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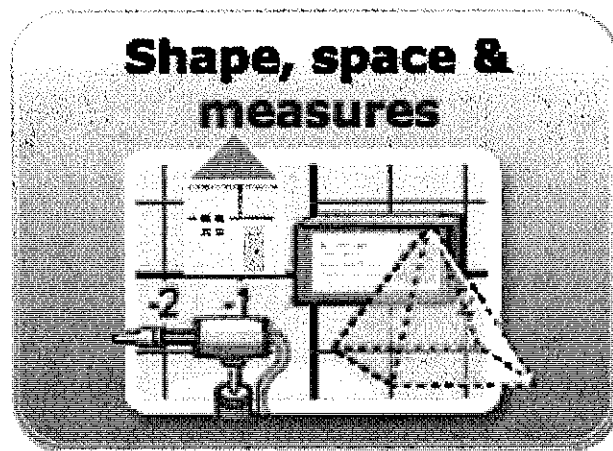
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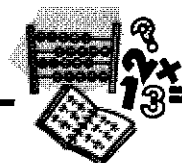
# Math 9 K&E

## Shape and Space





# Estimating Perimeter and Area



## Estimating Perimeter



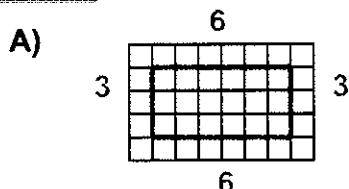
**Perimeter** is the distance around the outside of a shape. People use perimeter for a variety of purposes, such as building a fence around a field, framing a picture or putting baseboards on the walls of a room.

Perimeter can be determined using a variety of methods, such as grid paper or dot paper.

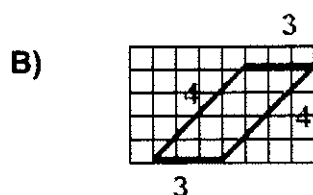
### Grid Paper

Count the number of squares along each of the sides and ADD them together to calculate the perimeter. Each square is one unit.

#### Examples



$$\begin{aligned}\text{Perimeter} &= 6 \text{ units} + 3 \text{ units} + 6 \text{ units} + 3 \text{ units} \\ &= 18 \text{ units}\end{aligned}$$



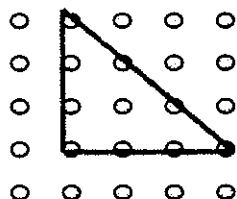
$$\begin{aligned}\text{Perimeter} &= 3 \text{ units} + 4 \text{ units} + 3 \text{ units} + 4 \text{ units} \\ &= 14 \text{ units}\end{aligned}$$

### Dot Paper

Count the number of spaces between dots along each of the sides and ADD them together to calculate the perimeter.

OR

Count the number of dots touched by a line.



$$\begin{aligned}\text{Perimeter} &= 3 \text{ units} + 3 \text{ units} + 3 \text{ units} \\ &= 9 \text{ units}\end{aligned}$$

## Estimating Area



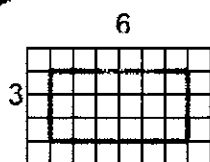
**Area** is the number of square units required to cover a 2-D object. People calculate area for many purposes, such as covering floors with carpet, purchasing seed for fields and buying paint for walls.

The area of a shape can be determined using a variety of methods.

### Grid Paper: Squares and Rectangles

Count the number of squares inside the shape. Each square is one unit.

#### Example

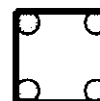


$$\begin{aligned}\text{Area} &= 6 \times 3 \\ &= 18 \text{ square}\end{aligned}$$

**Prove It!** Use a geoboard and construct a rectangle that is three squares wide and six squares long. How many squares are there inside the rectangle?

### Dot Paper: Squares and Rectangles

Units of measurement are called square units. Four dots make a square.

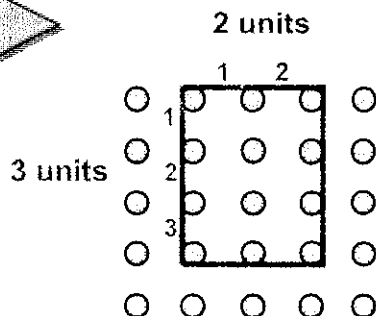


Square units can also be represented by  $\text{units}^2$ , which is an **exponent**.

$$\text{unit} \times \text{unit} = \text{units}^2$$

Count the number of squares that can be made inside the shape.

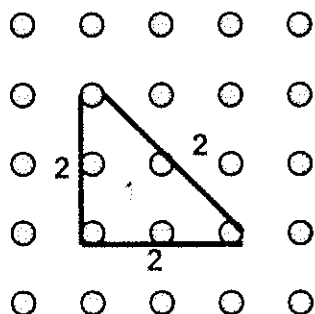
#### Example



$$\begin{aligned}\text{Area} &= 2 \times 3 \\ &= 6 \text{ square units}\end{aligned}$$

## Dot Paper: Triangles

### Example



1 whole square	=	1 unit <sup>2</sup>
2 partial squares	=	1 unit <sup>2</sup>
<hr/>		
Total area	=	2 units <sup>2</sup>

Count the number of whole squares inside the shape.

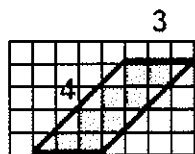
The triangle to the left has 1 whole square.

Combine partial squares to make whole squares.

The triangle has 2 partial squares that combine to make 1 whole square.

## Grid Paper: Parallelograms

### Example



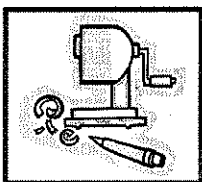
8 whole squares	=	8 units <sup>2</sup>
8 partial squares	=	4 units <sup>2</sup>
<hr/>		
Total area	=	12 units <sup>2</sup>

Count the number of whole squares inside the shape.

The parallelogram has 8 whole squares.

Combine partial squares to make whole squares.

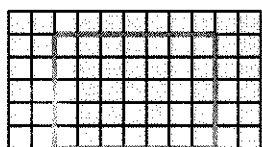
The parallelogram has 8 partial squares that combine to make 4 whole squares.



## Practice: Estimating Perimeter and Area

Determine the perimeter and area of the following shapes.

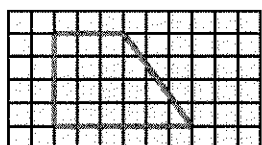
1.



Perimeter =

Area =

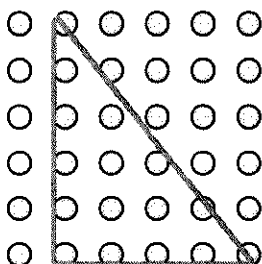
2.



Perimeter =

Area =

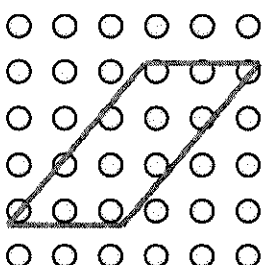
3.



Perimeter =

Area =

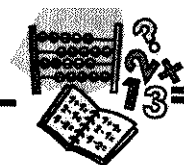
4.



Perimeter =

Area =

# Calculating Perimeter and Area



**Formulas** are equations used to make specific calculations.

Common formulas (equations) include:

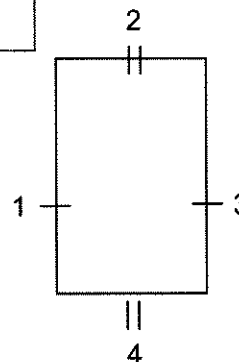
$$P = 2l + 2w \quad \text{perimeter of a rectangle}$$

$$A = l \times w \quad \text{area of a square or rectangle}$$

$$E = mc^2 \quad \text{Albert Einstein's famous formula for calculating energy.}$$

## Calculating Perimeter

Perimeter is the distance around the outside of a shape, or the sum of all the sides of any shape. Perimeter can be determined using grids, geoboards and dot paper, and is calculated using equations called formulas.



## Formulas for Perimeter

$P$  = perimeter

$l$  = length

$s$  = side

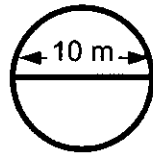
$w$  = width

Shapes	Formulas	Illustration	Words
<p>6 units</p>	$P = s + s + s + s$ or $P = 4 \times s$ $P = 4s$	$P = 6 + 6 + 6 + 6 = 24$ units $P = 4 \times 6 = 24$ units	Perimeter equals four times side.
<p>7 units</p> <p>3 units</p>	$P = s + s + s + s$ or $P = 2 \times l + 2 \times w$ $P = 2l + 2w$	$P = 7 + 3 + 7 + 3 = 20$ units $P = 2 \times 7 + 2 \times 3 = 20$ units	Perimeter equals two times length plus two times width.
<p>5</p> <p>4</p> <p>3</p>	$P = s + s + s$	$P = 5 + 4 + 3 = 12$ units	Perimeter equals side plus side plus side.
<p>2</p> <p>3</p> <p>4</p> <p>5</p> <p>6</p>	$P = s + s + s + s + s$	$P = 2 + 3 + 4 + 5 + 6 = 20$ units	Perimeter equals side plus side plus side plus side plus side.

## Circumference

The perimeter of a circle is called **circumference**. The formulas to calculate circumference are:

$$C = \pi d \text{ and } C = 2\pi r$$



$$\begin{aligned} C &= \pi d \\ &= 3.14 \times 10 \text{ m} \\ &= 31.4 \text{ m} \end{aligned}$$

$$\pi = 3.14$$

$c$  = circumference (the distance around the circle)

$r$  = radius (the distance from middle of circle to circumference)

$d$  = diameter (the distance across at the middle of the circle)

## Calculating Area

**Area** is the space inside a flat, two-dimensional shape. For example, a carpet covers an area of the floor. The following words and abbreviations are used when talking about area:

$A$  = area

$l$  = length

$b$  = base

$w$  = width

$h$  = height

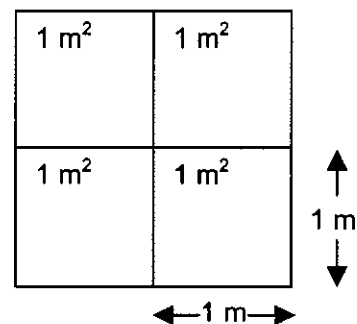
The basic formula for calculating the area of 4-sided shapes is **length times width** ( $l \times w$ ). Area is always an amount "squared," which is shown by writing the number 2 after and a little above the units.

$$\text{units} \times \text{units} = \text{units}^2$$

**Example**

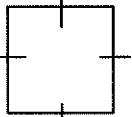
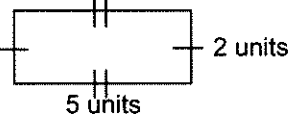
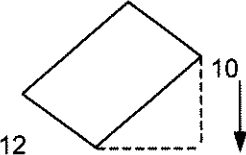
$$2\text{m} \times 2\text{m} = 4\text{m}^2$$

**4 m<sup>2</sup> (squared) is:**



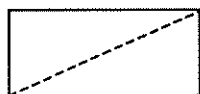
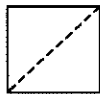


## Formulas for Area of Quadrilaterals (four-sided shapes)

Shape	Formula	Example
 3 units	$A = l \times w$	$A = 3 \times 3 = 9 \text{ units}^2$
 5 units      2 units	$A = l \times w$	$A = 5 \times 2 = 10 \text{ units}^2$
 12      10	$A = b \times h$	$A = 12 \times 10 = 120 \text{ units}^2$

## Area of Triangles

If you fold a square or rectangle in half diagonally, you make two triangles. Try it!

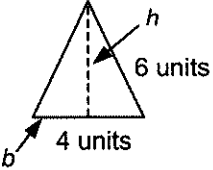
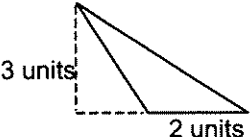


The area of the triangle must be half of the area of the square.

The formula for calculating the area of a triangle is the  $A = b \times h$  formula divided by 2.

$$A = \frac{b \times h}{2}$$

$b$  = base  
 $h$  = height

Shapes	Formulas	Illustration
 4 units      6 units	$A = \frac{b \times h}{2}$	$A = 4 \times 6$ $= 24 \div 2$ $= 12 \text{ units}^2$
 3 units      2 units	$A = \frac{b \times h}{2}$	$A = 2 \times 3$ $= 6 \div 2$ $= 3 \text{ units}^2$

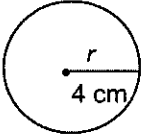
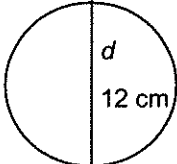
## Area of Circles

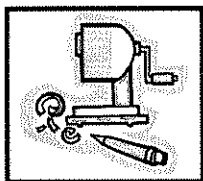
Mathematicians found that, when measured exactly, the circumference of a circle divided by its diameter always equals 3.14 (rounded off). You can prove this by wrapping a piece of string around a tubular object, measuring the string and then dividing that number by the diameter.

This constant repeated number is called pi (pronounced "pie") and is represented by the symbol:

$\pi$

Working backwards, pi can be used to figure out the circumference of a circle—diameter multiplied by  $\pi$  or  $\pi d$ .

Shapes	Formulas	Illustration
	$A = \pi r^2$	$A = 3.14 \times 4 \times 4$ $= 50.24 \text{ cm}^2$
	$A = \pi r^2$	$r = d \div 2 = 12 \div 2 = 6$ $A = 3.14 \times 6 \times 6$ $= 113.04 \text{ cm}^2$

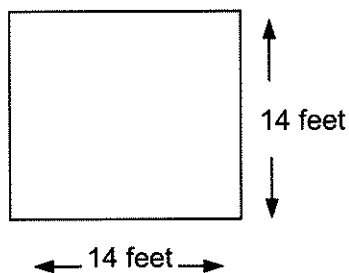


## Practice: Calculating Perimeter and Area

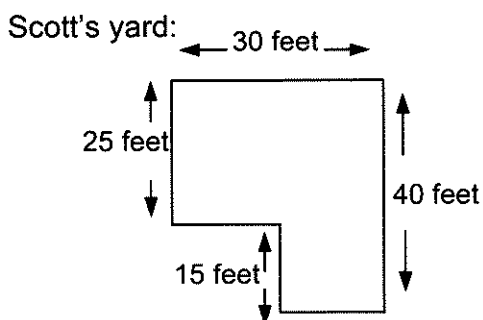
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1. Solve for perimeter in the following word problems.

- a) Duane built a square patio in his back yard. The material he used came in 1 foot square pieces. How many pieces did Duane use to build his patio?



- b) Scott walked around the outside of his yard to decide where he should plant trees and hedges. How far did Scott walk?



2. Do the following activity to learn about circumference.

**Materials:**

- measuring tape
- string
- ruler or metre stick

**Objects to be measured:**

- juice can
- soup can
- coffee can
- garbage can top
- fruit can

**Directions:**

Use a measuring tape or the string and ruler/metre stick to measure the circumference of the tops of the objects. Then measure the length of the diameter.

List these measurements in a table like the one below:

Object	Circumference	Diameter	Comparison
1)			
2)			
3)			
4)			
5)			

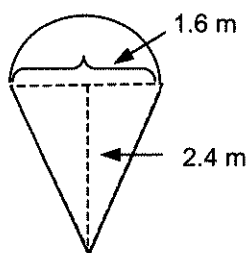
- a) How does the measurement of the circumference compare to the measurement of the diameter? Is it twice as large? Is it three times as large or more than three times as large? This comparison is the ratio of the circumference to the diameter of the circle. This ratio is called  $\pi$ .
- b) In the column marked COMPARISON, list the answer for the circumference divided by the diameter.

3. Solve for the area of quadrilaterals, triangles and circles in these word problems.

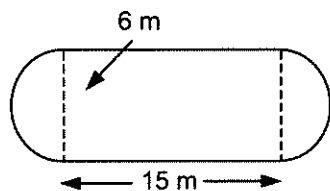
a) Ariel added fertilizer to a circular flower bed that has a radius of 3.2 m. What is the area that Ari covered with fertilizer?

b) The glass on one side of the pyramid-shaped Muttart Conservatory in Edmonton was replaced. The height of the side is 100 ft. and the base is 56 ft. What is the area of the side that was replaced?

c) Leon needs to paint a cone shape on the wall of a gym. A diagram with dimensions is provided below. How much area will Leon cover with paint?



d) The swimming pool below needs a new winter cover. Calculate the area to be covered.



4. Katya is an interior decorator. She has been hired to:
- install carpet in all of the rooms of the house
  - put up a wallpaper border around the perimeter of each room.

Complete the chart to determine the amount of wallpaper border and carpet Katya must install.

Length of room	Width of room	Perimeter of room (for borders)	Area of room (for carpets)
4 metres	8 metres		
3 metres	9 metres		
5 metres			25 metres <sup>2</sup>
	10 metres	30 metres	
25 metres	14 metres		
	11 metres	36 metres	
		24 metres	36 metres <sup>2</sup>
15 metres			225 metres <sup>2</sup>
28 metres		68 metres	

Katya must install \_\_\_\_\_ carpet.  
 Katya must install \_\_\_\_\_ wallpaper border.

5. Measure the length and width of rooms in your house/apartment or in a friend's house. Use pencil and paper or a computer to draw the rooms. Rooms may include:

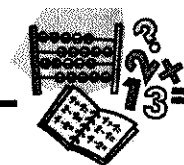
- living room
- bathroom
- two bedrooms
- dining room
- laundry room
- kitchen

Label each room on the floor plan with the dimensions.

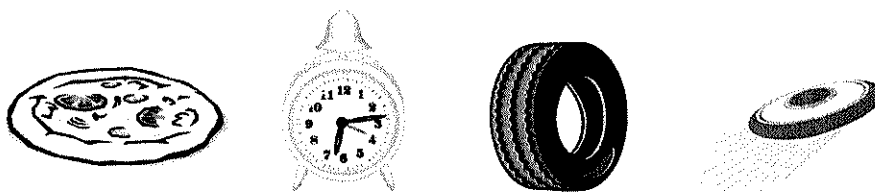
Calculate the perimeter and area of each room.



# Circumference



What do a pizza, a clock, an automobile tire and a throwing disc have in common?



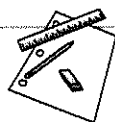
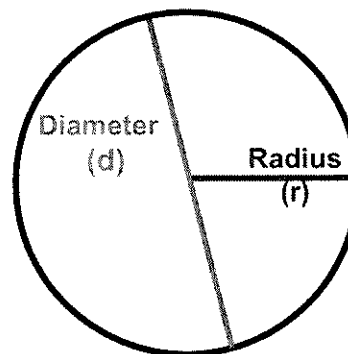
They are all **circular**!

**Circumference, diameter and radius** can be measured and/or calculated for circles.

**Circumference** is the distance around the outside surface of a circle.

**Diameter** is the distance from a point along one edge of the circle, through the centre of the circle, to a point on the opposite side of the circle.

**Radius** is the distance from a point along the edge of the circle to the exact centre of the circle. Radius is half the value of the diameter.



Pi is a mathematical constant that demonstrates the relationship between the diameter and circumference of a circle. The symbol for pi is  $\pi$



Early mathematicians who studied circles discovered that the circumference of circles divided by the diameter equals approximately **3.14**.

The value **3.14** is called **pi**, which is a mathematical constant common to all circles, no matter how big or small.

## Calculating Circumference

The circumference of a circle can be calculated using two different formulas.

- If you know the diameter, use the formula:

$$C = \pi d \quad \text{Circumference equals pi times diameter}$$

- If you know the radius, use the formula:

$$C = \pi 2r \quad \text{Circumference equals pi times two times the radius}$$

The diameter is two times larger than the value of the radius as represented by the following:

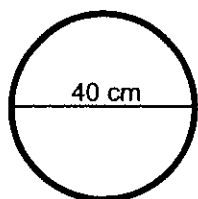
$$d = 2 \times r \quad \text{Diameter equals two times the radius}$$

Remember that  $\pi d$  is the same as  $\pi \times d$  and  $\pi 2r$  is the same as  $\pi \times 2 \times r$ .

