cabin overlooking Sandwich Bay has the following floor plan.



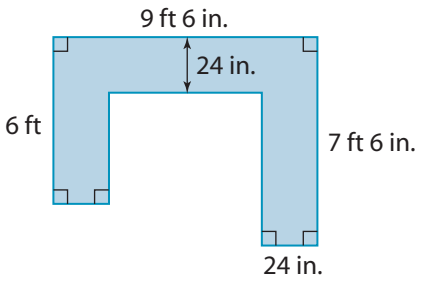
a) Calculate the total area of the bedrooms.

b) Calculate the area of the sitting room.

c) What is the floor area of the cabin?

d) What would the floor area be if the outer dimensions were doubled?

3. Eric is starting a catering business. He is adding a kitchen in his basement. He plans to include a U-shaped kitchen counter as shown.



a) What is the surface area of the countertop, in square inches?

b) What is the surface area of the countertop, in square feet?

c) Research the cost of two different materials that could be used for the countertop. Include the name of each material and its cost. What is the cost for the countertop using each material?

Discuss It

4. A rectangle has a length of 8 m and a width of 5 m. Its area is 40 m^2. If the length is changed to 4 m, the new area is 20 m^2. This is half the original area. Explain the effect this change would have on the perimeter of the rectangle.

5. a) Write a problem that involves using an area formula.

b) Solve your problem, and then exchange problems with a classmate.

c) Solve your classmate's problem and compare the strategies that you used.

6. Discuss different strategies for estimating the area of the top face of this artifact.

7. Consider the various jobs referred to in this chapter. Which of these jobs might require someone to calculate the area of a circle? When might they have to use the formula?

3.4 Surface Area of Three-Dimensional Objects

Focus On . . .

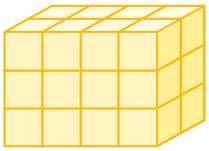
- displaying the surface area of a 3-D object as a combination of 2-D shapes
- calculating the surface area of 3-D objects

Manufacturers must consider the amount of materials needed to make packaging. To estimate the costs, manufacturers must know the surface area of the packaging. Surface area measures the amount of exposed area of an object.

What other jobs might require knowing the surface area of an object?

surface area

- the number of square units needed to cover an object



Materials

- empty cardboard box (cereal, snack, toothpaste)
- measuring tape or ruler
- Explore Net of a Rectangular Prism worksheet (optional)

Explore Surface Area of Three-Dimensional Objects

Most products come in some type of packaging, such as rectangular boxes. These boxes are made up of two-dimensional (2-D) surfaces: the sides, the top, and the bottom.

1. a) Measure and record the dimensions of one side of the box. Express the answers to the nearest 0.5 cm.

b) What is the area of this surface, to the nearest 0.1 cm^2? Write the area on the surface.

c) Is there another side with the same dimensions? If so, record the area on its surface.

2. a) Is there a side with different dimensions?

b) If so, what is the area of this surface, to the nearest 0.1 cm^2? Write the area on the surface.

c) Is there another side with the same dimensions? If so, record the area.

3. a) Measure the dimensions of the bottom of the box, to the nearest 0.5 cm.

b) What is its area, to the nearest 0.1 cm^2? Write the area on the surface.

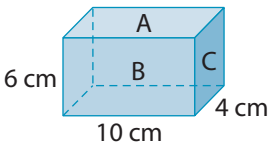
c) Is there another surface with the same dimensions? If so, record the area.

4. What is the total area of the surfaces that make up the box?

5. Reflect The boxes you have been working with are rectangular prisms. Work with a partner. Develop a formula for calculating the surface area of a **rectangular prism**.

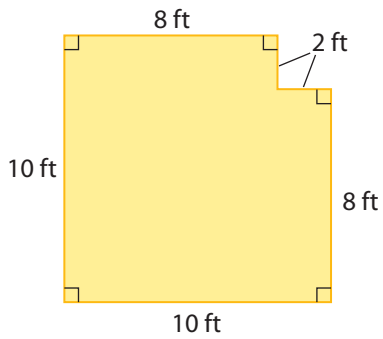
rectangular prism

- a 3-D object in which the six sides are made up of three pairs of rectangles

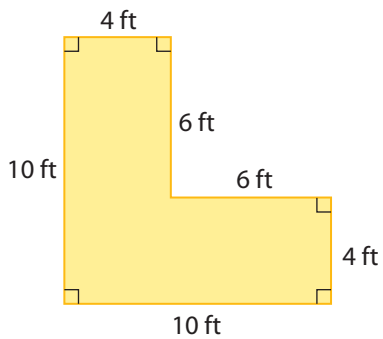


6. Extend Your Understanding The scale drawings below show the floor plan of two storage rooms. For each diagram, determine the total area of the walls. Assume that each ceiling is 8 ft high.

a)



b)

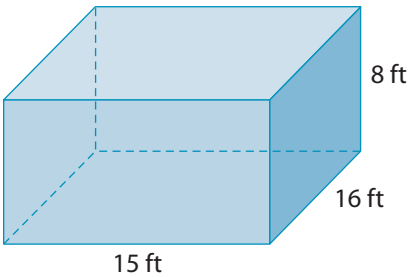


c) Explain the results you obtained in parts a) and b).