### Examples

Check out the following examples that show how to use both equations to calculate the circumference of circles.

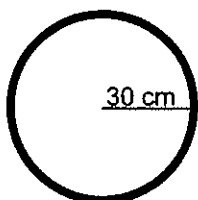
- A) A tire is 40 cm in diameter. What is the circumference of the tire?



$$\begin{aligned} C &= \pi \times d \\ &= 3.14 \times 40 \text{ cm} \\ &= 125.60 \text{ cm} \end{aligned}$$

The circumference of the tire is 125.60 cm.

- B) A bicycle tire has a radius of 30 cm. What is the circumference of the tire?

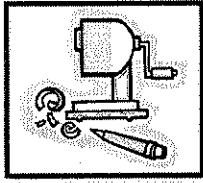


$$\begin{aligned} C &= \pi \times 2 \times r \\ &= 3.14 \times 2 \times 30 \text{ cm} \\ &= 188.40 \text{ cm} \end{aligned}$$

The circumference of the bicycle tire is 188.40 cm.

Do you notice that the units used for circumference, diameter and radius are the same?





## Practice: Calculating Circumference

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1. Locate and measure, using metric and imperial tools, the diameter and radius of a variety of circles in and around the school or community. With a partner, calculate the circumference of these circles.
2. Marcy cleaned out an old barrel to paint and decorate for her room. She painted the barrel and made a string of beads to glue to the barrel opening. If the diameter of the barrel was 56 centimetres, what was the length of string needed for the beads?
3. Brandon is helping paint the basketball circles on the floor of the gym. The circles must have a radius of 0.8 m. What will be the circumference of the circles Brandon will paint?

## Calculating Diameter and Radius

The formulas for calculating the circumference of a circle can be rearranged to calculate the diameter and radius of a circle.

**If you do not know the diameter**, use opposite operations to isolate the diameter on one side of the equation.

$$C = \pi \times d$$

Divide each side of the equation by  $\pi$  to isolate  $d$ .

$$\frac{C}{\pi} = \frac{\pi \times d}{\pi}$$

Remember that  $\frac{\pi}{\pi} = 1$ .

Therefore, the diameter equals circumference divided by  $\pi$ .

$$d = \frac{C}{\pi}$$

**If you do not know the radius**, calculate diameter and divide by 2.

OR

Use opposite operations to isolate the radius on one side of the equation.

$$C = \pi \times 2 \times r$$

Divide by  $\pi \times 2$

Remember that  $\frac{\pi \times 2}{\pi \times 2} = 1$

$$\frac{C}{\pi \times 2} = \frac{\pi \times 2 \times r}{\pi \times 2}$$

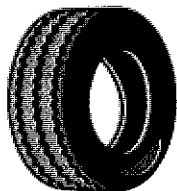
Therefore, the radius is circumference divided by  $\pi \times 2$ , which can also be represented as  $2\pi$ .

$$r = \frac{C}{2\pi}$$

## Examples

Check out the examples below that illustrate the use of equations to solve for diameter and radius.

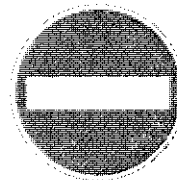
- A) Some tractors have tires with circumferences of 150 cm. What is the diameter of these tires, rounded to the nearest cm?



$$\begin{aligned}d &= C \div \pi \\&= 150 \text{ cm} \div 3.14 \\&= 48 \text{ cm}\end{aligned}$$

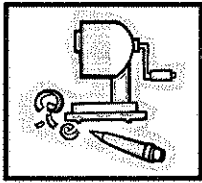
The diameter is 48 cm.

- B) A Do Not Enter traffic sign has a circumference of 60 cm. What is the radius of the sign?



$$\begin{aligned}r &= \frac{C}{\pi \times 2} \\&= \frac{60 \text{ cm}}{3.14 \times 2} \\&= \frac{60 \text{ cm}}{6.28} \\&= 9.55, \text{ rounds to } 9.6 \text{ cm}\end{aligned}$$

The radius of the sign is approximately 9.6 cm.



## Practice: Working with Circumference

1. Use a string, metre-stick, yardstick or other instruments to measure the circumference and diameter of several circular objects, such as a volleyball, pumpkin, dinner plate, basketball hoop, tire and steering wheel.
  - a) Divide the circumference by the diameter and record the answer in the column on the right.

Object	Circumference	$C \div d$	Diameter
1.			
2.			
3.			
4.			

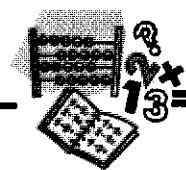
- b) What value did you calculate in the right-hand column?
- c) Write a statement about the relationship between circumference and diameter.

2. Find the missing information. **Round** answers to the nearest tenth.

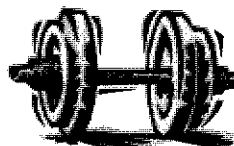
- a) A dime has a diameter of approximately 10 mm. Calculate its circumference.
- b) The minute hand of a clock is 20 cm long. Calculate how far the clock hand travels in one hour.
- c) Two circular car stereo speakers each have diameters of 8 inches. What is the size of the hole that must be cut for each speaker?
- d) The circumference of a round pond is 6.6 m. How long will the bridge be that goes from one side to the other and crosses at the middle of the pond?
- e) A farmer is building a circular shed for grain. If the circumference is  $28\frac{1}{4}$  feet, what will the diameter be? What will the radius be?
- f) A person swings a ball attached to a rope in a circular motion. If the rope and ball are 1.5 m long, how far will the ball travel in a circular path with each swing?



# Mass



The circular plates on either end of the bar have been calibrated (measured) to a specific mass (e.g., 10 lbs.).



**Mass** is the amount of material or matter in an object.

Mass should not to be confused with weight, although in everyday life the word “weight” is often used when referring to mass.

Weight is a measurement of how gravity affects mass. Weight changes as the force of gravity changes.

Mass does not change from place to place.

For example, the moon is approximately  $\frac{1}{5}$  the mass of the Earth. The weight of an object on the moon would be about  $\frac{1}{5}$  of the weight of the same object on Earth, because the gravitational pull on the moon is less.



The mass (amount of matter) is the same on the moon as on Earth.

Mass is measured using the SI base unit called **grams** (g). The SI terms for mass are:

## Mass Staircase

1000 g kilograms (kg)  
100 g hectograms (hg)  
10 g decagrams (dag)  
1 g grams (g)  
1/10 g decigrams (dg)  
1/100 g centigrams (cg)  
1/1000 g milligrams (mg)

1 tonne (t) = 1000 kg or 1 000 000 g

Hint: Remember to use this ACRONYM to help you with the order of the units:

**K**ing  
**H**enry's  
**D**aughter  
**B**etty  
**D**etested  
**C**ounting

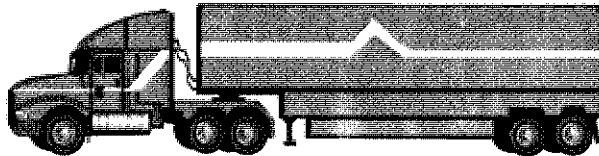
Kilograms, grams and tonnes are commonly used units for measuring mass.



Ingredients in medication are measured and listed in milligrams (**mg**).



Cereal ingredients are measured and listed in grams (**g**).



Tractor-trailer vehicles often carry loads measured in tonnes (**t**).

## Converting Between g, kg and t



Shippers at factories that produce many types of products convert between different units of mass when loading products onto trucks.

### Examples

Check these out! Use the mass staircase or move the decimal to convert.

A) How many mg does 25 g represent? 25 000 mg

**g** to **mg** is 3 steps down

$$1 \text{ g} = 10 \times 10 \times 10 = 1000 \text{ mg}$$

$$25 \text{ g} = 25\,000 \text{ mg}$$

B) How many kg does 1200 g represent? 1.2 kg

**g** to **kg** is 3 steps up

$$\underline{1\,200} = 1.2 \text{ kg}$$

C) How many tonnes does 16 900 kg represent? 16.9 t

**kg** to **t** is 3 steps up

$$3 \text{ steps are } 10 \times 10 \times 10 = 1000$$

$$16\,900 \text{ kg} \div 1000 \text{ (3 steps)} = 16.9 \text{ t}$$

D) How many g does 2 t represent? 2 000 000 g

**t** to **g** is 6 steps down

$$\underline{2\,000\,000} = 2\,000\,000 \text{ g}$$



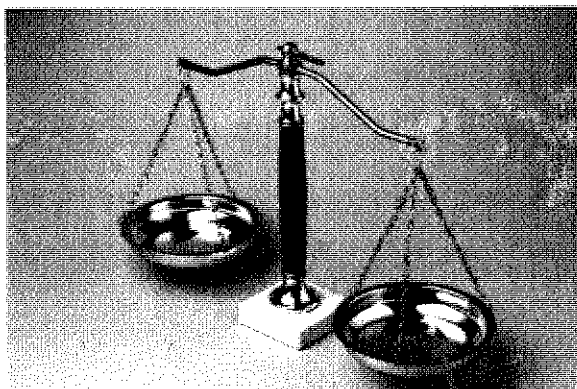
## Measuring Mass

Truck drivers must keep track of the mass of their vehicles and their loads. Carrying too much mass can damage roads and the vehicle's suspension, and cost the driver in fines at vehicle weigh stations located along highways.

Small amounts of mass can be measured using a **balance scale**.



A **balance scale** is a device that has two pans or trays with a balance point (fulcrum) in the middle.



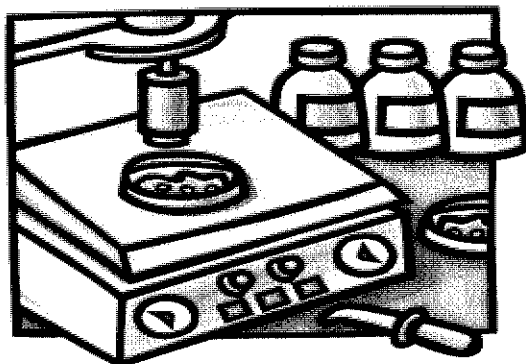
To measure the mass of an object, the object is placed on one pan and **standard masses** are placed on the other pan until the pans *balance* each other. The mass of the object is the sum of the standard masses on the other pan.



A **standard mass** is an object that has been tested and certified to accurately represent the value stated on the mass.

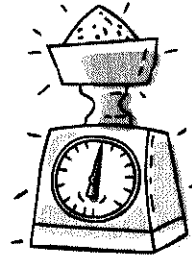
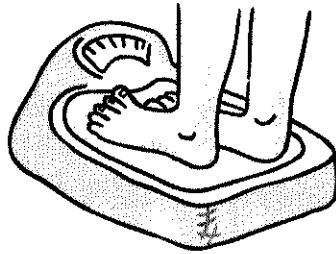


New digital balance scales allow objects to be measured without having to use and calculate the sum of standard masses.



### ***Did You Know?***

Most commonly used scales at home measure **weight** (the gravitational pull) and use grams (g) or kilograms (kg). Check out these examples.



### **Think About ...**

What types of equipment are used to measure mass in your community and in the workplace?

What types of units are used?

Think about farms, mail outlets, construction sites and grocery stores.



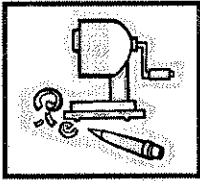
## Practice: Estimating and Measuring Mass

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1. Using a balance scale, estimate and then measure the masses of the following items and four other items of your choice. Be sure to include the units of measurement.

Item	Estimated Mass	Actual Mass
Piece of chalk		
Pencil		
Shoe		
Can of pop		
Stapler		
Hole punch		

2. Check out the science lab to examine standard masses. Locate a balance scale and record the masses of a variety of objects.



## Practice: Converting Between g, kg and t

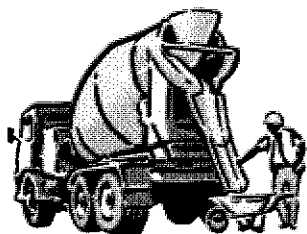
1. Use the mass staircase, move the decimal or use other strategies to complete the following metric conversions.

tonnes (t)		kilograms (kg)		grams (g)
1	=		=	
	=	1	=	
	=		=	25 000 000
	=	400	=	
10	=		=	
	=		=	10
	=	7000	=	
3	=		=	
	=		=	650 000

2. Sami has a job at a truck weigh scale station for the summer. One of Sami's tasks is to calculate the total mass of trucks coming through the station and record them in tonnes. The first three semis of the day have masses of 12 300 kg, 9460 kg and 10 350 kg. What is the total mass, in tonnes, of the first three trucks of the day?

## Solving Mass Problems

### Examples



A) The cement truck is carrying 2500 kg of cement.

If a wheelbarrow can carry approximately 150 kg of cement per load, how many loads will the worker need to empty the cement truck?

**Solution:**

$$\begin{array}{ccccccc} 2500 \text{ kg} & \div & 150 \text{ kg/load} & = & 16.666... & = & 17 \text{ loads} \\ \uparrow & & \uparrow & & \uparrow & & \uparrow \\ \text{Amount of cement} & & \text{Amount of cement} & & \text{More than 16} & & \text{Rounding up to 17 loads} \\ \text{in the cement truck} & & \text{in each} & & \text{wheelbarrow loads} & & \text{allows for the removal of} \\ & & \text{wheelbarrow load} & & \text{of cement needed} & & \text{all the cement from the} \\ & & & & & & \text{cement truck} \end{array}$$

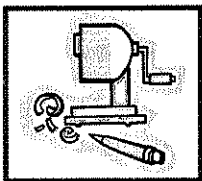
The worker will need to take **17 loads** of cement from the cement truck to empty the truck.



B) A large dump truck can hold 3400 kg of household garbage. If the average household has 19.4 kg of garbage on pick-up day, how many households' worth of garbage could this truck pick up?

**Solution:**  $3400 \div 19.4 = 175.26$

The truck could pick up the garbage from 175 households.  
(0.26 represents part of a load, but not an entire household)

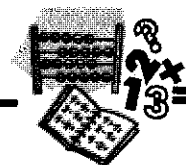


## Practice: Mass Problems

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1. Jacqueline is sending three presents in one box by truck to the U.S. If the masses of the presents are 25 kg, 32 kg and 550 kg respectively and the mass of the box is 2 kg, what is the total mass of the box full of presents?
2. A courier company charges a \$30.00 handling fee for packages over 100 kg. If the contents of Erin's package have masses of 25 500 g, 36 000 g, 19 500 g and 20 500 g, will she be charged the \$30.00 handling fee?
3. At the gym, Ali places two 50 kg plates, four 25 kg plates and two 10 kg plates on the bar to match his personal best lift. What mass represents Ali's personal best?

# Capacity and Volume

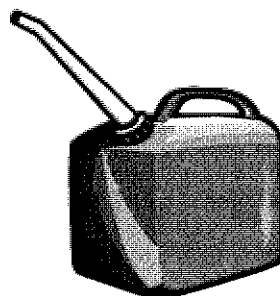
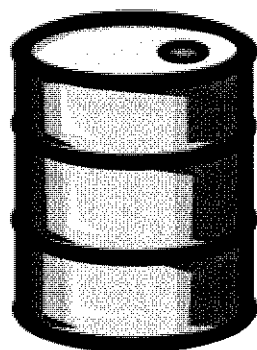


## Capacity

**Capacity** is the amount a container can hold.



The oil, juice drink and gasoline containers are just a few examples of objects that illustrate capacity.



Capacity is measured in the SI base unit called **litres (L)**. The most common units for capacity are litre (L) and millilitre (mL).

1000 L kilolitre (kL)  
100 g hectolitre (hL)  
10 g decalitre (daL)  
1 g litre (L)  
1/10 g decilitre (dL)  
1/100 g centilitre (cL)  
1/1000g millilitre (mL)

Hint: Remember to use this ACRONYM to help you with the order of the units:

**K**ing  
**H**enry's  
**D**aughter  
**B**etty  
**D**etested  
**C**ounting  
**M**oney



Recipes require ingredients in specific amounts to create the desired finished product.

Not all ingredients come packaged in the quantities that recipes call for, so converting between different units of capacity is important.

## Examples

- A) How many mL does 10 L represent? 10 000 mL
- B) How many L does 4000 mL represent? 4 L
- C) How many mL does 7.4 L represent? 7400 mL

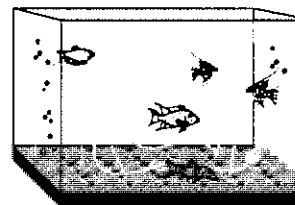
## Volume

**Volume** is the amount of space a container or object occupies.

### Example

Capacity is the amount of water required to fill the fish tank (mL or L).

Volume is the space the tank and water take up.



The most common unit of volume is centimetres cubed ( $\text{cm}^3$ ).

One centimetre cubed will hold one millilitre of fluid or another substance.

1000  $\text{cm}^3$  will hold one thousand millilitres of fluid or another substance.

$$1000 \text{ mL} = 1000 \text{ cm}^3$$

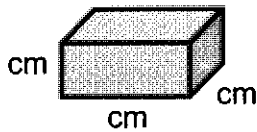
Remember that  $1000 \text{ mL} = 1\text{L}$ , so  $1\text{L} = 1000 \text{ cm}^3$ .

**Do you see how capacity and volume are similar?**

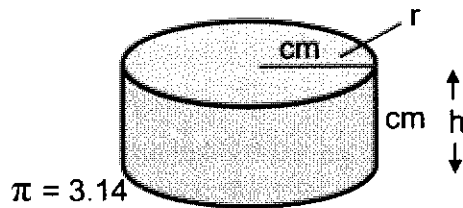
The number stays the same, but the units change.



Volume is commonly measured in cubic units, such as  $\text{cm}^3$ , because volume is a measure of an object's length, width and height as shown below.



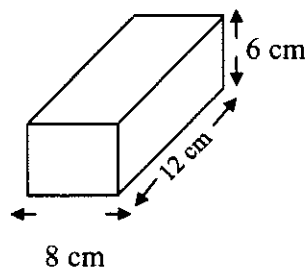
Volume of a cube or rectangular prism  
 $= l \times w \times h$   
 $= \text{cm} \times \text{cm} \times \text{cm}$   
 $= \text{cm}^3$



Volume of a cylinder  
 $= \pi \times r^2 \times h$   
 $= \pi \times \text{cm}^2 \times \text{cm}$   
 $= \text{cm}^3$

### Examples

A) Calculate the volume of the box.

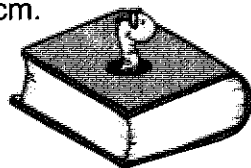


$$\begin{aligned} V &= l \times w \times h \\ &= 12 \times 8 \times 6 \\ &= 576 \text{ cm}^3 \end{aligned}$$

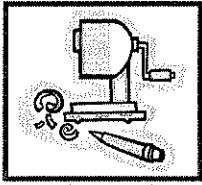
How much space does the box take up?  $576 \text{ cm}^3$

The volume of the box is  $576 \text{ cm}^3$ .

B) Calculate the volume of a book that has a length of 10 cm, a width of 3.2 cm and a height of 15 cm.



$$\begin{aligned} V &= l \times w \times h \\ &= 10 \times 3.2 \times 15 \\ &= 480 \text{ cm}^3 \end{aligned}$$



## Practice: Calculating and Converting Capacity

---

1. Shaz is cleaning under the kitchen sink. He found five 2-litre bottles of glass cleaner. None of the bottles is full. The bottles contain the following amounts.