On the Job 1

Calculate the Surface Area of a Rectangular Prism

A drywall installer estimates the amount of drywall required to complete a room. What is the approximate surface area of the room that needs to be drywalled?



This estimate is high because the room has two doors and two windows.

Tools of the Trade

Drywall installers put up drywall, apply plaster, sand, and finish walls and corners of drywall surfaces. Tools such as measuring tapes, T squares, drills, and razor knives are used to install drywall. Finishing tools include drywall tape, drywall compound, trowels, and sanding blocks. To learn more about drywall installing, go to www.mhrmathatwork10.ca and follow the links.

Solution

The room is in the shape of a rectangular prism.

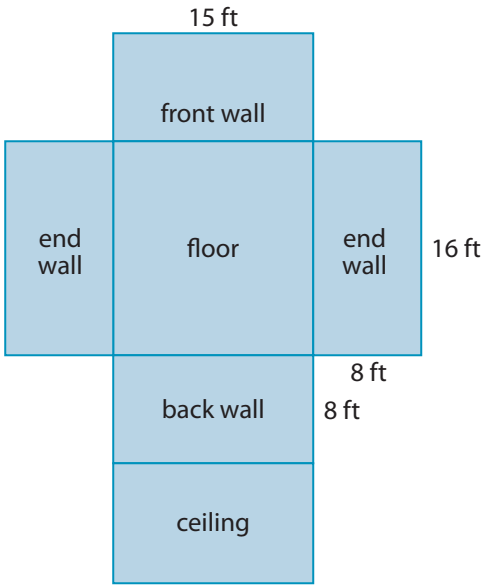
Method 1: Use a Net

Unfolded, the prism has six faces: the four walls, the floor, and the ceiling.

The room has six surfaces that are of three different sizes.

One face is the floor, which will not be drywalled.

Use the five surfaces that are to be drywalled.



Front or Back Wall

$A = l \times h$

$A = 15 \text{ ft} \times 8 \text{ ft}$

$A = 120 \text{ ft}^2$

Ceiling

$A = l \times w$

$A = 15 \text{ ft} \times 16 \text{ ft}$

$A = 240 \text{ ft}^2$

Each End Wall

$A = l \times h$

$A = 16 \text{ ft} \times 8 \text{ ft}$

$A = 128 \text{ ft}^2$

The area of the front or the back wall is 120 ft^2.
The area of the ceiling is 240 ft^2.
The area of each end wall is 128 ft^2.

Puzzler

Which block is represented by the following net?

The total surface area is the sum of the areas of the five surfaces.

$SA = 120 \text{ ft}^2 + 120 \text{ ft}^2 + 240 \text{ ft}^2 + 128 \text{ ft}^2 + 128 \text{ ft}^2$

$SA = 736 \text{ ft}^2$

or

$SA = (120 \text{ ft}^2 \times 2) + (240 \text{ ft}^2 \times 1) + (128 \text{ ft}^2 \times 2)$

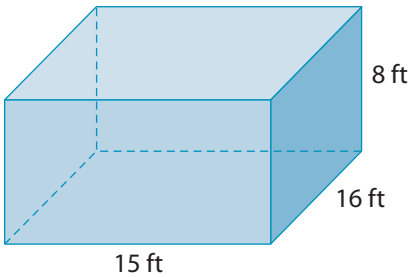
$SA = 240 \text{ ft}^2 + 240 \text{ ft}^2 + 256 \text{ ft}^2$

$SA = 736 \text{ ft}^2$

The amount of drywall required is 736 ft^2.

Method 2: Use a Formula

Use a formula to calculate the surface area of a rectangular prism.



$SA = 2 \text{ (length} \times \text{width)} + 2 \text{ (length} \times \text{height)} + 2 \text{ (length} \times \text{height)}$

$SA = 2(15 \text{ ft} \times 16 \text{ ft}) + 2(15 \text{ ft} \times 8 \text{ ft}) + 2(16 \text{ ft} \times 8 \text{ ft})$

$SA = 2(240 \text{ ft}^2) + 2(120 \text{ ft}^2) + 2(128 \text{ ft}^2)$

$SA = 480 \text{ ft}^2 + 240 \text{ ft}^2 + 256 \text{ ft}^2$

$SA = 976 \text{ ft}^2$

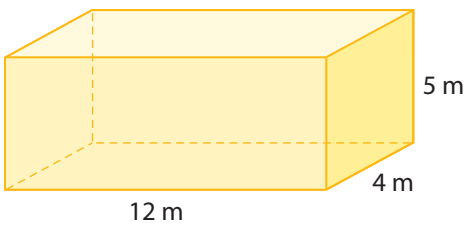
The floor will not be covered with drywall. So, you can subtract the area of one base from the total.