Bottle 1 – 375 ml  
Bottle 2 – 150 ml  
Bottle 3 – 190 ml  
Bottle 4 – 780 ml  
Bottle 5 – 630 ml

- a) How many litres of glass cleaner do the five bottles contain?
- b) If Shaz combines all of the glass cleaners into as few bottles as possible, how many bottles will he use?
2. Perform the following conversions.

a) 250 mL =  L

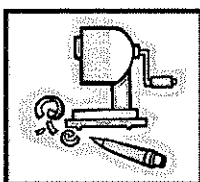
b) 1350 mL =  L

c) 62 L =  mL

d) 0.9 L =  mL

e) 625 mL =  L

f) 3.8 L =  mL



## Practice: Estimating and Calculating Capacity and Volume

1. Find a variety of waterproof containers. Fill them with water, without measuring the amount of water poured into each container.

Estimate the capacity of each container and record these values in the table.

Use measuring devices or instruments to measure the actual capacity of water in each container and record these values.

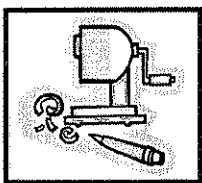
Use the data about capacity to estimate and calculate volume.

Be sure to include your units of measurement.

Container Number	Estimated Capacity	Estimated Volume	Actual Capacity	Actual Volume
1				
2				
3				
4				
5				

### Think About ...

Think about the different uses of capacity and volume in your community. Collect examples and think about the different jobs that are in charge of monitoring or maintaining volume or capacity.



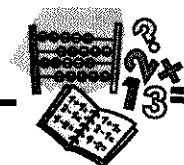
## Practice: Converting Capacity and Volume

1. Kathy played a practical joke on her sister. She filled a box with Styrofoam chips and wrapped it. If the box measures 12 cm by 5 cm by 15 cm, what volume of chips did Kathy use to completely fill the box?
2. a) Various sizes of containers are filled to the top with water. Determine the volume of water and the capacity of each container by performing the following conversions.

Complete the three empty rows using containers from school, home or workplace.

<b>cm<sup>3</sup></b>	<b>mL</b>	<b>L</b>
	45	
9		
		20
160		
12		

# Temperature



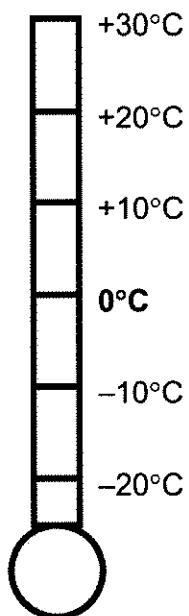
People talk about weather and weather conditions daily. Temperature, precipitation, UV index and amount of sunshine are important to the way we dress, what we do and even how we feel!

Temperature is commonly measured in Canada using the **Celsius scale**. The unit of measurement is degree Celsius ( $^{\circ}\text{C}$ ).

Normal room temperature is around  $20^{\circ}\text{C}$ .

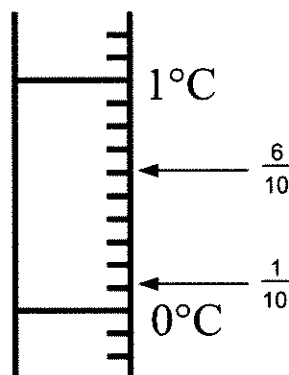
The boiling point of water is  $100^{\circ}\text{C}$ .

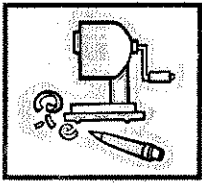
Healthy body temperature is  $37^{\circ}\text{C}$ .



Thermometers are used to measure the temperatures of air, liquids and human bodies.

Each degree has a value of 1 and is divided into tenths, just like metric lengths.





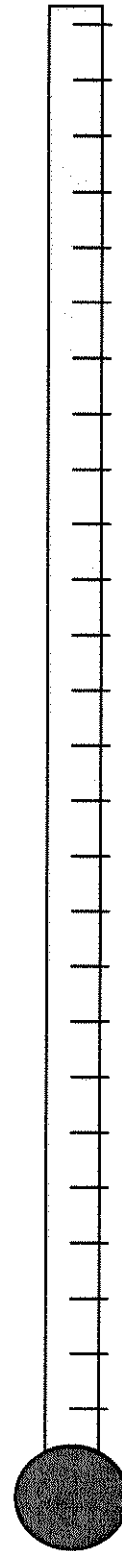
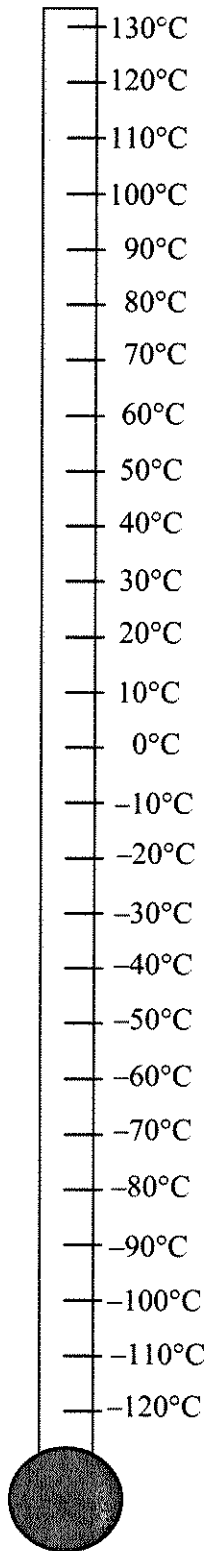
## Practice: Temperatures on a Thermometer

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1. Use experimentation, reference materials or other sources of information to fill in the temperatures in the chart below. Use the last two rows to take interesting temperatures of your own.

Condition	Temperature (°C)
Freezing temperature of water	
Boiling point of water	
Normal body temperature	
Normal room temperature	
Armpit temperature	
Hands before rubbing them together	
Hands after rubbing them together for 10 seconds	

2. Label and identify the temperatures from the table above on printed copy of the thermometer on the next page.



3. For each of the following, work with classmates to estimate, then measure each temperature using a thermometer.

<b>Situation/Condition</b>	<b>Estimated Temperature (°C)</b>	<b>Actual Temperature (°C)</b>
Glass of warm water		
Outside temperature		
Glass of ice water		
Room temperature		

4. Estimate the following temperatures on your own, then compare estimations with one or two of your classmates and be prepared to support or alter your estimations.

<b>Situation/Condition</b>	<b>Estimated Temperature (°C)</b>
Cool day	
Warm bath	
Refrigerator	
Ice cream	
Freezer	
Very cold day	
Hot tub	
Cold drink	



## Converting Celsius and Fahrenheit Temperatures

Temperature is commonly measured in Canada using the **Celsius scale**. The unit of measurement is degree Celsius ( $^{\circ}\text{C}$ ).

Another scale used to measure temperature is the **Fahrenheit scale**. The United States and some countries in Europe measure temperatures in degrees Fahrenheit ( $^{\circ}\text{F}$ ).

$^{\circ}\text{Fahrenheit}$	$^{\circ}\text{Celsius}$
96	35.5
95	35
91.5	33
69	20.5
60	15.5
55.5	13
50	10
32	0
28.5	-2
5	-15

## Converting from Celsius to Fahrenheit

To **convert** from Celsius to Fahrenheit, use the following formula:

$$^{\circ}\text{F} = \frac{9}{5} \times \text{---}^{\circ}\text{C} + 32$$

To **estimate** a temperature in  $^{\circ}\text{F}$  when given a temperature in  $^{\circ}\text{C}$ :

Take the temperature in  $^{\circ}\text{C}$ , multiply by 2 and add 20.

### Example



**Exactly**

$$\begin{aligned} ^{\circ}\text{F} &= \frac{9}{5} \times 20^{\circ}\text{C} + 32 \\ &= 36 + 32 \\ &= 68^{\circ}\text{F} \end{aligned}$$

**Approximately**

$$\begin{aligned} ^{\circ}\text{F} &= 20^{\circ}\text{C} \times 2 + 20 \\ &= 40 + 20 \\ &= 60^{\circ}\text{F} \end{aligned}$$

If the temperature is  $20^{\circ}\text{C}$ , what is the temperature in  $^{\circ}\text{F}$ ?

## Converting from Fahrenheit to Celsius

To **convert** from Fahrenheit to Celsius, use the following formula:

$$^{\circ}\text{C} = \frac{5}{9} ( \text{---}^{\circ}\text{F} - 32 )$$

To **estimate** a temperature in  $^{\circ}\text{C}$  when given a temperature in  $^{\circ}\text{F}$ :

Take the temperature in  $^{\circ}\text{F}$ , divide by 2 and subtract 15.

### Example

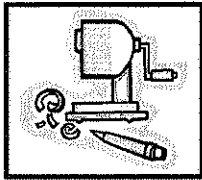
$85^{\circ}\text{F}$  would be how many  $^{\circ}\text{C}$ ?

**Exactly**

$$\begin{aligned} ^{\circ}\text{C} &= \frac{5}{9} (85^{\circ}\text{F} - 32) \\ &= \frac{5}{9} (53) \\ &= 29.4^{\circ}\text{C} \end{aligned}$$

**Approximately**

$$\begin{aligned} ^{\circ}\text{C} &= 85^{\circ}\text{F} \div 2 - 15 \\ &= 42.5 - 15 \\ &= 27.5^{\circ}\text{C} \end{aligned}$$



## Practice: Converting Temperatures

1. Use a variety of strategies to estimate the following temperatures.

a)  $30^{\circ}\text{C} = \square^{\circ}\text{F}$

b)  $80^{\circ}\text{F} = \square^{\circ}\text{C}$

c)  $25^{\circ}\text{C} = \square^{\circ}\text{F}$

d)  $65^{\circ}\text{F} = \square^{\circ}\text{C}$

e)  $0^{\circ}\text{C} = \square^{\circ}\text{F}$

f)  $70^{\circ}\text{F} = \square^{\circ}\text{C}$

g)  $12^{\circ}\text{C} = \square^{\circ}\text{F}$

h)  $92^{\circ}\text{F} = \square^{\circ}\text{C}$

2. Amandeep is investigating tropical locations to plan a winter vacation. He is experiencing some difficulties because his sources identify average temperatures using the Fahrenheit scale. Help Amandeep convert each temperature to Celsius.

Cuba	$68^{\circ}\text{F}$
Jamaica	$78^{\circ}\text{F}$
Hawaii	$74^{\circ}\text{F}$
Greece	$70^{\circ}\text{F}$
Australia	$66^{\circ}\text{F}$
England	$56^{\circ}\text{F}$

3. Brendon left London, where the temperature was  $21^{\circ}\text{C}$ , and arrived in Florida, where the temperature was  $70^{\circ}\text{F}$ . Which location had the warmer temperature?

### Think About ...

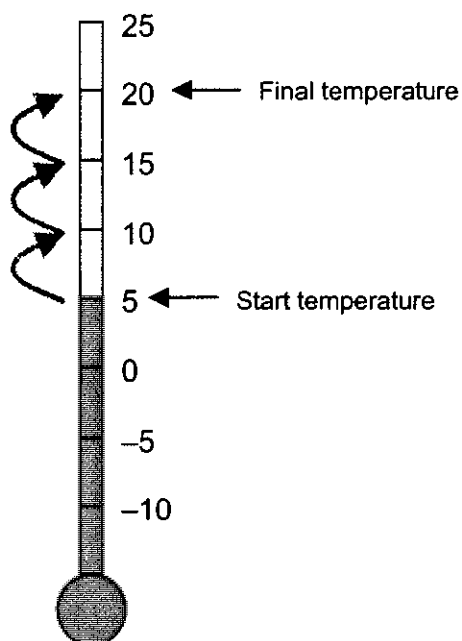
How do you and your family use temperature at **home**? Do you use degrees Fahrenheit or Celsius? How is temperature use in the **workplace**? Think of examples of how temperature is important to chefs, welders, pet store clerks, factory workers and millwrights.

## Temperature Changes

A thermometer or a number line can be used to help determine changes in temperature.

### Example

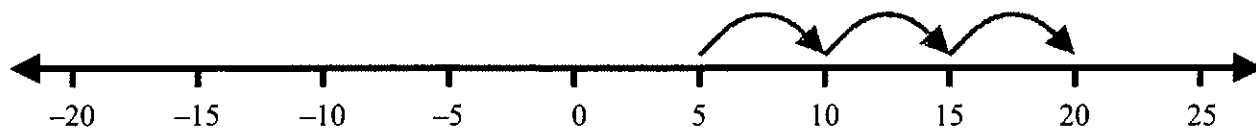
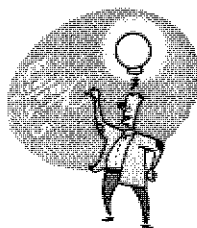
- A) In the morning, the temperature outside was  $5^{\circ}\text{C}$ . By late afternoon, the temperature was  $20^{\circ}\text{C}$ . How many degrees did the temperature increase during the day?



$$5^{\circ}\text{C} \text{ to } 20^{\circ}\text{C} = 15$$

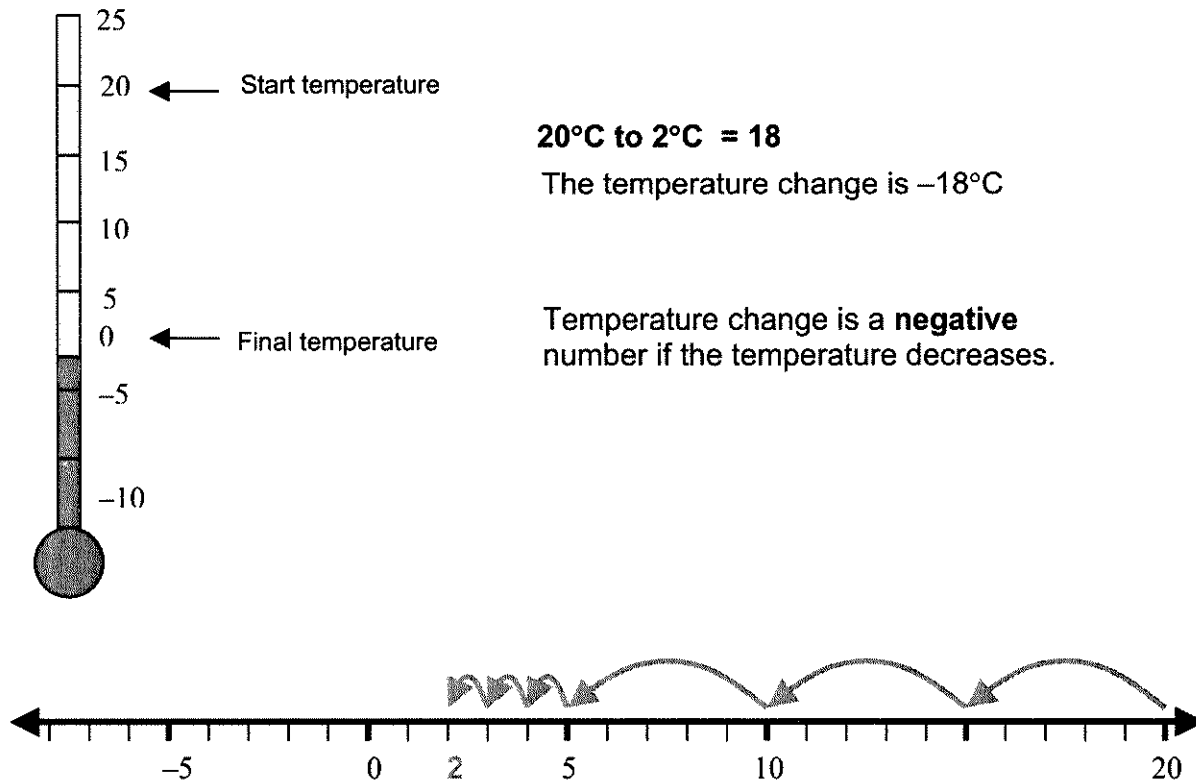
The temperature change is  $+15^{\circ}\text{C}$

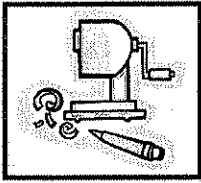
Temperature change is a **positive number** if the temperature increases.



Hint: Temperature changes are just like adding and subtracting integers. Think back to the hot air balloon examples in Adding Integers and Subtracting Integers.

- B) On another day, the afternoon temperature was  $20^{\circ}\text{C}$ . By evening, the temperature decreased to  $2^{\circ}\text{C}$ . What is the change in temperature?





## Practice: Calculating Temperature Changes

---

1. A storm was blowing across southern Alberta. At 2:00 p.m., the temperature was  $26^{\circ}\text{C}$ . An hour later, it had dropped by  $7^{\circ}\text{C}$ . At 4:30 p.m., the temperature rose by  $5^{\circ}\text{C}$ . Two hours later, the temperature dropped another  $2^{\circ}\text{C}$ . What was the temperature at 6:30 p.m.?
2. Daniel and Missy wanted to examine world temperature changes. They found the daily low and high temperatures for one day at various locations around the world. Use the data they collected below to calculate the temperature change at each location.

Use a thermometer or number line to indicate the following temperature changes.

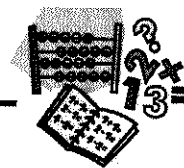
Location	Temperatures	Temperature Change
1	$5^{\circ}\text{C}$	to $25^{\circ}\text{C}$
2	$-5^{\circ}\text{C}$	to $18^{\circ}\text{C}$
3	$-10^{\circ}\text{C}$	to $-30^{\circ}\text{C}$
4	$8^{\circ}\text{C}$	to $-1^{\circ}\text{C}$
5	$0^{\circ}\text{C}$	to $-28^{\circ}\text{C}$

Remember:

- + indicates an increase in temperature
- indicates a decrease in temperature.

3. Examine the temperature changes above to answer the following questions.
  - a) Which location had the:
    - greatest temperature change?
    - smallest temperature change?
  - b) Using sentences, explain where you would like to live (locations 1 through 5) and give reasons for your choice.

# 12-hour and 24-hour Clocks



## 12-hour Clock

The 12-hour clock system displays time for a 12-hour period, which is half of the 24-hour day.

- Time from midnight to noon is represented by the abbreviation “a.m.”
- Time from noon to midnight is represented by the abbreviation “p.m.”



**a.m.** is from *ante meridiem*, which means before midday.  
**p.m.** is from *post meridiem*, which means after midday.

Most analog clocks are 12-hour clocks. The time on this analog clock reads 6:13, but that could be a.m. (morning) or p.m. (evening).



## 24-hour Clock

The 24-hour clock system shows time for a 24-hour period of time.

On the 24-hour clock, the first 12 hours of the day are numbered 1 to 12. The next hour is 13. The next hour is 14, and so on.



The military uses the 24-hour clock system to avoid confusion in determining if a given time is **a.m.** or **p.m.** For this reason, the 24-hour clock is often referred to as **military time**.

### 12-hour clock

7:00 a.m.  
11:00 a.m.  
12:00 a.m.  
1:00 p.m.  
2:00 p.m.

↓  
11:00 p.m.

### 24-hour clock

07:00  
11:00  
12:00  
13:00  
14:00

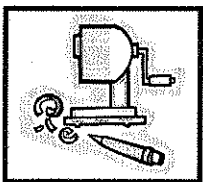
↓  
23:00

Seven hundred hours or “O” (*oh*) seven hundred  
Eleven hundred hours  
Twelve hundred hours  
Thirteen hundred hours  
Fourteen hundred hours

↓  
Twenty-three hundred hours

**Note:** **a.m.** and **p.m.** symbols are not needed with a 24-hour clock.

Some analog timepieces have the 24-hour clock numbers printed in an inner circle on the clock face. Many digital timepieces allow you to select the 12-hour or 24-hour clock system by the press of a button.




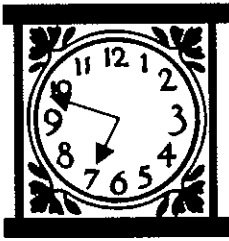
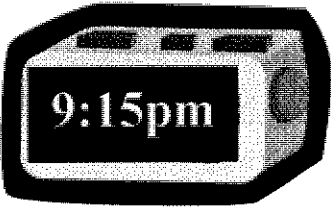
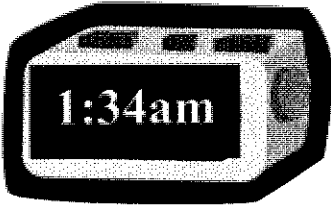
## Practice: Reading 12-hour and 24-hour Clocks

---

1.
  - a) If it is 1:00 p.m., what time is it on a 24-hour clock?
  - b) If it is 3:00 a.m., what time is it on a 24-hour clock?
  - c) If it is 2200 hours, what time is it on an analogue clock?
  - d) If it is 1500 hours, what time is it on an analogue clock?
  - e) If it is 6:00 p.m., what time is it on a 24-hour clock?
  - f) If it is 1900 hours, what time is it on an analogue clock?
  
2.
  - a) If it is 2:20 a.m., what time is it on a 24-hour clock?
  - b) If it is 7:43 p.m., what time is it on a 24-hour clock?
  - c) If it is 12:34 on a 24-hour clock, what time is it on an analogue clock?
  - d) If it is 19:12 on a 24-hour clock, what time is it on an analogue clock?
  - e) If it is 4:55 p.m., what time is it on a 24-hour clock?
  - f) If it is 16:03 on a 24-hour clock, what time is it on an analogue clock?



3. Record the time shown on each clock.

Timepiece	12-hour time	24-hour time
 <p>p.m.</p>		
 <p>a.m.</p>		
		
		


4. Calculate the following changes in time. The first question has been completed for you.

- a) Jodi has two hours to complete her job at the carwash. If she begins at 12:30 p.m., at what time will she be finished?

**Solution:**

Starting time: 12:30 p.m.

+ 2:00 hours

  
Jodi will finish in 2 hours, so ADD 2 hours to the start time.

---

**2:30 p.m.**

**Jodi will finish work at 2:30 p.m.**

- b) Jeff began babysitting at 7:10 p.m. and the parents arrived home at 1:40 a.m. For how many hours will Jeff get paid?
- c) Lars has been playing the drums since 5:00 p.m. When he finishes practising, Lars notices that it is now 6:52 p.m. How long has Lars been practising?
- d) Shauna began reading her book at 7:15 p.m. and finished the book at 10:45 p.m. For how long did Shauna read?
- e) Kim started work at 8:05 a.m. Kim checks her wristwatch and notices that the time is 10:35 a.m. How long has Kim been at work?

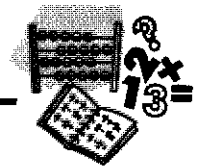
5. Using the bus schedule below, answer the following questions.

- a) Which bus arrives earliest in the morning?
- b) Which bus arrives latest in the evening?
- c) Which bus takes the least amount of time (shortest duration)?
- d) If you have to get to Calgary before 5:00 p.m., which buses could you take?
- e) If you have to get to Calgary before 10:30 a.m., which buses could you take?

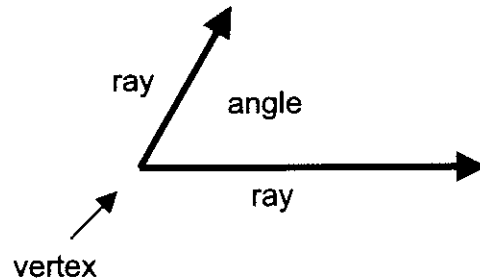
Schedules for April 20					
From: EDMONTON, AB To: CALGARY, AB					
Schedule	Departs	Arrives	Duration	Carrier	Frequency
1111	0:30	6:05	05:35	GLC	Daily
1105	7:00	10:20	03:20	GLC	Daily
1189	9:00	12:45	03:45	GLC	Daily
1181	12:00	15:20	03:20	GLC	Daily
1113	13:00	16:40	03:40	GLC	Daily
1191	14:00	17:30	03:30	GLC	Daily
1177	15:00	18:55	03:55	GLC	Daily
1179	18:00	22:00	04:00	GLC	Daily
2003	19:00	22:50	03:50	GLC	Daily
1187	20:00	23:50	03:50	GLC	Daily
GLC=GREYHOUND CANADA TRANSPORTATION CORP					



# Angles

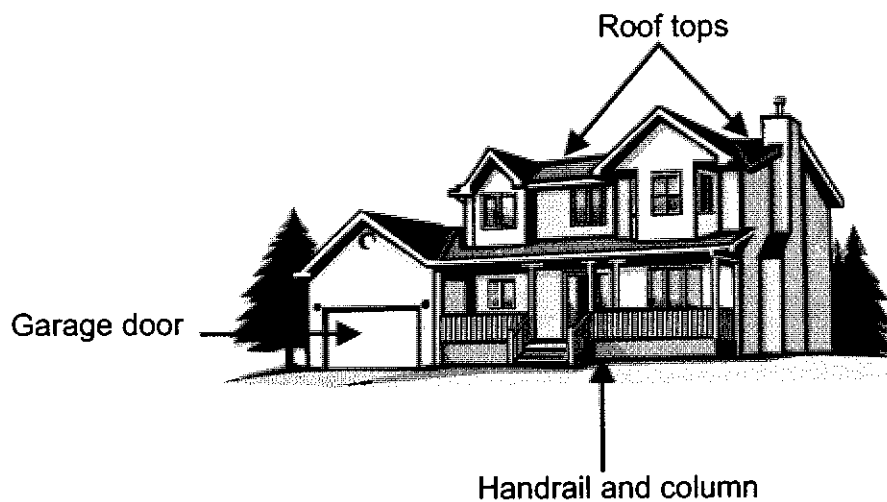


An **angle** is formed when two lines, line segments or rays meet. The point where they meet is called the vertex.



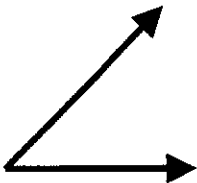
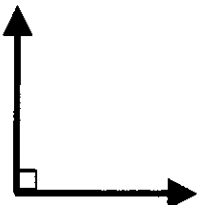

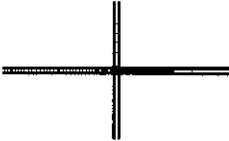

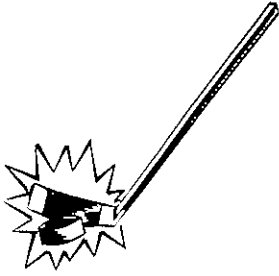
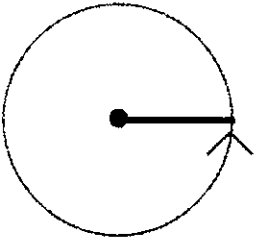
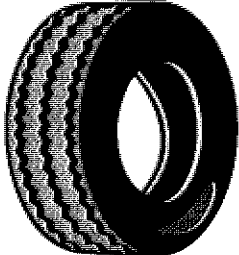
## Example

There are many angles in a building. Can you find ten in this picture?



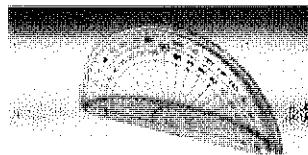
## Common Angles

Some of the more common angles we see daily are shown in the table below.

Angle	Illustration	Examples
45°		Pictures, mirrors and door frames are cut at 45° each and joined to form 90° corners.
90°	 The  is used to represent 90°	Intersections where streets and avenues meet.  Steps Where walls meet floors
180°		Straight lines Beams and studs Roadways Ski poles Hockey stick shafts 
360°		All circular objects Tires Ferris wheels Steering wheels 

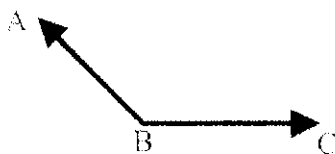
## Measuring and Drawing Angles

Angles are measured in units called degrees ( $^{\circ}$ ), using a measuring device called a protractor. A protractor has  $180^{\circ}$  marked on it.

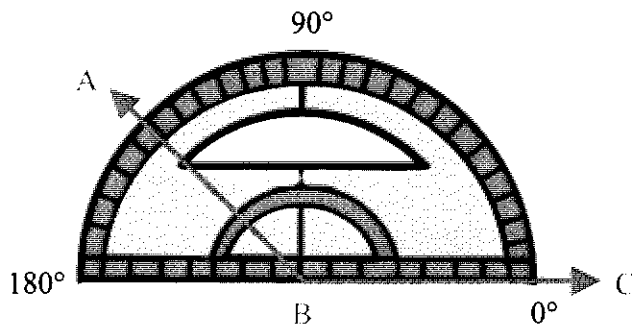


### Example

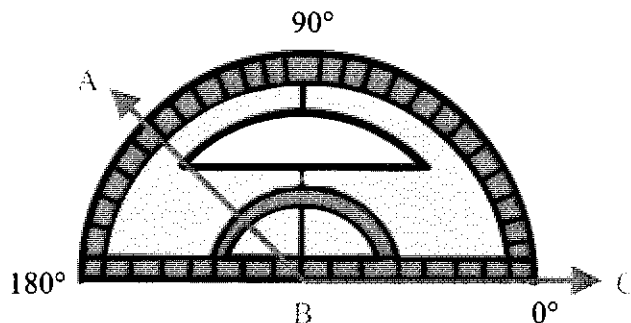
What is the measure of  $\angle ABC$ ?



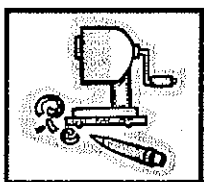
1. Extend the rays of the angle so it shows outside of the protractor. Place the centre of the protractor on the vertex of the angle AND align one of the rays along the  $0^{\circ}$  mark at the bottom of the protractor.



2. From the  $0^{\circ}$  mark, count the number of degrees to the other ray. This is the measure of the angle in degrees.



$\angle ABC$  measures  $135^{\circ}$ .



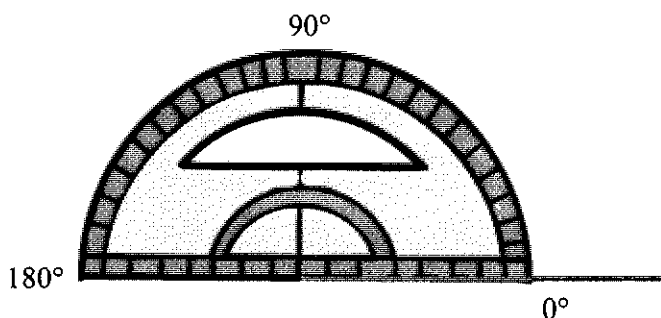
## Practice: Drawing Angles Using a Protractor

Follow these steps to draw an angle of  $50^\circ$ .

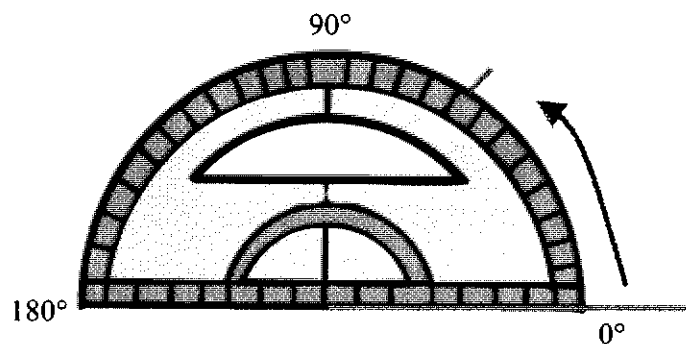
1. Draw a straight line using the bottom of the protractor or a ruler.



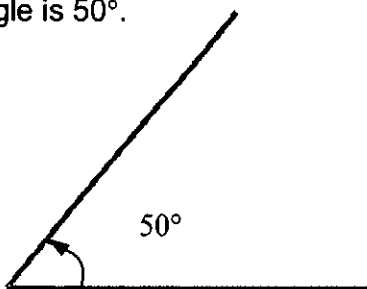
2. Place the centre of the protractor at one end of the line and turn the protractor so that one of the  $0^\circ$  marks is aligned with the other end of the line.



3. Begin where the line is on  $0^\circ$  and measure the desired angle. Mark that spot along the outside edge of the protractor using a pencil.




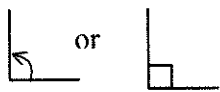


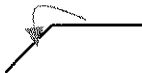
4. Turn the protractor and use a pencil to draw a straight line connecting the vertex and the pencil mark. The angle is  $50^\circ$ .





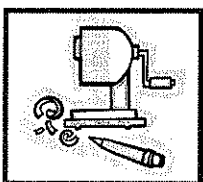
## Classifying Angles

Angles are named according to their size in degrees.

Angle	Diagram	Name
Less than $90^\circ$		Acute angle
Exactly $90^\circ$		Right angle
Greater than $90^\circ$ , less than $180^\circ$		Obtuse angle
Exactly $180^\circ$		Straight angle
Greater than $180^\circ$ less than $360^\circ$		Reflex angle

The sum of the angles in a triangle equals  $180^\circ$ .

The sum of the angles in a quadrilateral equals  $360^\circ$ .

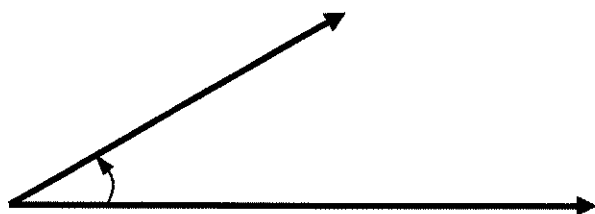


## Practice: Angle Practice

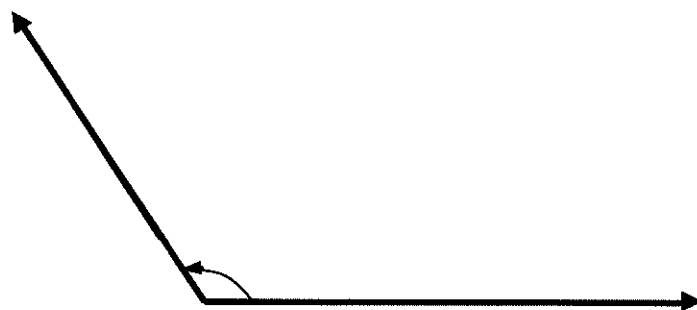
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1. Measure the following angles. Record each angle and classify.

a.



b.



c.



2. Draw and classify the following angles.

a)  $60^\circ$

b)  $35^\circ$

c)  $125^\circ$

d)  $70^\circ$

e)  $95^\circ$

f)  $135^\circ$

g)  $25^\circ$

h)  $10^\circ$

3. Use your knowledge of angles to estimate and calculate angles in science class, such as:

- the angle made by earth, you and a star or other night sky object
- angles of reflection and refraction.

Measure angles around the classroom and find as many different angles as you can. Record the angles you find in a chart like the one below.

Where I found angle	Size of angle	Type of angle

4. Visit the Muttart Conservatory in Edmonton, or other buildings. Classify the shapes and objects within the building and those that make up the building.

### Think About ...

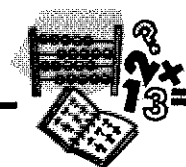
Angles are very important in the business of construction.

Carpenters must measure the angles to make sure that everything will fit together. For example, you can't make a square room without four angles of  $90^\circ$ .

What other trades people need to measure angles on the job?



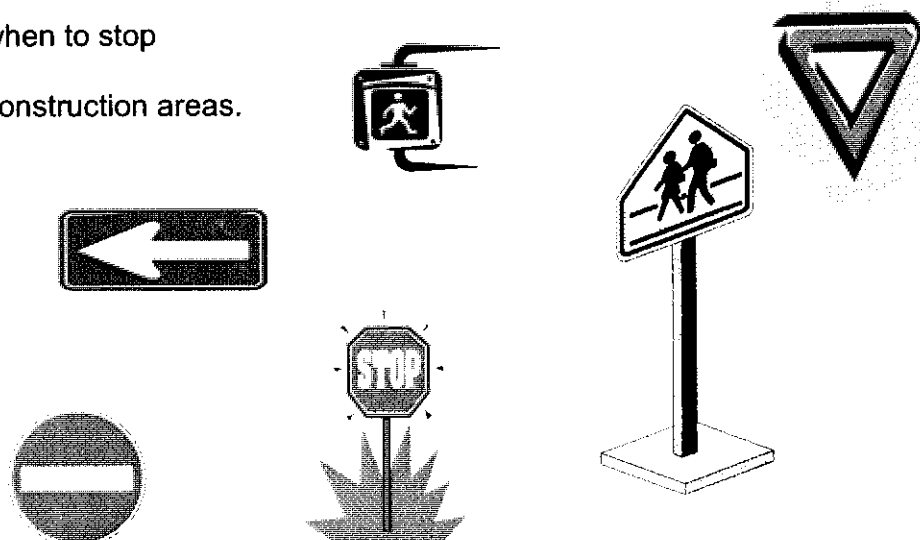
## Identifying and Classifying 2-D Shapes



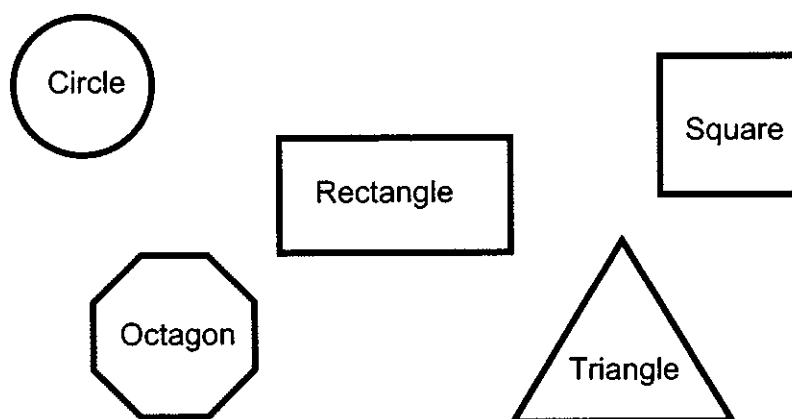
### What is your sign?

The shape and colour of traffic signs let motorists know important information such as:

- when to stop
- construction areas.



Some basic shapes used in traffic signs are illustrated below.



The table shows how many sides each shape has.

Shape	Number of sides
Circle	1
Triangle	3
Rectangle	4
Square	4



Shapes that have more than one side are called **polygons**. A stop sign is an 8-sided polygon called an octagon and a yield sign is a 3-sided polygon called a triangle.

## Quadrilaterals

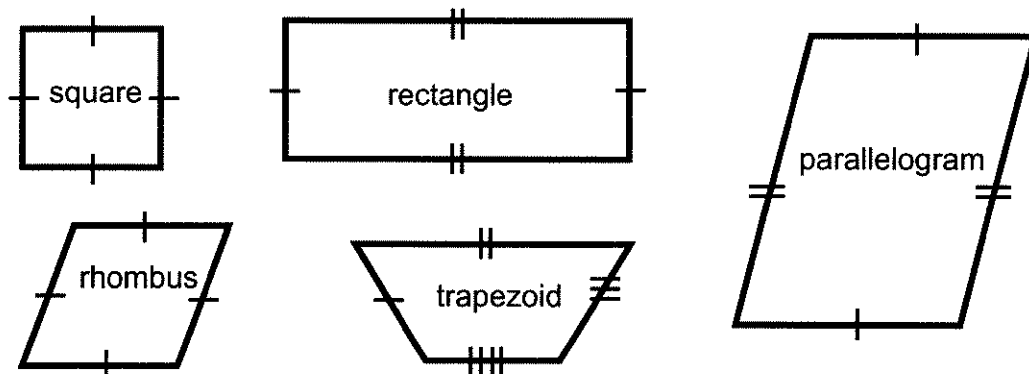
Rectangles and squares have four sides and are part of a larger group of four-sided shapes called **quadrilaterals**. The angles of quadrilaterals total  $360^\circ$ .