$976 \text{ ft}^2 - 240 \text{ ft}^2 = 736 \text{ ft}^2$

The amount of drywall required is 736 ft^2.

Your Turn

Determine the surface area of the rectangular prism.

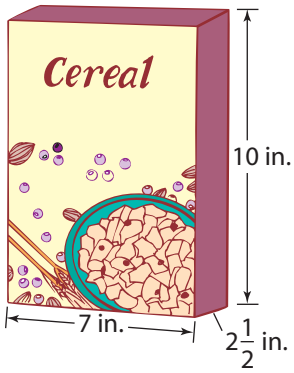


Check Your Understanding

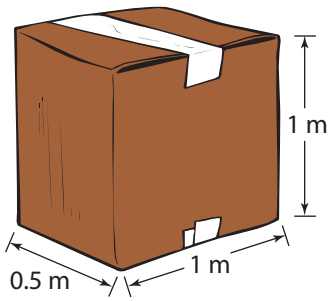
Try It

1. Calculate the surface area of each three-dimensional (3-D) object.

a)



b)



2. Scott grew up in Cow Head but moved to St. John's to go to school. He bought an old fridge and plans to paint its outer surface.

a) Consider the two doors to be one surface. How many surfaces will Scott need to paint?

b) Calculate the surface area to be painted in square inches.

c) Convert the dimensions of the fridge to feet. Round each dimension to the nearest half foot. Calculate the surface area to be painted in square feet.

Apply It

3. Small items are often sold in big packages to reduce the chance of theft. A Secure Digital (SD) card has approximate dimensions of 24 mm by 32 mm by 2 mm. A store in Windsor sells an SD card enclosed in a rectangular package that is 18 cm by 10 cm by 2 cm.

Recall that 1 cm = 10 mm.

a) Convert the dimensions of the SD card to centimetres.

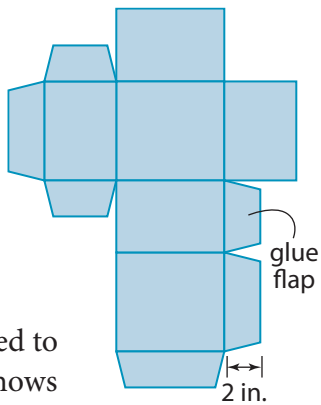
b) Calculate the surface area of the SD card in square centimetres.

c) Calculate the surface area of the package in square centimetres.

d) How many times as great is the surface area of the package than the surface area of the SD card? Give your answer to the nearest whole number.

4. You want to sit by the water in the evening protected from insects. How much mosquito netting do you need to provide sides for this gazebo?

5. Martina lives in Stephenville. She is sending a fragile gift to a relative in Toronto, ON. The gift will be sent in a box measuring 6 in. long by $5\frac{1}{2}$ in. wide by 4 in. high.



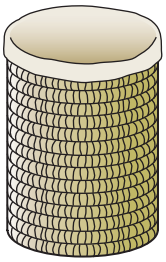
a) What is the surface area of the box, in square inches?

b) How much cardboard will Martina need to make this box? Include a sketch that shows where more area is required for glue flaps. Assume that glue flaps are 2 inches wide.

On the Job 2

Determine the Surface Area of a Right Cylinder

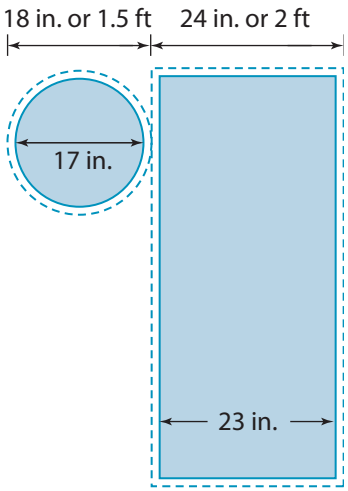
For this year's sewing project, Emma wants to design the canvas liner for a laundry hamper. She chooses a cylindrical hamper and wants to make the liner 23 in. high and with a diameter of 17 in. Emma wants to calculate the total amount of canvas, to the nearest square foot.



Solution

Method 1: Use a Net

Emma makes a sketch. The bottom of the liner is a circle and the tube, when opened, is a rectangle. She labels the dimensions. Emma adds a seam allowance of $\frac{1}{2}$ in. around the edge of each shape.



With seam allowances, the diameter of the circular piece of canvas needed is 18 in. $\left(\frac{1}{2}\text{ in.} + 17\text{ in.} + \frac{1}{2}\text{ in.}\right)$, or 1.5 feet. Since the diameter is 1.5 ft, the radius is 0.75 ft.

The length of the rectangular piece of material needed is 24 inches $\left(\frac{1}{2}\text{ in.} + 23\text{ in.} + \frac{1}{2}\text{ in.}\right)$, or 2 feet.