A **quadrilateral** is any four-sided figure.

quadri → four    lateral → side

There are many types of quadrilaterals, and they are classified according to their shapes, angles and lengths of sides, as shown below.

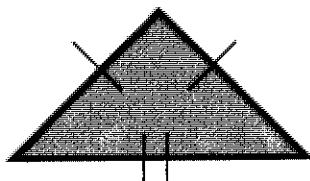


Shape	Characteristics
Square	<ul style="list-style-type: none"> <li>All sides equal in length</li> <li>All angles <math>90^\circ</math></li> </ul>
Rectangle	<ul style="list-style-type: none"> <li>Parallel sides equal in length, but not the same length as the other parallel sides</li> <li>All angles <math>90^\circ</math></li> </ul>
Parallelogram	<ul style="list-style-type: none"> <li>Two parallel sides are equal in length, but other two parallel sides are a different length</li> <li>Two different sets of angle measurements</li> </ul>
Rhombus	<ul style="list-style-type: none"> <li>All sides equal in length</li> <li>Two different sets of angle measurements</li> </ul>
Trapezoid	<ul style="list-style-type: none"> <li>Lengths of sides may not be equal</li> <li>Opposite sides are not parallel</li> <li>Angles vary and may differ from each other</li> </ul>

## Triangles

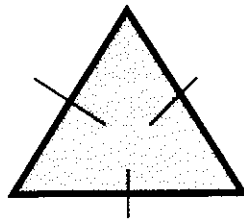
There are three types of triangles. Triangles are classified according to the length of their sides and the measurement of their largest angle. The angles of triangles total  $180^\circ$ .

### 1. Length of sides



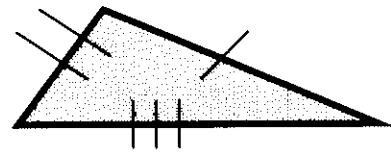
**Isosceles Triangle**

Two sides are equal in length.  
1 line of symmetry



**Equilateral Triangle**

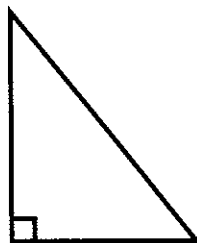
All sides are equal in length.  
3 lines of symmetry



**Scalene Triangle**

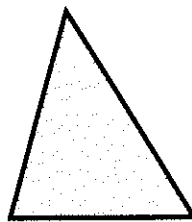
All sides are different in length.  
0 lines of symmetry

### 2. Measurement of the largest angle



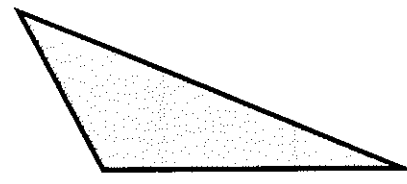
**Right Triangle**

Largest angle is exactly  $90^\circ$



**Acute Triangle**

Largest angle is  $<90^\circ$



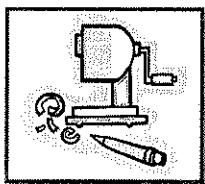
**Obtuse Triangle**

Largest angle is  $>90^\circ$

### Think About ...

Human-made structures such as buildings and bridges are created using shapes such as circles, rectangles and squares. Shapes are also found in nature, for example, the sun is a circle and the centre of a flower is a circle.

What other shapes are found in nature?



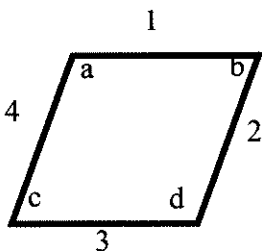
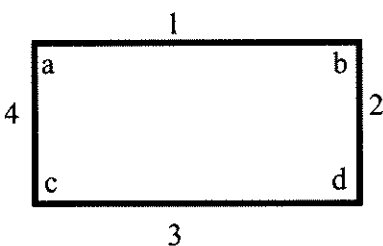
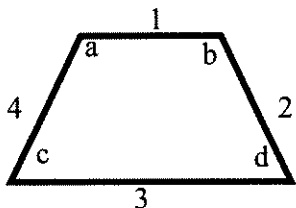
### Practice: Measuring and Classifying Quadrilaterals

1. Use a ruler and a protractor to measure and record the lengths of each side and angle. Then classify each quadrilateral.

Shape	Length of each side	Angles
Classification: 	1. 2. 3. 4.	a) b) c) d)
Classification: 	1. 2. 3. 4.	a) b) c) d)

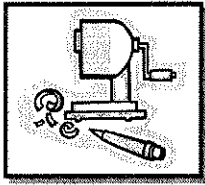


## Measure and Classify Quadrilaterals (continued)

Shape	Length of each side	Angles
Classification: 	1. 2. 3. 4.	a) b) c) d)
Classification: 	1. 2. 3. 4.	a) b) c) d)
Classification: 	1. 2. 3. 4.	a) b) c) d)

2. With a partner, locate a variety of large and small quadrilaterals in your classroom or school, such as doors, windows, tables and tiles. Use appropriate instruments to measure angles and sides (in metric and/or imperial units).





## Practice: Measuring and Classifying Triangles

- For each triangle, measure the lengths of each side and angle using a ruler and a protractor. Classify each triangle according to the length of sides and angles.

Shape	Length of each side	Angles
	1. 2. 3. Classification: _____	a) b) c) Classification: _____
	1. 2. 3. Classification: _____	a) b) c) Classification: _____
	1. 2. 3. Classification: _____	a) b) c) Classification: _____

- Mandy is designing triangular earrings. She makes each side of the triangles a different length. Two of the sides join together to form an angle of  $112^\circ$ . Classify, in two ways, the types of triangles Mandy designed.

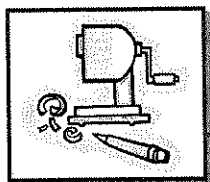
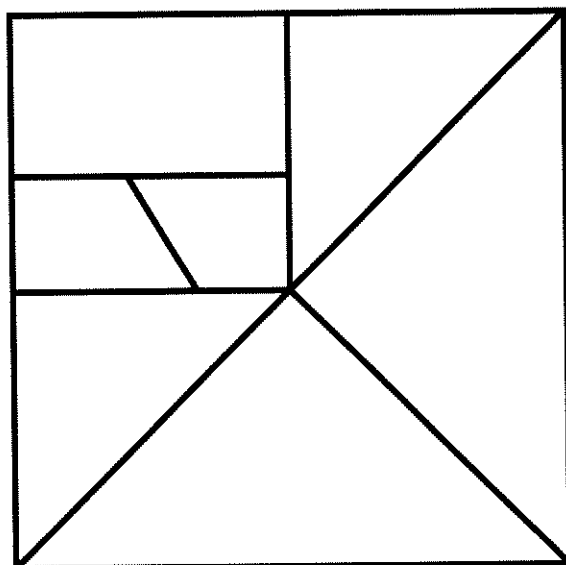
# Tangram Fun!

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A **tangram** is a square cut into seven pieces or shapes. Each shape is a quadrilateral or triangle.

For example, the tangram below has one rectangle, two trapezoids and four triangles.



## Practice: Making a Tangram

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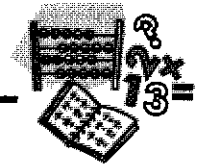
1. Make your own tangram by drawing a square on a piece of paper or coloured construction paper. Create seven different geometric shapes using straight lines. Cut out the shapes.

Trade tangrams with your classmates and put the tangrams back together. Classify the types of polygons used in your tangram.



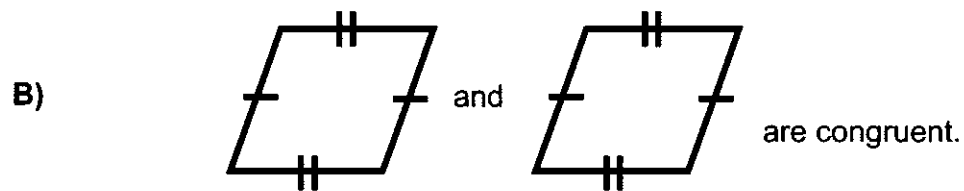
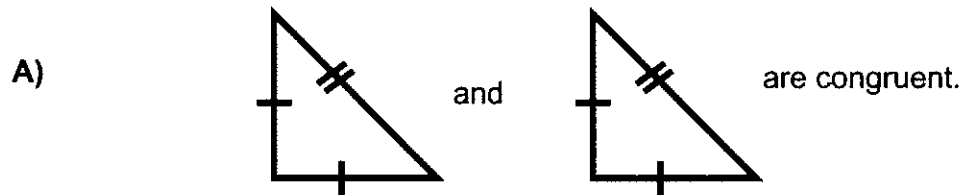


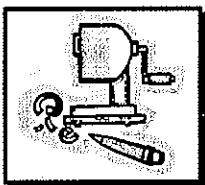
## Congruent 2-D Shapes



**Congruent** means the same size and shape.

### Examples

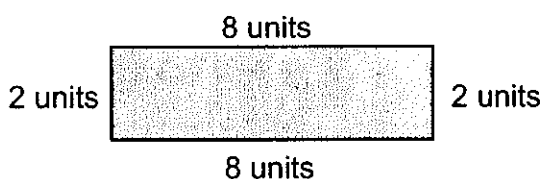




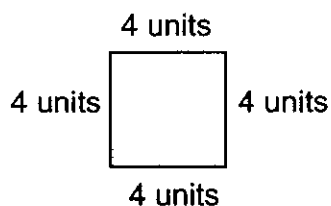
## Practice: Identifying Congruent Shapes

1. Look around the classroom and identify congruent 2-D shapes. Discuss your findings with a classmate or your teacher.
2. Using pencil and paper, ruler, protractor, grid paper, dot paper, geoboard or a computer, reproduce the following shapes.

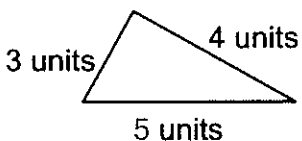
- a) Rectangle



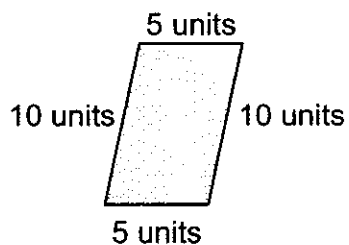
- b) Square



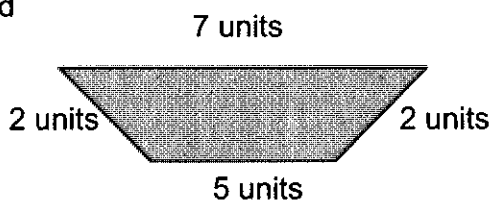
- c) Triangle



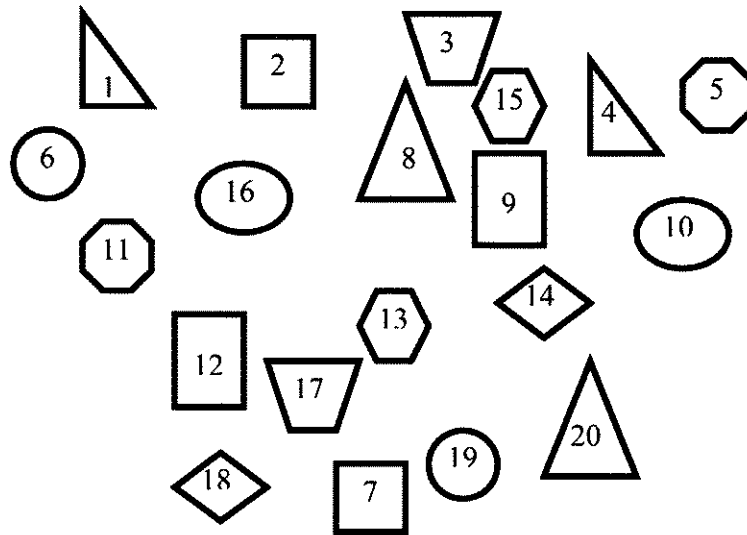
- d) Parallelogram



- e) Trapezoid

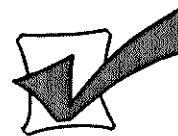


3. Find congruent pairs of shapes, using tracing paper or a ruler, and record the numbers of congruent pairs at the bottom of the page.



Congruent pairs are:

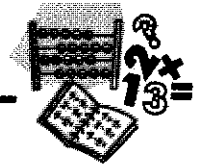
_____	and	_____	_____	and	_____
_____	and	_____	_____	and	_____
_____	and	_____	_____	and	_____
_____	and	_____	_____	and	_____
_____	and	_____	_____	and	_____





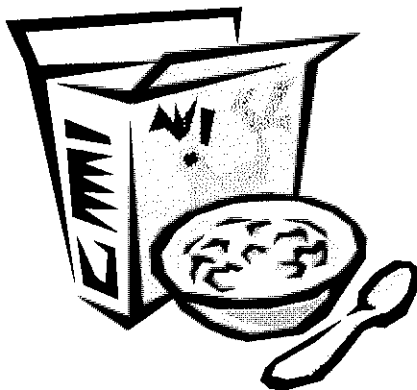


## Identifying and Classifying 3-D Objects

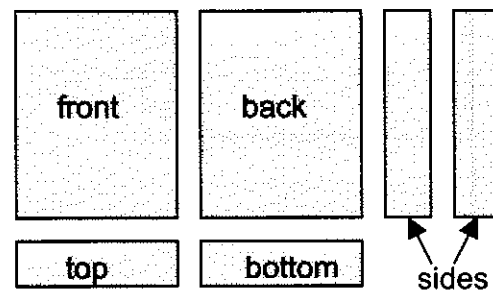


Have you noticed that many of the products we purchase come in packages or boxes? Take a look at the products below.

### Examples



A) Did you notice that all the sides or surfaces of the box are rectangles?

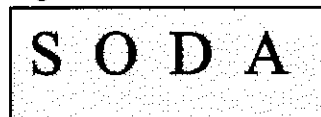


B) The cola can contains two different shapes:

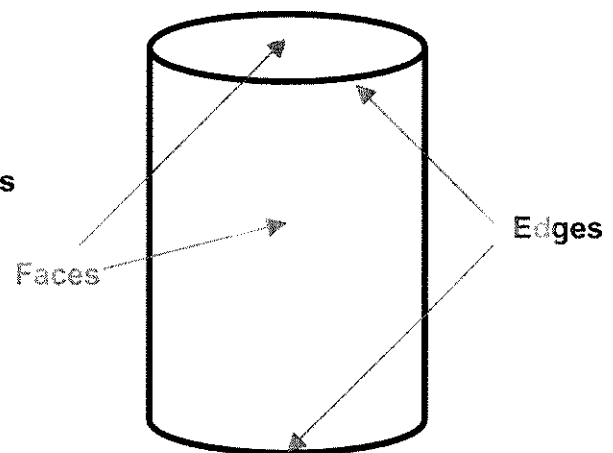
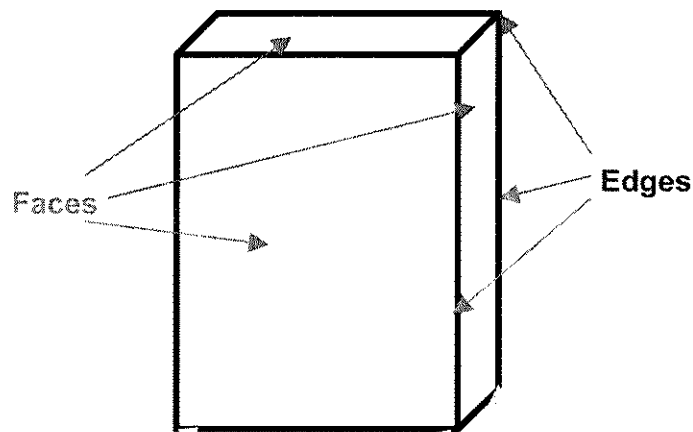
Circles: top and bottom of the can



Rectangle: side of the can



3-D objects are made of faces, vertices and edges. The diagrams illustrate parts of three-dimensional objects.



A **face** of a three-dimensional object is any flat surface that makes up the object.

Faces are common two-dimensional shapes, such as rectangles, squares, circles and triangles.



An **edge** of a three-dimensional object is where two faces meet.



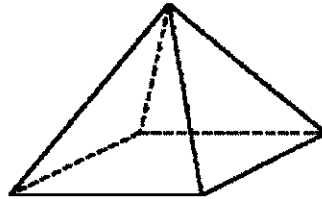
A **vertex (vertices)** is a corner or point of a three-dimensional object where three or more faces meet.

A cylinder does not have any vertices because the faces of a cylinder (top, side and bottom) do not meet in one location.

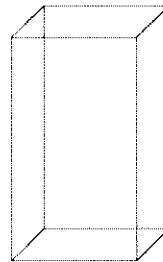
## Classifying 3-D Objects

A **polyhedron** is a 3-D object with all flat surfaces. The following are polyhedrons.

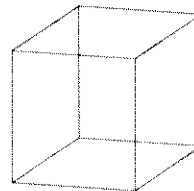
A **square pyramid** is a polyhedron with 4 triangular faces and a square face.



A **square prism** is a polyhedron with 4 rectangular faces and 2 square faces.

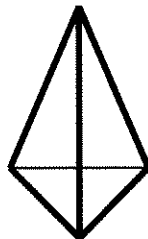


A **cube** is a square prism with 6 congruent square faces.



A polyhedron with faces that are all congruent regular **polygons** is a regular polyhedron.

For example, a **regular tetrahedron** has 4 congruent sides.

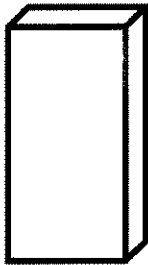


Three-dimensional objects are classified as prisms, pyramids or objects having at least one circle. The shapes of the faces determine their classification.

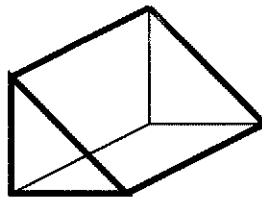
## Prisms

Prisms are named according to the shape of their end faces or base.

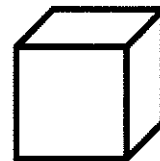
E.g.,



rectangular prism



triangular prism



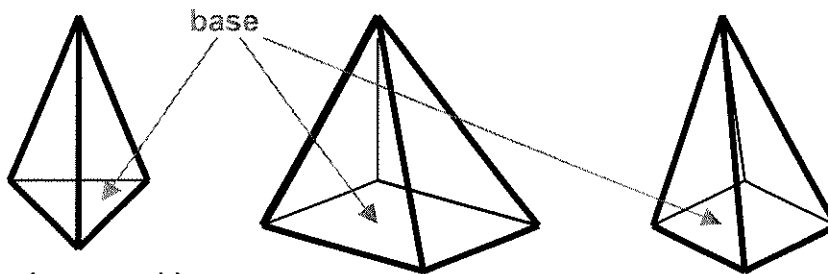
cube prism

## Pyramids

The faces of the sides of three-dimensional pyramids are triangles.

All pyramids have a point at one end where all the triangular faces of the pyramid form a vertex.

Pyramids are named according to the shape of the base.



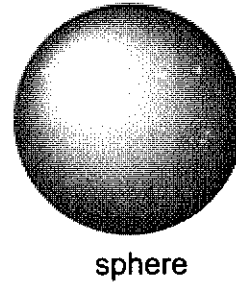
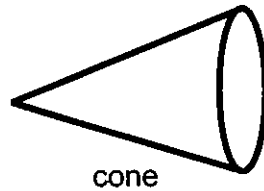
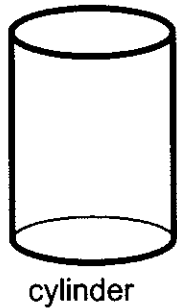
triangular pyramid

rectangular pyramid

square pyramid

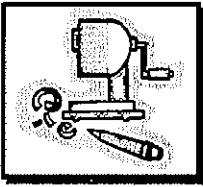
## Objects that contain at least one circle

These objects may have a circle at one end or may be circular in general.