F.Y.I.

Circumference is the distance around a circle. The formula is $C = \pi \times d$.

Using these numbers, Emma calculates the areas of the shapes.

Bottom Circle

$A = \pi r^2$

$A = \pi \times 0.75 \text{ ft}^2$

$A = \pi \times 0.5625 \text{ ft}^2$

$A = 1.767\ldots \text{ ft}^2$

1.767145868

Rectangle

$A = l \times w$

$A = \text{length} \times \text{circumference}$

$A = 2 \text{ ft} \times \pi d$

$A = 2 \text{ ft} \times (\pi \times 1.5 \text{ ft})$

$A = 9.424\ldots \text{ ft}^2$

To calculate the total amount of canvas, Emma adds all the areas.

$A = 1.767\ldots \text{ ft}^2 + 9.424\ldots \text{ ft}^2$

$A = 11.191\ldots \text{ ft}^2$

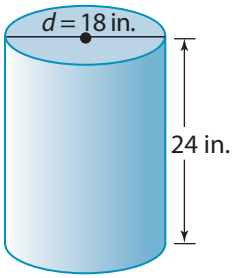
Emma needs a little more than 11 ft^2 of canvas for the liner.

Method 2: Use a Formula

right cylinder

- a 3-D object with two parallel circular bases

Calculate the surface area of a **right cylinder** using a formula.



$SA = 2\pi r^2 + 2\pi rh$, where r is the radius and h is the height of the cylinder.

The canvas liner has no top.
The formula for the bottom only is πr^2.

$SA = (\pi \times 9 \text{ in.}^2) + (2 \times \pi \times 9 \text{ in.} \times 24 \text{ in.})$

$SA = 254.469\ldots \text{ in.}^2 + 1357.168\ldots \text{ in.}^2$

$SA = 1611.637\ldots \text{ in.}^2$

The total surface area of the canvas liner is approximately 1612 in.^2

F.Y.I.

$1 \text{ ft}^2 = 144 \text{ in.}^2$

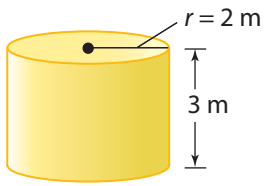
Divide by 144 to convert square inches to square feet.

$1612 \text{ in.}^2 \div 144 = 11.194\ldots \text{ ft}^2$

Emma needs a little more than 11 ft^2 of canvas for the liner.

Your Turn

Calculate the surface area of the cylinder. Round to the nearest tenth of a square metre.

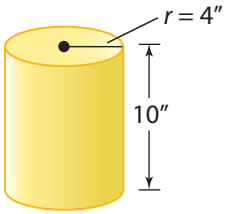


Check Your Understanding

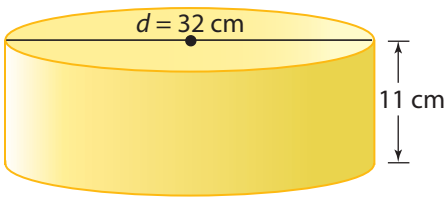
Try It

1. Calculate the surface area of each cylinder. Round to the nearest square unit.

a)

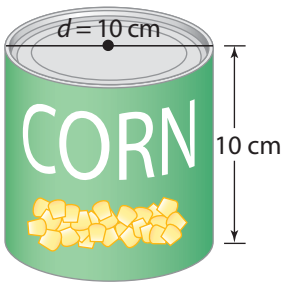


b)



Apply It

2. A steel can is used for packaging corn. Round each of the following answers to the nearest tenth of a square unit.



a) Calculate the surface area of the label that goes around the can. The label overlaps at the seam by 0.5 cm.

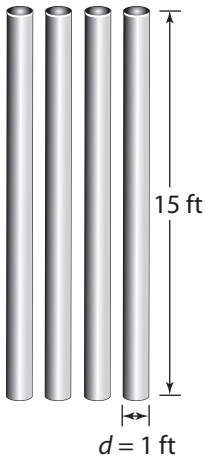
b) Calculate the surface area of the steel used to make the can.

3. Pam plans to make a two-layer cake similar to the one shown. She plans to cover the outside of the cake with chocolate icing. What is the surface area of the cake that needs icing? Express the answer to the nearest tenth of a square centimetre.

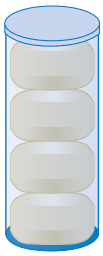
Web Link

To explore surface area and nets of 3-D shapes, go to www.mhrmathatwork10.ca and follow the links.

4. Sam is building the set for a school play. There are four pillars in the shape of a cylinder that need to be painted. The bottom of each pillar does not need paint. What is the total surface area to be painted? Express your answer to the nearest tenth of a square foot.



5. A skateboard wheel has a 27-mm radius and is 21 mm thick. Replacement wheels are sold in a pack of 4. The wheels are tightly packed in a thin, plastic cylinder.



a) What is the diameter of the cylinder?

b) What is the height of the cylinder?

c) Calculate the surface area of the plastic cylinder to the nearest square centimetre.

F.Y.I.

Tennis balls are packed in cylinders because a cylindrical shape withstands the pressure of shipping better than a rectangular one.

6. Tennis balls are sold in cylinders with a plastic lid. The diameter of the cylinder is 8 cm and the height is 24 cm.

a) Draw a sketch of the tennis ball container.

b) Calculate the surface area of the container, without the lid. Round your answer to the nearest square centimetre.

7. Melanie and Ron are building a greenhouse to grow vegetables. The greenhouse will be shaped like a half cylinder that has a length of 36 ft. The greenhouse has one end that is not covered in plastic. The end of the greenhouse measures 16 ft wide and 8 ft high. What is the area of the greenhouse that will be covered in plastic? Round your answer to the nearest square foot.

Work With It

F.Y.I.

The openings for windows and doors are cut out after the vapour barrier is attached to the walls.

1. Gary's room has not yet been finished in the addition to his house. It measures 20 ft wide and 24 ft long. The ceiling is 8 ft high. After the bare walls have been framed and insulated, a plastic sheet called a "vapour barrier" is attached. The vapour barrier helps prevent moisture from moving through the walls.

a) On grid paper, sketch a net of the floor and the four walls of the room.

b) Calculate the surface area of the four walls.

c) Vapour barrier is sold in rolls. One roll covers approximately 100 square feet. How many rolls will Gary need to buy?

Materials

- ruler
- construction paper
- scissors
- tape

2. **MINI LAB** You have been hired to design a cardboard box that holds 12 tightly packed golf balls. Each golf ball has a diameter of approximately 43 mm. Do the following steps.

STEP 1

Sketch the design of another container that will hold 12 balls.

STEP 2

What are the dimensions of your container? You may wish to include overlapping pieces that will keep the container secure. One possible design is shown.

STEP 3

Build your container.

STEP 4

Calculate the area of the cardboard needed to make the container. Express the answer in square centimetres.

STEP 5

Compare your design with those of your classmates. Which design uses the least amount of packaging?

3. Four cylindrical oil tanks are due to be repainted. This helps prevent them from rusting. Each tank has a height of 20 m and a diameter of 20 m. The bottom of the tanks do not need paint.

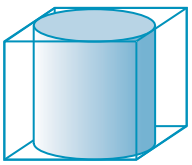
a) What is the surface area of the exposed portion of one tank? Express your answer to the nearest square metre.

b) One litre of spray paint covers 10 m^2. How many litres of paint are needed to cover the four tanks shown? Round your answer to the nearest litre.

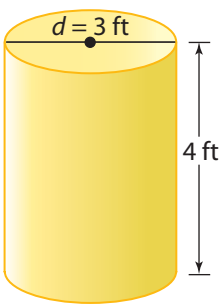
Discuss It

4. Consider the net of a cylinder. Explain why the circumference of the top of the cylinder is the same measurement as the width of the rectangle.

5. A cylinder has a diameter the same as the side length of a cube. Both objects have the same height. Which one has the greater surface area? Explain your reasoning.



6. Beth used a formula to determine the surface area of the cylinder shown. Identify Beth's error. Explain a strategy to help avoid making this error.



$SA = 2\pi r^2 + 2\pi rh$
$SA = (2 \times \pi \times 3\ ft^2) + (2 \times \pi \times 1.5\ ft \times 4\ ft)$
$SA = 56.548...\ ft^2 + 37.699...\ ft^2$
$SA = 94.247...\ ft^2$

The surface area is about 94 ft^2.

3 Skill Check

What You Need to Know

Section	After this section, I know how to . . .
3.1	■ calculate area when dimensions are given in imperial units ■ convert from one linear unit of imperial measure to another linear unit of imperial measure
3.2	■ calculate area when dimensions are given in SI units ■ convert from one linear unit of SI measure to another linear unit of SI measure
3.3	■ split a composite shape into a number of regular shapes ■ calculate the area of a composite shape
3.4	■ use various strategies and formulas to calculate the surface area of 3-D objects

If you are unsure about any of these questions, review the appropriate section or sections of this chapter.

3.1 Imperial Area Measurements, pages 116–127

1. a) Estimate the area of each figure.

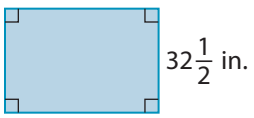


Figure A

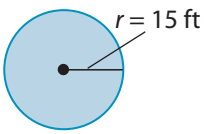


Figure B

F.Y.I.

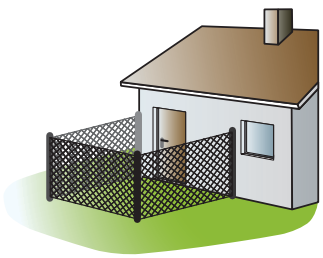
$1\ ft^2 = 144\ in.^2$

$1\ yd^2 = 9\ ft^2$

b) Calculate the area of the rectangle. Round the answer to the nearest square foot.

c) Calculate the area of the circle. Round the answer to the nearest square yard.