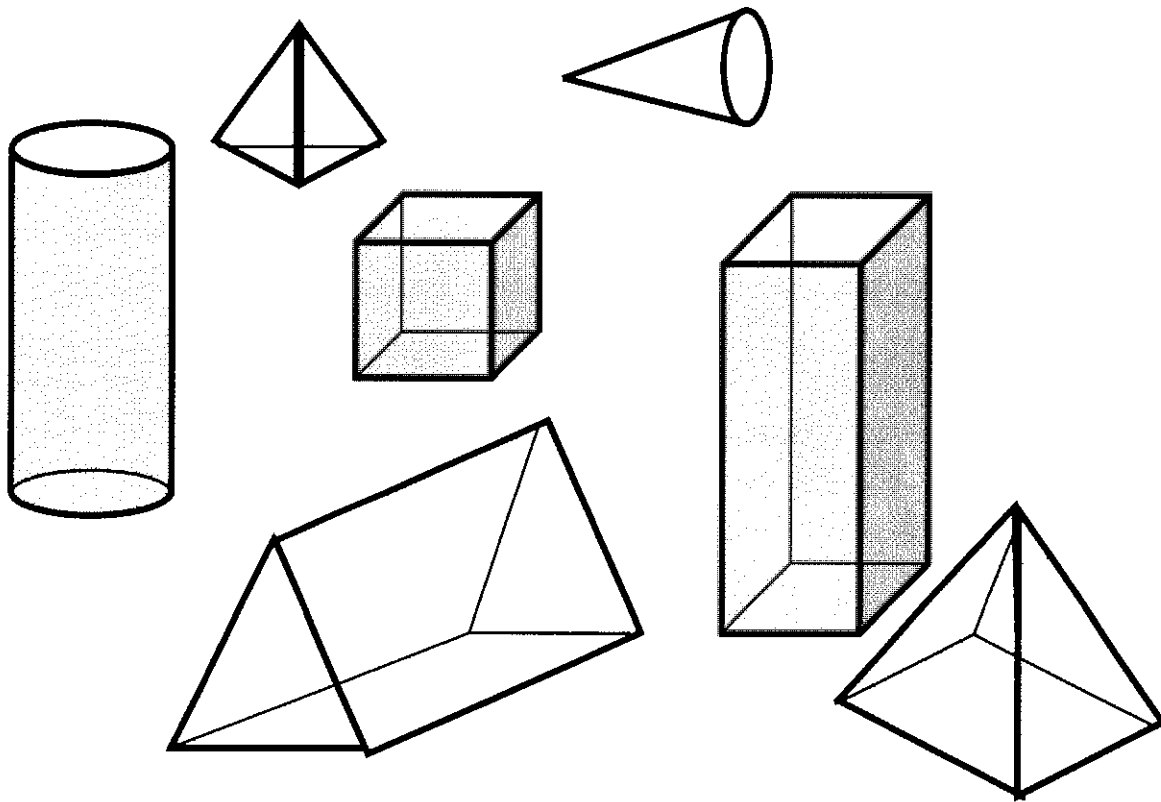
These objects have properties that do not allow them to be grouped as prisms or pyramids.

- A **cylinder** is similar to a prism (the two end faces are the same), but only has one rectangular face (the side of the cylinder).
- A **cone** is a pyramid, with one circle face.
- A **sphere** has one face and no vertices or edges.



## Practice: Identifying and Classifying 3-D Objects


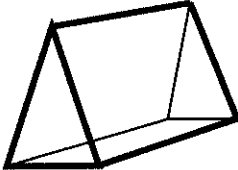
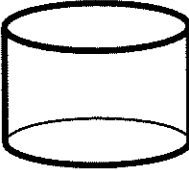
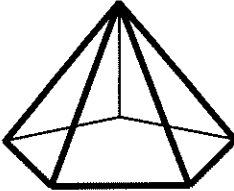
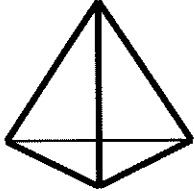
1. Use the diagrams below or obtain 3-D objects from your teacher. Work individually, or in a group, to place these objects into groups. Be prepared to explain the reasons for your groupings.



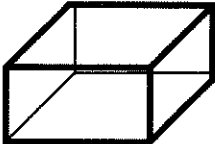

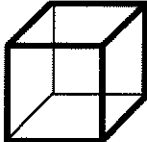
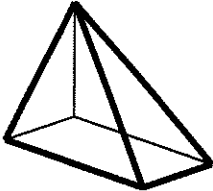
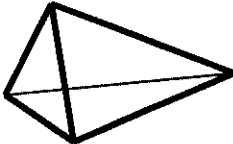
### Think About ...

For each of the shapes above, name something in your home or community that contains the 3-D shape. Think of the roof of your house, buildings and containers.

2. Classify each of the objects below. Identify the number of faces. In the right column, list examples of these shapes from your workplace and/or community.

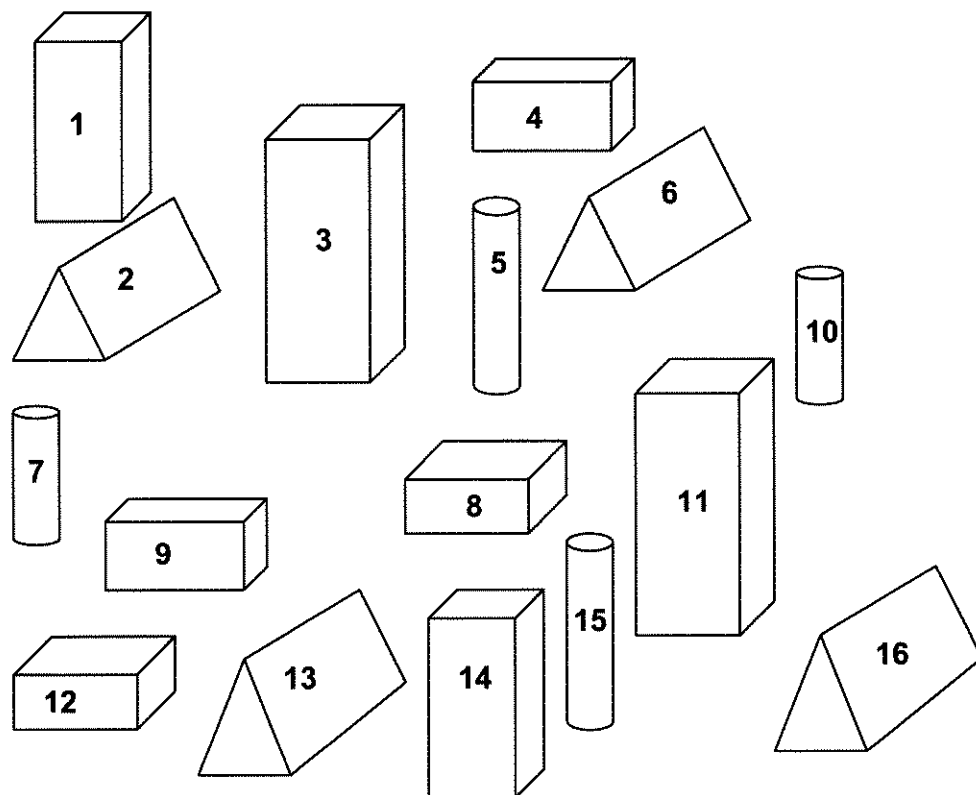
Object	Shape and Number of Faces	Example
		
		
		
		
		

3. Classify the following objects.

Object	Name
	
	
	
	
	



4. Identify pairs of congruent objects using a variety of methods, such as tracing paper or a ruler. Record the numbers of congruent pairs at the bottom of the page.



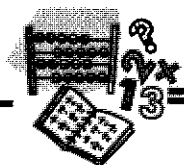
**Congruent pairs are:**

\_\_\_\_\_ and \_\_\_\_\_  
 \_\_\_\_\_ and \_\_\_\_\_  
 \_\_\_\_\_ and \_\_\_\_\_  
 \_\_\_\_\_ and \_\_\_\_\_

\_\_\_\_\_ and \_\_\_\_\_  
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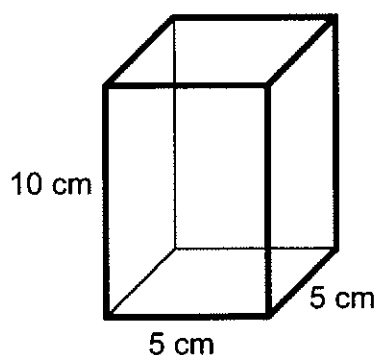
## Surface Area of 3-D Objects



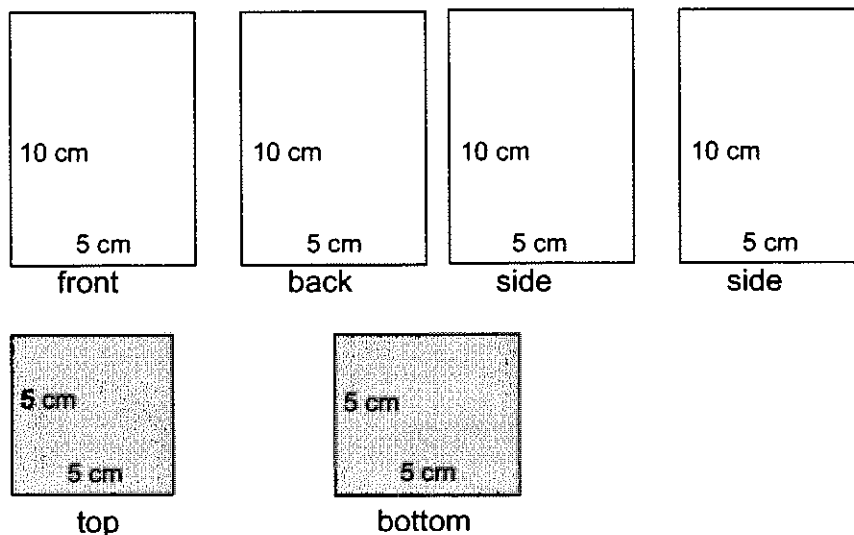
**Surface area** is the sum of the areas of the faces that make up a three-dimensional object.

### Example

Joan wants to completely cover a box with decorative fabric as a gift for a friend. To purchase the needed amount of fabric, Joan will calculate **surface area**.



Each face is a 2-D shape as illustrated below:



Calculate the area of each different face.

Area = length  $\times$  width

$A = 10 \times 5 = 50 \text{ cm}^2$  (front, back, side, side)

$A = 5 \times 5 = 25 \text{ cm}^2$  (top, bottom)

Find the sum of the areas of each face.

$$\begin{aligned}\text{Surface Area} &= 50 + 50 + 50 + 50 + 25 + 25 \\ &= \mathbf{250 \text{ cm}^2}\end{aligned}$$

$$\text{or } (50 \times 4) + (25 \times 2) = \mathbf{250 \text{ cm}^2}$$

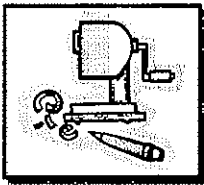
Joan will need  $250 \text{ cm}^2$  of fabric to cover the box.

**Example**

Trevor needs to purchase paint for the walls, floor and ceiling of his room. Each wall is 10 feet by 8 feet and the floor and ceiling are each 10 feet by 10 feet. If a can of paint covers 130 square feet, how many cans of paint should Trevor buy?

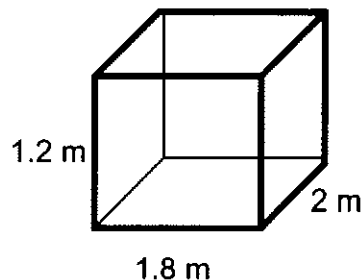
$$\begin{aligned} &4(10 \times 8) + 2(10 \times 10) \\ &320 \text{ ft}^2 + 200 \text{ ft}^2 \\ &= 520 \text{ ft}^2 \\ &520 \div 130 = 4 \text{ cans of paint} \end{aligned}$$

Trevor will need to purchase 4 cans of paint.

**Practice: Calculating Surface Area of 3-D Objects**

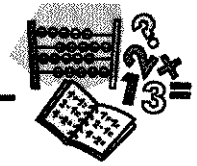
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1. A juice box measures 10 cm high by 6 cm wide by 3 cm deep. A packing plant is wrapping each individual box in shrink wrap. Calculate how much shrink wrap would be needed for one juice box.
2. You are painting the sides, top and bottom of this toy box.



What is the total surface area you will have to paint? How would your area change if you were painting the inside of the toy box as well?

## Constructing 2-D Shapes and 3-D Objects



Carpenters and architects often use common geometric shapes, such as rectangles, squares, triangles and circles, when constructing buildings, bridges and recreational equipment. To create these shapes accurately, they use geometric tools, such as protractors, compasses, straightedges and rulers, and computer programs.

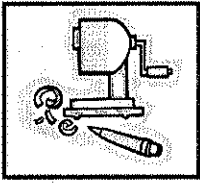
### Terms for Constructing Shapes and Objects



As a construction worker, one of Bobbi's jobs is to draw shapes and objects before cutting them out or piecing them together. To draw shapes and objects, Bobbi must have an understanding of the language of geometry.

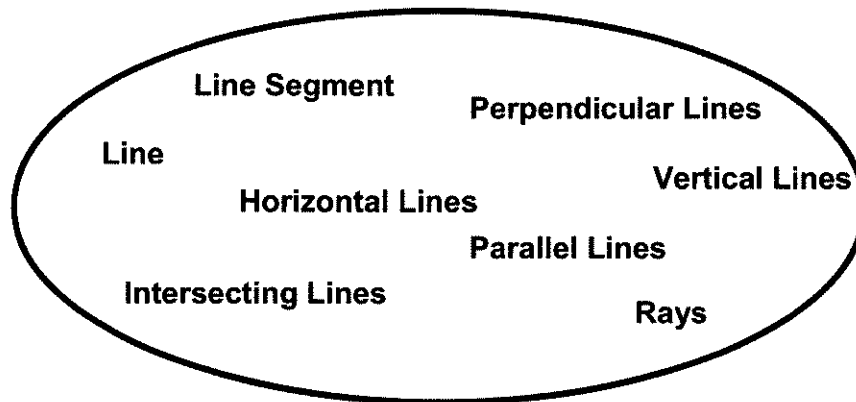
The table below describes some common terms associated with shapes and objects.

Term	Meaning	Example
Point	A location or starting point	•
Line	A row of points that continue infinitely in two directions	↔
Line Segment	A portion or part of a line	—•—•—
Parallel Lines	Two lines that never cross or intersect one another	↔ ↔
Intersecting Lines	Two lines that cross each other	↗ ↘
Perpendicular Lines	Two lines that cross each other at 90°	↔ ↑ ↓
Horizontal Lines	Lines that move side to side	↔
Vertical Lines	Lines that move up and down	↑ ↓
Rays	Line segments with one end point	•→



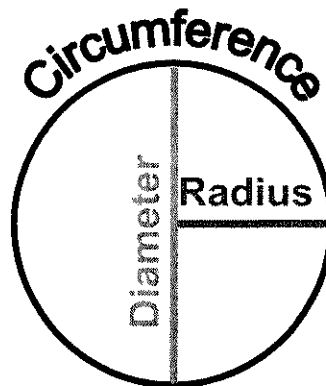
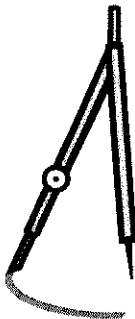
## Practice: Terms for Constructing Shapes and Objects

1. Find examples of the following at school or in your community, such as in scale drawings, sketches and photographs. Identify each using the appropriate term or terms. Be prepared to present your examples to your teacher or classmates.



## Constructing Circles

A compass is a geometric tool consisting of two arms. It is used to draw circles and arcs, and to measure diameter.



Use a compass and construct circles with various radii.

## Constructing Squares and Rectangles

To draw squares and rectangles accurately, use a ruler and a protractor.

A ruler is used to measure and draw the lengths of each side.

A protractor is used to measure the angles.

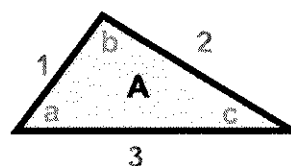


Follow these steps to draw a rectangle or a square with a ruler and protractor.

1. Use a ruler to draw a straight line the length of one of the sides.
2. Use a protractor to measure and mark a  $90^\circ$  angle from one end of the line.
3. Draw another straight line the length of the next side along your  $90^\circ$  mark.
4. Repeat steps 2 and 3 until you have finished making your square or rectangle.

## Constructing Triangles

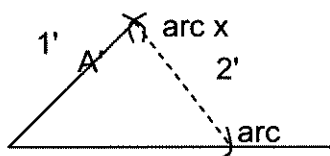
To copy and recreate a triangle, follow these steps.



1. Measure the length of each side (1, 2, 3) and the angle (a, b, c) of each vertex, using a ruler or a compass.
2. Use a ruler to measure and draw the base of the triangle.
3. Use a protractor to measure and mark one angle from the base.
4. Use a ruler to draw the next side to the correct length. Use the angle mark to guide you.

OR

1. Draw a horizontal line (for A').
2. Use a compass to measure the length of basic line A'.
3. Place the compass point on one end of line A' and draw an arc intercepting the horizontal line.
4. Use the compass to measure the length of side 1.
5. Place the compass point on the end of the horizontal line (A') and draw an arc (arc x).
6. Use the compass to measure the length of side 2.
7. Place the compass point on the arc on the horizontal line and draw an arc intercepting arc x.
8. Use a ruler to draw a straight line (1') connecting the end of the horizontal line to the intersection of the arcs.

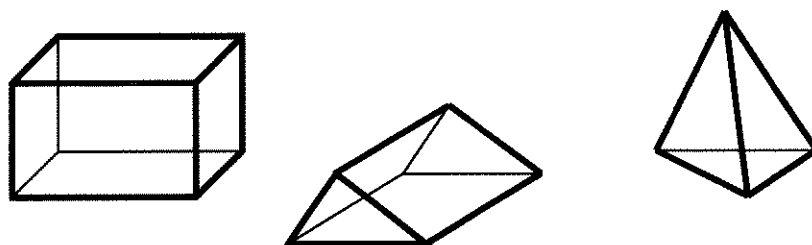


9. Draw a straight line (2') connecting the arc on the horizontal line to the intersection of the arcs.
10. Check for accuracy using a protractor.

## Constructing Shapes Using a Computer

You can use a computer to draw circles, rectangles, squares and triangles quickly by using a drawing program or other software. Check with your teacher for more information.

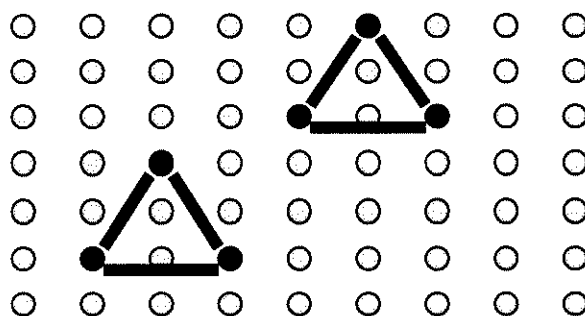
## Representing 3-D Objects Using 2-D Strategies



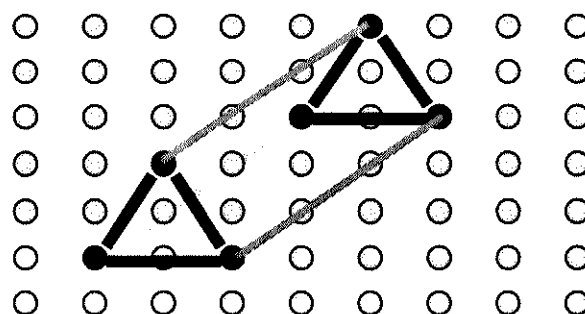
The above objects can be created using a series of points and line segments.