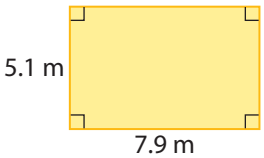
2. Shawn has 60 ft of chain-link fence to create a dog kennel. He wants to make a rectangle with one side along the wall of his house. The wall is 24 ft long. What is the largest area that he can enclose?



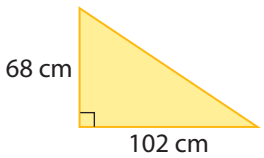
3.2 SI Area Measurements, pages 128–139

3. Estimate the area of each figure.

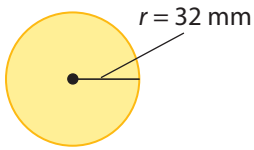
a)



b)



c)



4. In #3, calculate

a) the area of the rectangle to the nearest 0.1 square metre

b) the area of the triangle in square centimetres

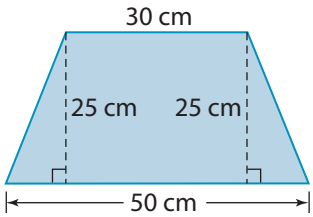
c) the area of the circle to the nearest square millimetre and then show the area in square centimetres

F.Y.I.

$1\ cm^2 = 100\ mm^2$

3.3 Working With Area, pages 140–151

5. What is the area of this figure?

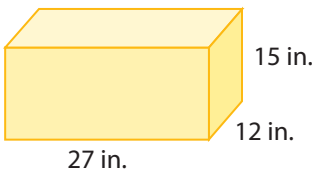


6. Jean has a circular rug with a radius of 2 ft in the hall of her home. She is making a similar rug for her living room. This rug has a radius triple the size of the one in the hall. How many times larger is the area of the living room rug than the hall rug?

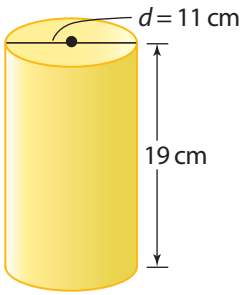
3.4 Surface Area of Three-Dimensional Objects, pages 152–163

7. Calculate the surface area of each object. Round your answer to part b) to the nearest square centimetre.

a)



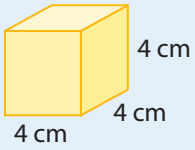
b)



3 Test Yourself

For #1 to #6, select the best answer.

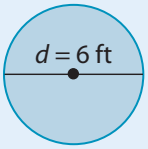
1. What is the surface area of a cube with side length 4 cm?



A 16 cm^2 **B** 27 cm^2

C 64 cm^2 **D** 96 cm^2

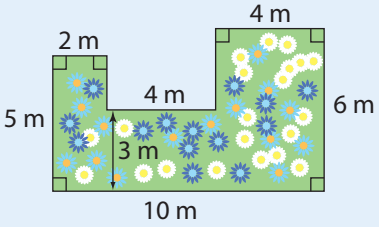
2. What is the approximate area of a circle with a diameter of 6 ft?



A 10 ft^2 **B** 30 ft^2

C 108 ft^2 **D** 200 ft^2

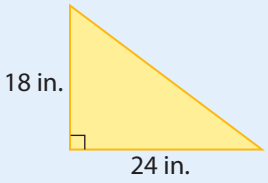
3. What is the area of the garden?



A 42 m^2 **B** 44 m^2

C 46 m^2 **D** 48 m^2

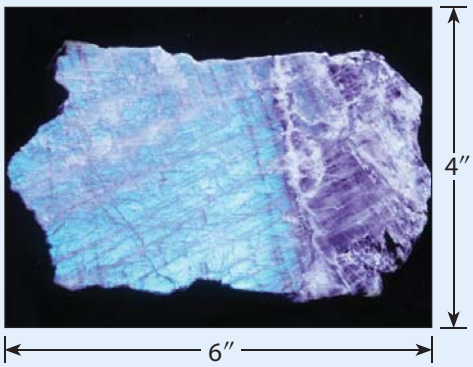
4. What is the area of the triangle?



A 1 ft^2 **B** $1\frac{1}{2}$ ft^2

C 2 ft^2 **D** $2\frac{1}{2}$ ft^2

5. A 4-inch by 6-inch photo of labradorite has both sides doubled. What is the area of the enlarged photo?



A 96 $in.^2$ **B** 72 $in.^2$

C 48 $in.^2$ **D** 24 $in.^2$

F.Y.I.

Labradorite is the provincial mineral of Newfoundland and Labrador. It is found mostly in the Nain area of Labrador. It is mined at Ten Mile Bay by the Labrador Inuit Association.

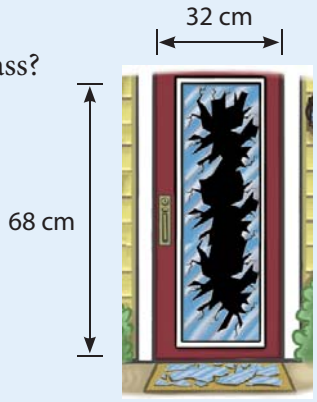
6. What is a reasonable estimate for the area of a 32-cm by 68-cm piece of glass?

A 180 cm^2

B 210 cm^2

C 1800 cm^2

D 2100 cm^2

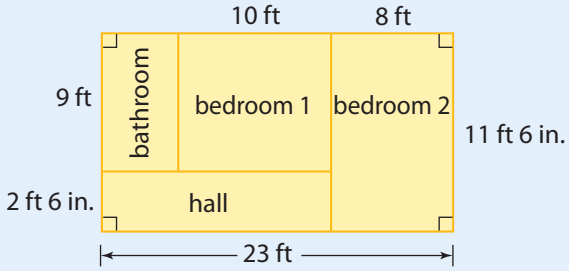


7. Calvin plans to frame this photo taken of Quidi Vidi Lake by his late grandfather. The print measures 24 in. by 17 in. The mat to be placed around the print is 3 in. wide on each side.

a) Sketch and label the dimensions of the print with a 3-in. mat.

b) What is the area of the glass that Calvin needs?

8. The diagram shows a portion of the floor plan of a house.



a) Hardwood flooring costs $3.00 per square foot. How much would it cost to have this flooring installed in the hall and the two bedrooms?

b) The entire bathroom floor will be tiled. Tiles are 6 inches by 6 inches. How many tiles are needed?

3 Chapter Project

Design Your Own Yard

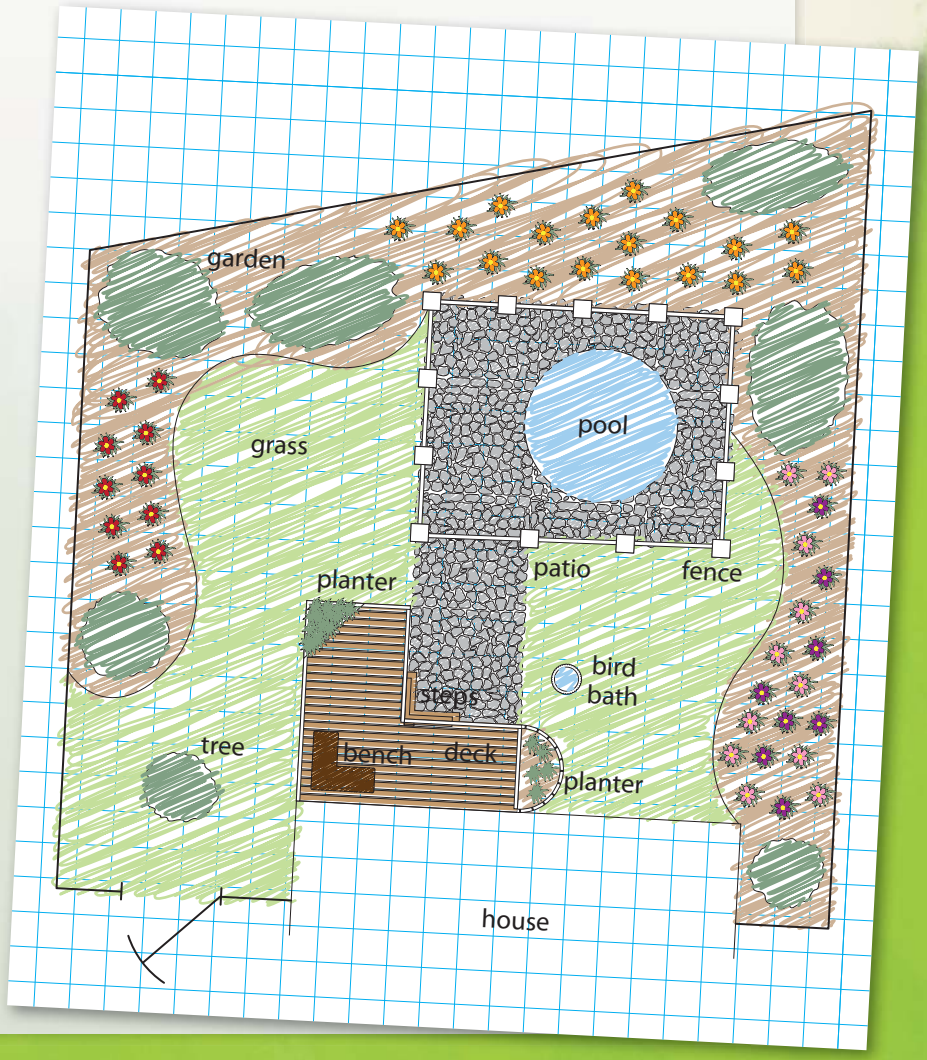
You are now ready to design your own yard.
Your design must include at least two composite shapes.