### Drawing 3-D Objects on Dot Paper

Draw the two end faces of the object.



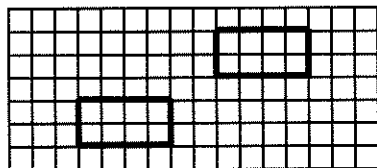
Connect similar points or dots. Keep line segments the same length and parallel to each other.



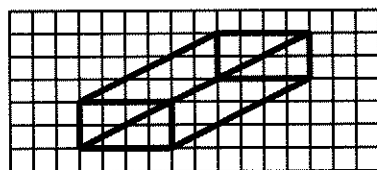


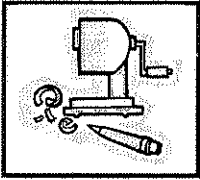
## Drawing 3-D Objects on Grid Paper

Draw the two end faces of the object.



Connect similar points. Keep line segments the same length and parallel to each other.





## Practice: Drawing Two-dimensional Shapes

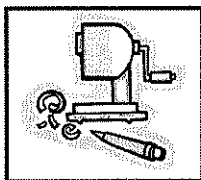
1. Construction workers use blueprints or scale drawings of two-dimensional shapes to create two-dimensional and three-dimensional objects.



What information is needed to create the following two-dimensional shapes?

Fill in the table with the minimum amount of information needed to draw each shape.

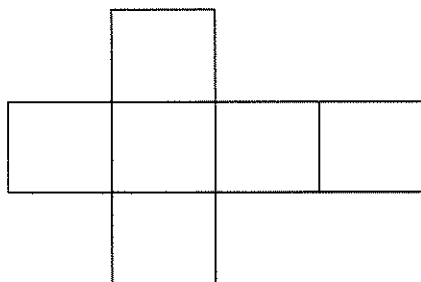
Shape	Minimum information required to create this shape
Triangle	
Rectangle	
Square	
Circle	
Parallelogram	
Trapezoid	



## Practice: Making or Representing 3-D Objects

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1. The example below is a net. When folded, it will form a cube.



Use grid paper to make a variety of nets and create a number of 3-D objects.

2. Challenge your classmates to create a variety of shapes using grid paper or other methods.
3. Make a variety of 3-D objects using pencil and paper, grid paper, nets and/or a computer, such as:

prisms: triangular prism, cube, rectangular prism

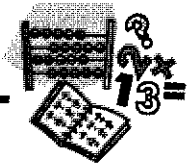
pyramids: triangular, square, rectangular

others: cone, cylinder, sphere.

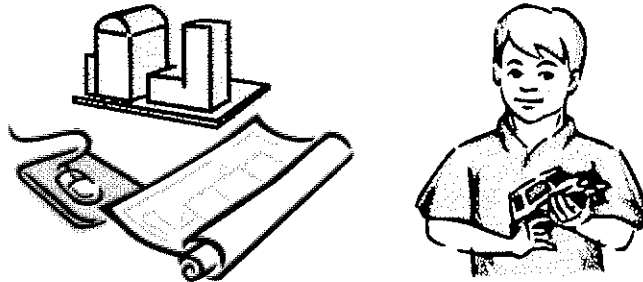




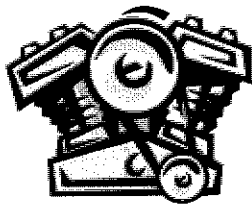
## Constructions to Scale



**Scale** means to use proportions to accurately reduce or enlarge objects. Measurements of the scale object or drawing are proportionally the same as the original object or drawing.



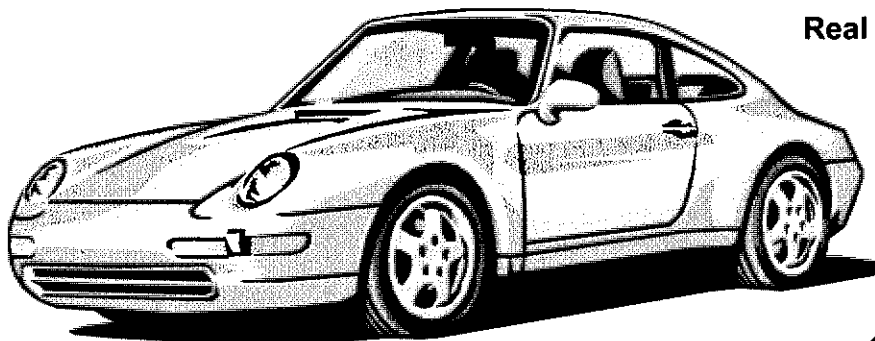
A scale model is a 3-D proportionate replica of the object.



Scale models are used in a variety of situations, for example:

- models of car engines are helpful to automotive mechanics when explaining engine problems to a customer
- models of the human heart are useful when training healthcare workers
- models of shopping malls assist city planners to make roadway and traffic flow decisions.

Car model kits are often accurate representations of real vehicles, except that models are much smaller than actual vehicles. These model kits often include the scale of the model on the box.



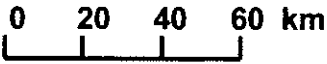
Real car



Scale model

## Calculating Scale

Ratios and proportions are used when calculating scale.

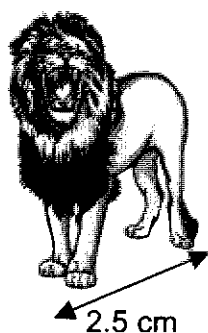
Scales as Ratios	Scales as Ruler Measures
<p style="text-align: center;"><b>1 : 30</b></p> <p style="text-align: center;">↙                  ↘</p> <p style="text-align: center;">Representation size   Actual size</p> <p>For every 1 cm in a representation, the actual measurement is really 30 cm long.</p>	<p style="text-align: center;">  </p> <p>The actual distance that 1 cm represents on a map is 20 km.</p> <p style="text-align: center;">1 cm : 20 km</p> <p>For every 1 cm, the actual measurement is really 20 km in distance.</p>

## Determining Scale Using Ratios

Make a proportion of the scale equivalent to the drawing length and actual length as shown below.

### Examples

- A) The picture of a lion is drawn on a scale of 1:50, which is the same as a ratio of 1 to 50.



Using the scale (ratio) of 1:50, calculate the actual length of the lion.

$$1 \text{ cm} : 50 \text{ cm}$$

$$2.5 \text{ cm} : n$$

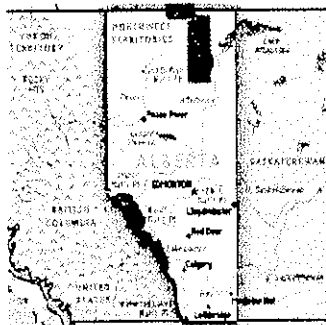
Solve for  $n$ .

$$\frac{1}{50} = \frac{2.5 \text{ cm}}{n \text{ cm}}$$

$$\frac{1 \times 2.5}{50 \times 2.5} = \frac{2.5 \text{ cm}}{125 \text{ cm}}$$

$$n = 125 \text{ cm}$$

The actual lion is 125 cm or 1.25 m long.



- B) Joanne used a road map of Alberta to determine the distance between Calgary and Edmonton. She measured the distance between the two cities using a ruler and found that they are 22 cm apart on the map.

The scale on the map is:

**1 cm : 12.5 km**

Calculate the approximate distance from Edmonton to Calgary.

Set up ratios.

1 cm : 12.5 km

22 cm :  $n$

Solve for  $n$ .

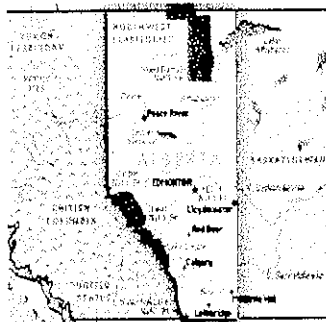
$$\frac{1}{12.5} = \frac{22}{n}$$

$$\frac{1}{12.5} \times 22 = \frac{22}{n}$$

$$n = 275 \text{ km}$$

The distance from Edmonton to Calgary is approximately **275 km**.

## Reducing Size



A map of Alberta is a reduction of the actual province of Alberta.

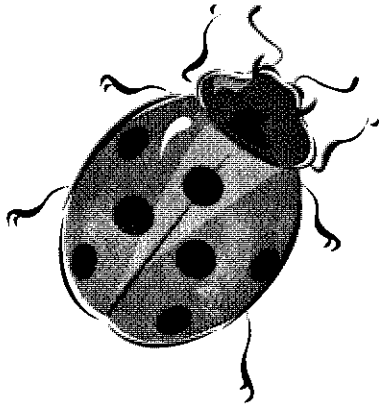
Scales show reduction when the first number in the scale is smaller than the second number.

Example: **1 : 30** (30 times smaller)

**1 : 2000** (2000 times smaller)

## Enlarging Size

### Example



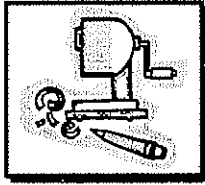
Check out the size of this monster ladybug!

Scales show enlargement when the first number in the scale is larger than the second number.

Example: **10 : 1** (10 times larger)

**250 : 1** (250 times larger)

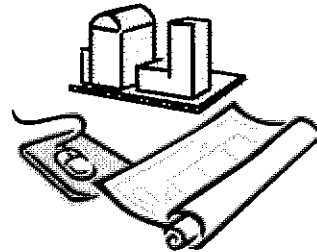




## Practice: Constructions to Scale

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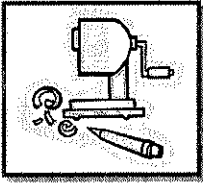
1. Anita and her class are on a field trip to an abandoned farmyard. Their assignment is to draw a barn on an  $8\frac{1}{2}$ " by 14" sheet of art paper. The scale is to be 1 : 30. If the height of the barn is 8 metres, the length 9 metres and the width 6 metres, what size will each of these be on Anita's drawing?
2. Kevin is working on a science report on different types of spiders. He cannot find suitable pictures in colour, so he decides to draw his own using a scale of 8:1. If, in the pictures, the body of the spider is 2.5 centimetres in length and each of the eight legs is 4 centimetres in length, calculate the length of the body and each leg in Kevin's drawing.
3. Individually or with a partner, create a three-dimensional scale model of a room in your house or in another building. Include all major pieces of furniture in the room. Use a measuring tape, metre-stick or yardstick to measure and record the dimensions of the following items:
  - walls
  - floor
  - doors and windows
  - major pieces of furniture, such as dressers, TVs and TV stands, tables, desks.



Convert each of your measurements using a scale, such as 1 cm = 0.3 m or 1 inch = 1 foot.

Record these scale drawing measurements along with the actual measurements. Use construction paper, manila tag, cardboard or other building materials to cut and piece together each of the items above. Be sure to place all items in their correct locations in the room.

Complete the scale model by colouring or decorating your model to reflect the items in the room.



## Practice: Reading Maps

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Using a map of the province of Alberta, locate the scale in the legend. Use the legend, a ruler and a calculator to calculate the approximate distances between the following locations.

1. Jasper to Banff
2. Calgary to Lethbridge
3. Lethbridge to Medicine Hat
4. Grand Prairie to Peace River
5. Ft. McMurray to Edmonton

Select villages, towns and cities in your area and calculate actual distances using maps and map scales.

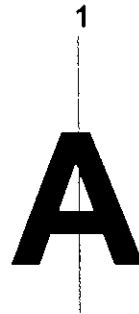
# Lines of Symmetry



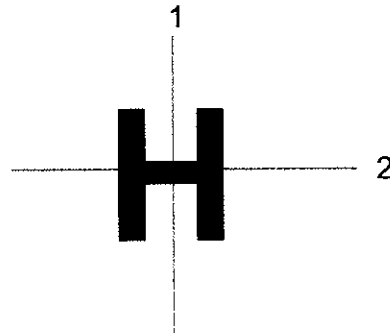
A **line of symmetry** divides an object into two identical parts (halves) that are reflections of each other.

## Examples

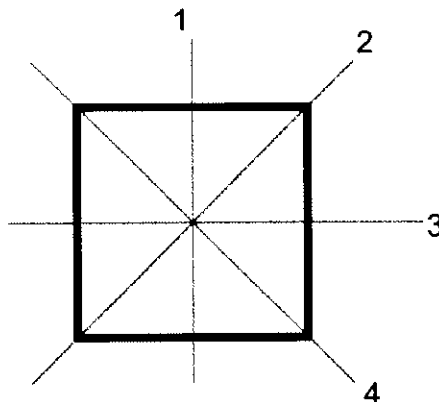
A) The letter "A" has one line of symmetry.



B) The letter "H" has two lines of symmetry.

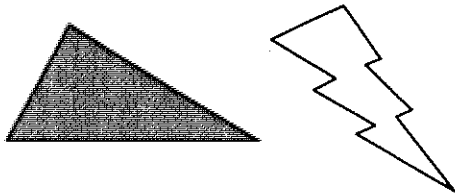


C) A square has four lines of symmetry.

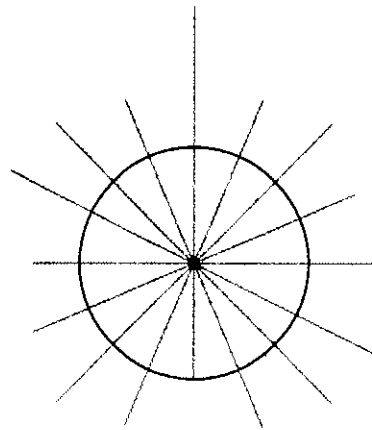


Some shapes have no lines of symmetry and others have many. It depends on the shape of the object.

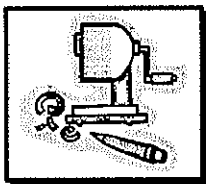
### Examples



The shapes above have no lines of symmetry.



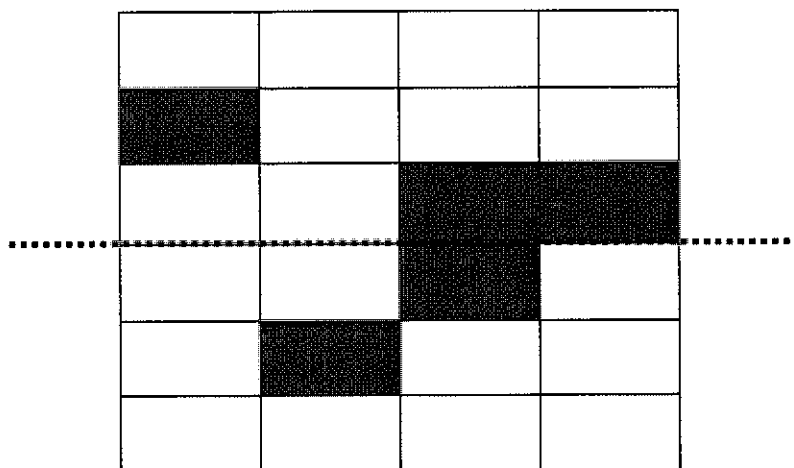
A circle has many lines of symmetry. No matter where you draw a straight line passing through the centre of the circle, a line of symmetry is created.



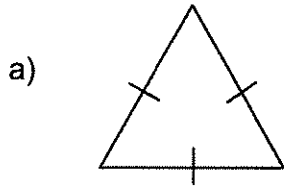
## Practice: Lines of Symmetry

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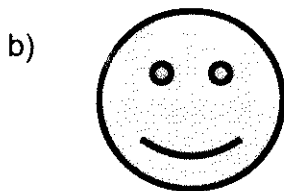
1. Draw letters, numbers and shapes, such as a triangle, the letter B and the number 8. Draw lines of symmetry through them.
2. Identify lines of symmetry in a variety of objects and shapes, such as buildings, photographs and volleyball courts.
3. Complete the shading of the squares below so that the floor has one line of symmetry and each side is a reflection of the other.



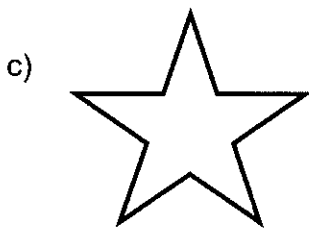
4. Draw and count the lines of symmetry for each of the shapes below.



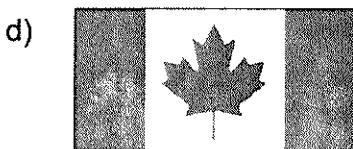
Number of lines of symmetry: \_\_\_\_\_



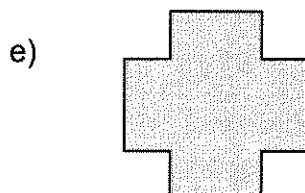
Number of lines of symmetry: \_\_\_\_\_



Number of lines of symmetry: \_\_\_\_\_

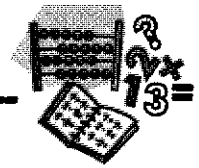


Number of lines of symmetry: \_\_\_\_\_



Number of lines of symmetry: \_\_\_\_\_

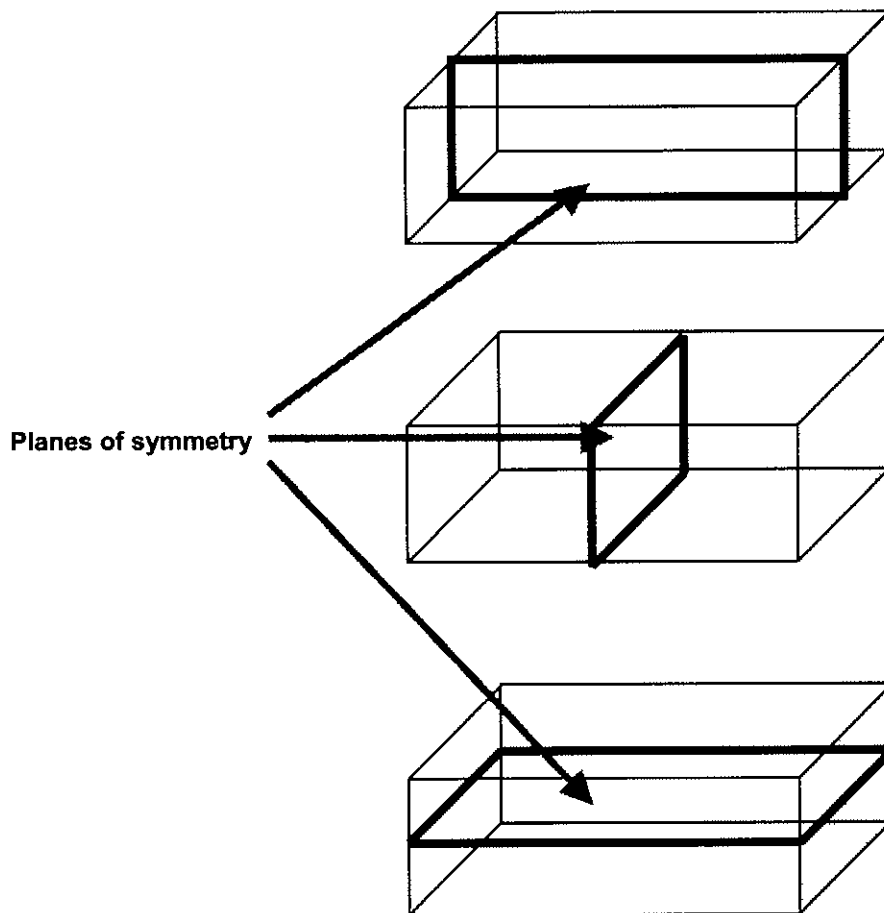
# Planes of Symmetry

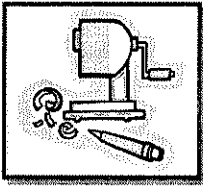


A **plane of symmetry** is an imaginary line or cut that creates two congruent (equal) three-dimensional pieces that are reflections of each other.