1. Choose items to include in your design. Be creative.
   Consider some of the following ideas:
   - ✓ a patio
   - ✓ a putting green, a pond, or a pool
   - ✓ large boulders near or around a pond or a pool
   - ✓ containers for flowers
   - ✓ a garden
   - ✓ stone or wood borders around a garden
   - ✓ gravel walks
   - ✓ trees or bushes

2. **a)** Choose a scale for your design.
   b) Draw the area to scale.

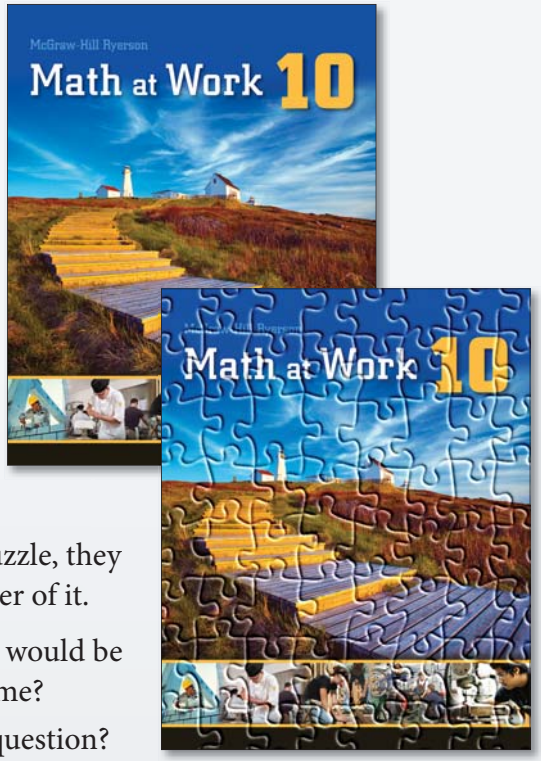
3. Place the items on your design.

4. What areas do you need to calculate in order to buy the materials you need? Calculate those areas.

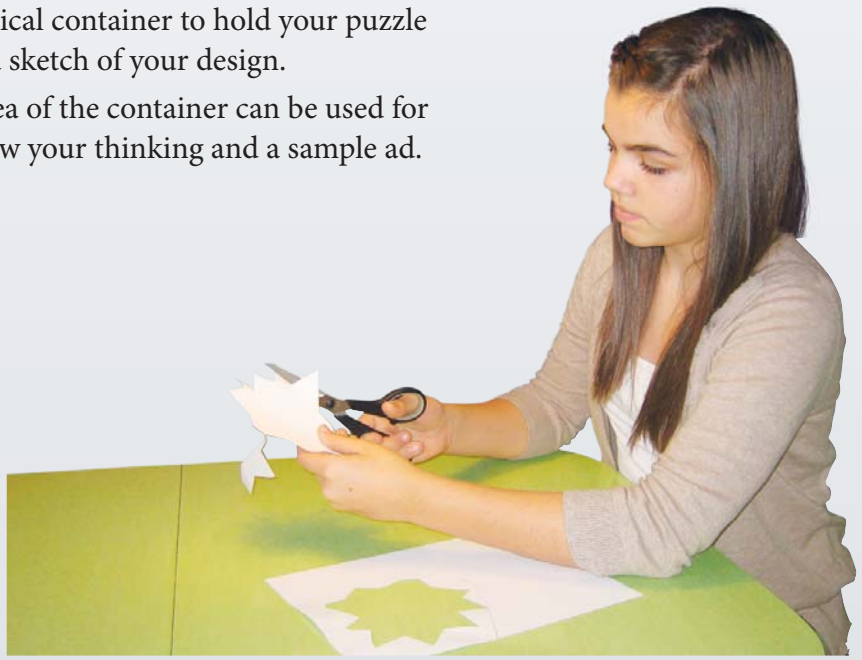


3 GAMES AND PUZZLES

Design a Puzzle



1. Photocopy the cover of this book or a photo of your choice.
2. Glue the photocopy to a piece of cardboard.
3. Use a pencil and design a jigsaw puzzle pattern on the cardboard.
4. How many pieces does your puzzle have?
5. Carefully cut out the pieces.
6. Exchange puzzles with a partner. Check each other's solution.
7. Sometimes when people complete a jigsaw puzzle, they glue it to a backing, frame it, and make a poster of it.
8. **a)** If you framed this completed puzzle, what would be the area of the piece of glass inside the frame?
   b) What strategy did you use to answer this question?
9. **a)** Design a cylindrical container to hold your puzzle pieces. Provide a sketch of your design.
   b) What surface area of the container can be used for advertising? Show your thinking and a sample ad.



Web Link

Play games that involve area and perimeter. Go to www.mhrmathatwork10.ca and follow the links.