## Example

A rectangular prism has three planes of symmetry. Each cuts the object into two equal pieces.



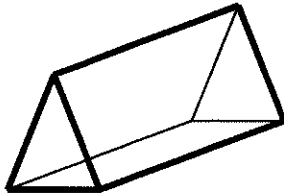


## Practice: Planes of Symmetry

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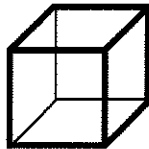
For each of the following three-dimensional objects, draw the planes of symmetry. In the blanks, write the number of planes of symmetry.

1.



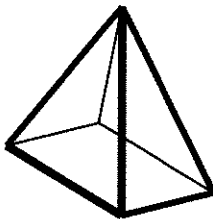
\_\_\_\_\_

2.



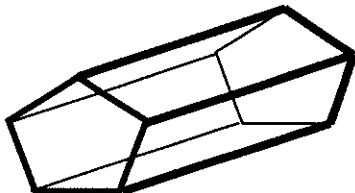
\_\_\_\_\_

3.



\_\_\_\_\_

4.

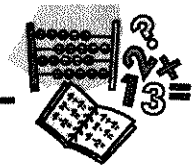


\_\_\_\_\_

5. What are some generalizations you notice about the lines of symmetry and quadrilaterals?



# The Coordinate Plane

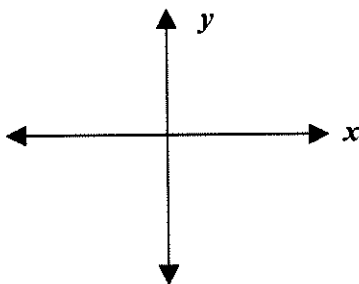


Workers in the forestry industry often spend time in remote areas of the forests of Alberta. A Global Positioning System (GPS) helps people keep track of their exact location. Pilots and air traffic controllers also rely on GPS and other technology to keep track of where planes are flying.

Maps and sections of maps use grids to identify specific areas and locations.

Grids are used to identify integers and ordered pairs and to display data.

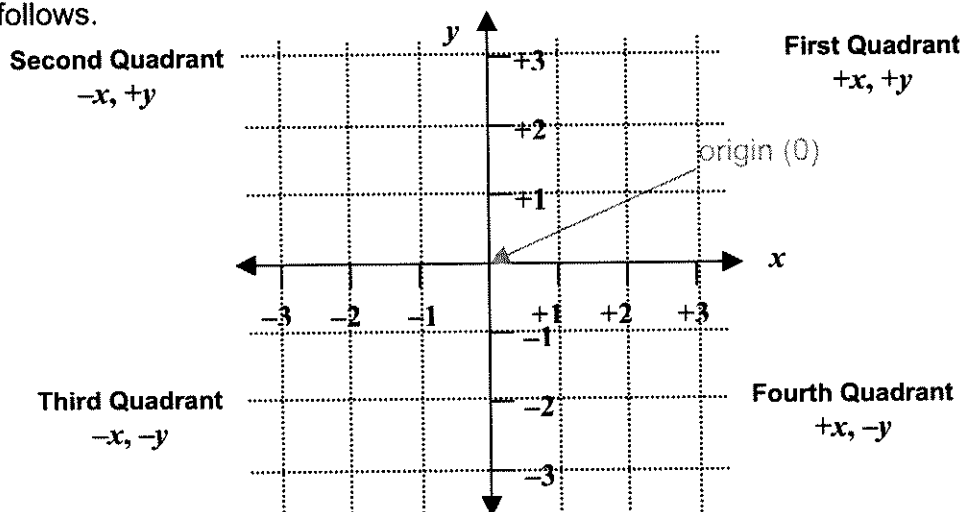
A **coordinate plane** is used to help mark locations. A coordinate plane is a two-dimensional surface with locations identified using  $x$  and  $y$  coordinates ( $x$ -axis and  $y$ -axis). Coordinates are similar to latitude and longitude.



The  **$x$ -axis** lists points horizontally, from left to right.

The  **$y$ -axis** lists points vertically, up and down.

The coordinate plane is organized into four quadrants. The quadrants are labelled as follows.



The **origin** is the point where the  $x$ -axis and  $y$ -axis meet and is labelled 0.

Integers are used to describe locations on the coordinate plane.

From the origin,

- a move of two places to the right represents  $+2$  on the  $x$ -axis
- a move of three places to the left represents  $-3$  on the  $x$ -axis
- $+1$  represents moving one place up on the  $y$ -axis
- a move of two places down represents  $-2$  on the  $y$ -axis.

**Ordered pairs** are used to represent exact locations. Locations on the  $x$ -axis are the first digit of an ordered pair. Locations on the  $y$ -axis are the second digit of an ordered pair.

### Examples



For the ordered pairs:

- A)  $(+3, +1)$**   
move three places to the right of the origin and up one place
- B)  $(-2, -1)$**   
move two places to the left of the origin and down one place
- C)  $(-2, +4)$**   
move two places to the left of the origin and up four places
- D)  $(+2, -3)$**   
move two places to the right of the origin and down four places.

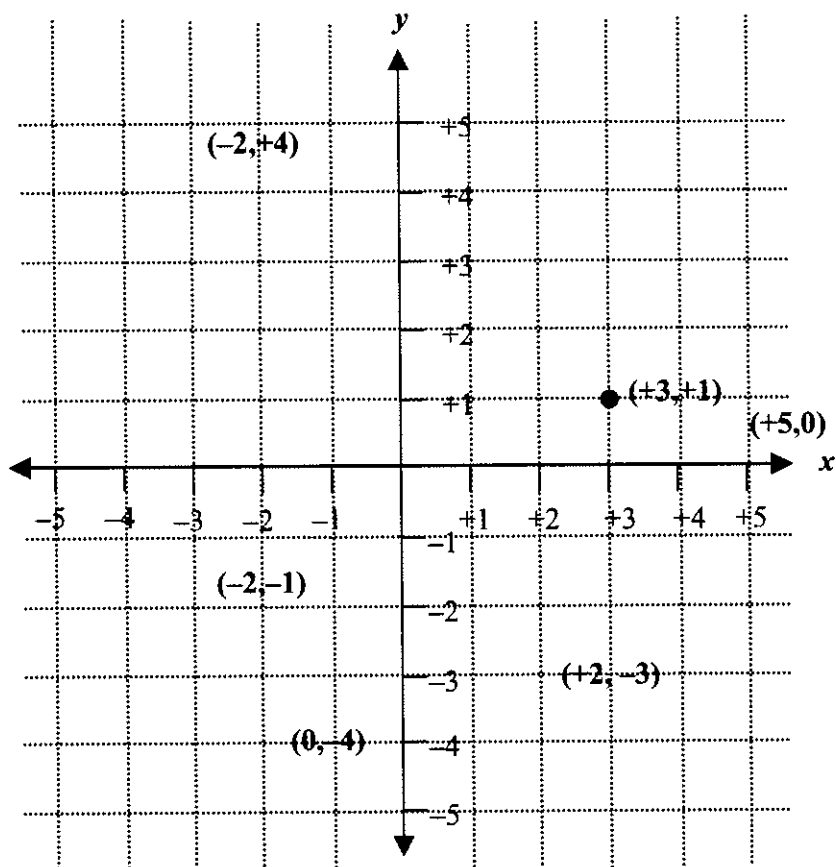
The table below is helpful when identifying quadrants and plotting ordered pairs.

Quadrant	Signs of the Ordered Pair
1	$(+, +)$
2	$(-, +)$
3	$(-, -)$
4	$(+, -)$

## Locating Ordered Pairs on the Coordinate Plane

### Examples

A)  $(+5,0)$   $(0,-4)$   $\bullet(+3,+1)$   $(-2,+4)$   $(-2,-1)$   $(+2,-3)$



Notice that  $(+5,0)$  is located on the  $x$ -axis.

Ordered pairs with a  $y$ -axis value of zero are always located on the  $x$ -axis because they do not extend up or down.

Notice that  $(0,-4)$  is located on the  $y$ -axis.

Ordered pairs with a  $x$ -axis value of zero are always located on the  $y$ -axis because they do not go left or right.

**B)** As a park warden, Marie patrols an area of a park to ensure that visitors are safe and are respecting the environment. One day, the patrol route is from headquarters (0,0) to the locations listed below. The locations are placed on the coordinate plane below.

Checkpoint #1: A(0,4)

Checkpoint #3: C(3,0)

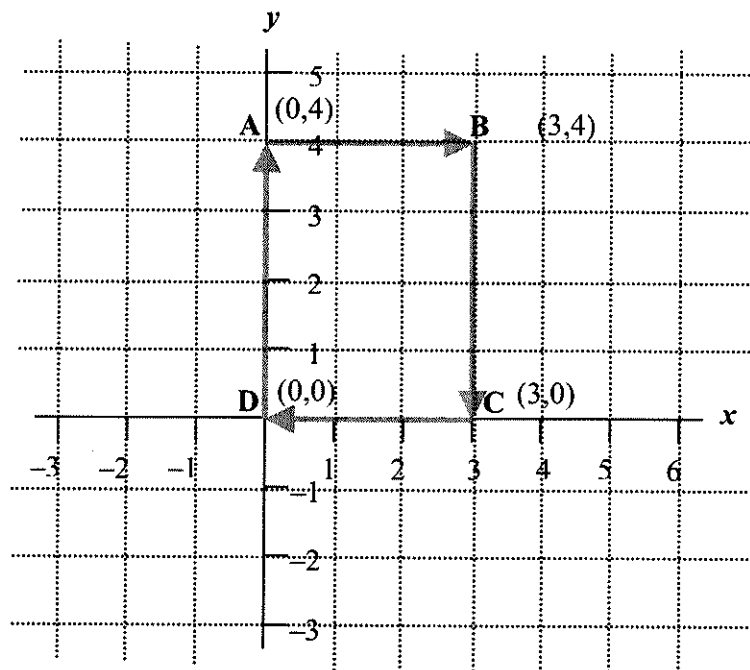
Checkpoint #2: B(3,4)

Back to headquarters: D(0,0)



Ordered pairs are often labelled using a letter to easily identify one point from another.

Park Quadrant in km.

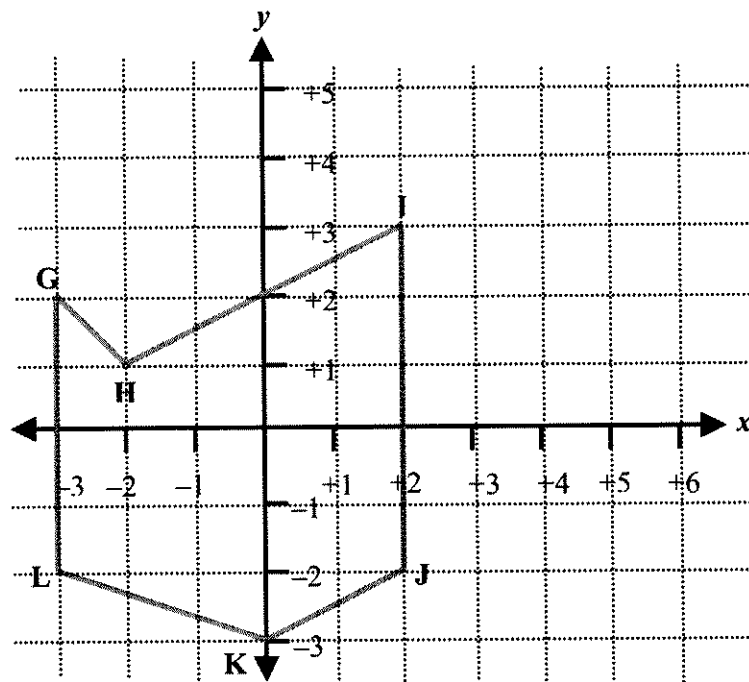


The park warden's patrol route is in the shape of a rectangle. He moves in the direction of the arrow.

**C)** Marie was promoted and is now responsible for supervising 4 park wardens in Jasper National Park.

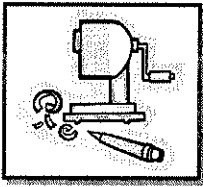
The following letters, ordered pairs and grid represent the park area.

**G**  $(-3,2)$  **H**  $(-2,1)$  **I**  $(2,3)$  **J**  $(2,-2)$  **K**  $(0,-3)$  **L**  $(-3,-2)$



In the example, points are located in all four quadrants of the coordinate plane.

Quadrant	Points
1	I $(2,3)$
2	G $(-3,2)$ , H $(-2,1)$
3	L $(-3,-2)$ , K $(0,-3)$
4	J $(2,-2)$



## Practice: The Coordinate Plane

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1. Mario is a courier. To make efficient deliveries, he has divided his delivery area into 4 quadrants. Today, he has to make deliveries to the following locations:

Hospital  $(-4, 3)$

Bakery  $(5, 2)$

Vet  $(-3, -1)$

Car dealership  $(1, -2)$

Grocery store  $(-3, 5)$

Law office  $(4, -3)$

- a) Using the Coordinate Plane Grid, place the location of Mario's deliveries on the grid.
- b) Mario wants to make his deliveries in the following order: quadrant 4, 3, 2 and 1. List the order of the businesses that he will visit.
2. Use the Coordinate Plane Grid to plot each of the following sets of ordered pairs. Join the points using a different colour or type of line for each of the five shapes. For each, join the points in order from first to last. Then, join the last point to the first point to create a shape. When you are finished each, classify the shape you created.
- a)  $A(-11, +12)$   $B(-17, -2)$   $C(-8, -8)$
- b)  $D(-5, +2)$   $E(+8, -11)$   $F(+12, -7)$   $G(0, +6)$
- c)  $W(+19, +16)$   $X(+16, +16)$   $Y(+16, +9)$   $Z(+19, +9)$
- d)  $R(-17, -8)$   $S(-14, -5)$   $T(-11, -13)$   $U(-14, -16)$
- e)  $G(-16, -4)$   $H(0, -17)$   $I(+20, +19)$   $J(0, -7)$

3. With a partner, create a shape on a grid and coordinate plane. Describe how to make the shape. Give the description to other students to draw.

Note that ordered pairs often show a direction change.

4. Garth and his friends are playing hide-and-seek. Home is identified as  $(0,0)$ . To get to his hiding spot, Garth goes 5 metres east, 4 metres south, 6 metres west, 8 metres north, 2 metres east and 7 metres north. Use an ordered pair and the Coordinate Plane Grid to represent Garth's hiding spot. Each grid line represents a unit of 1 metre.

5. Describe the movements that are represented by the following ordered pairs.

1.  $(3,4)$       Movement is three spaces to the right, four spaces up.

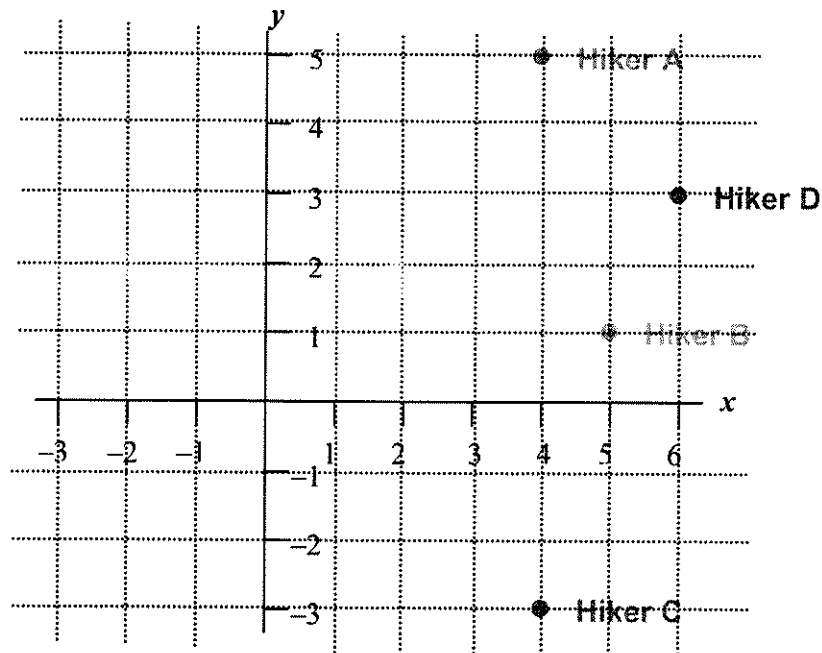
2.  $(6,1)$       \_\_\_\_\_

3.  $(0,5)$       \_\_\_\_\_

4.  $(-1,0)$       \_\_\_\_\_

5.  $(-8,-5)$       \_\_\_\_\_

6. Four hikers have lost their way in a forest. A search and rescue helicopter has spotted them and mapped their locations on the grid below. Your job is to hike in on foot and rescue them.



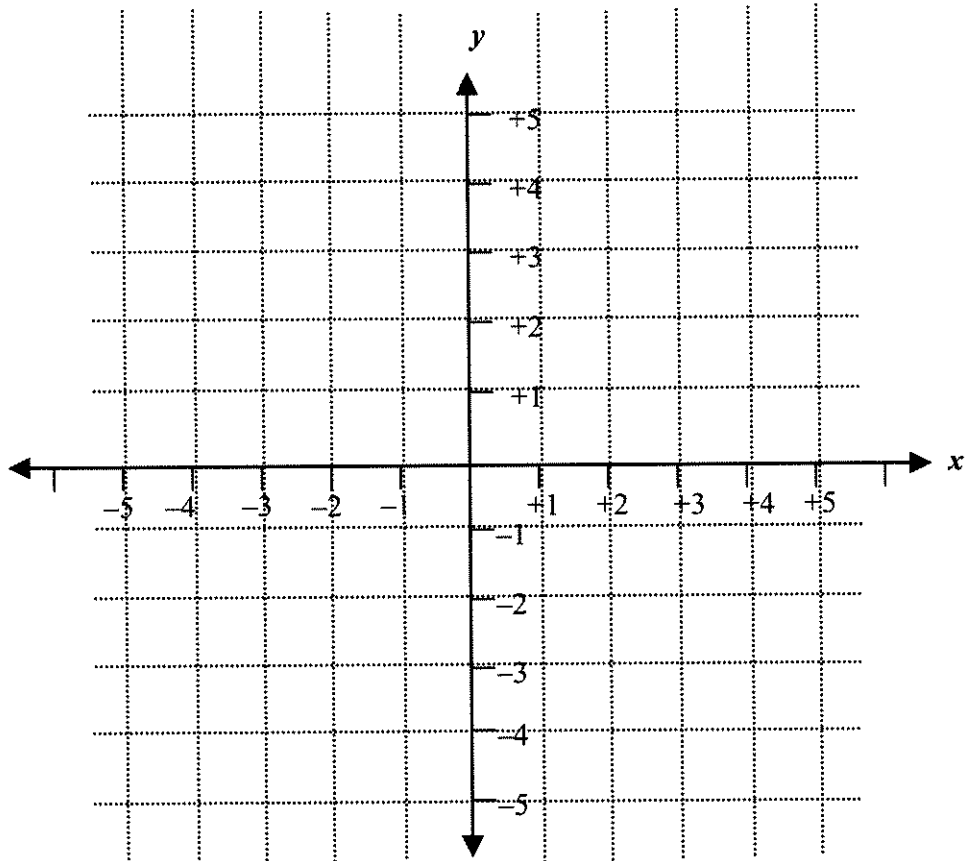
If the search and rescue headquarters is located at the origin  $(0,0)$ , describe each of the hikers locations using ordered pairs in the form of  $(x,y)$ .

Hiker	Location $(x,y)$	Quadrant Number
A		
B		
C		
D		



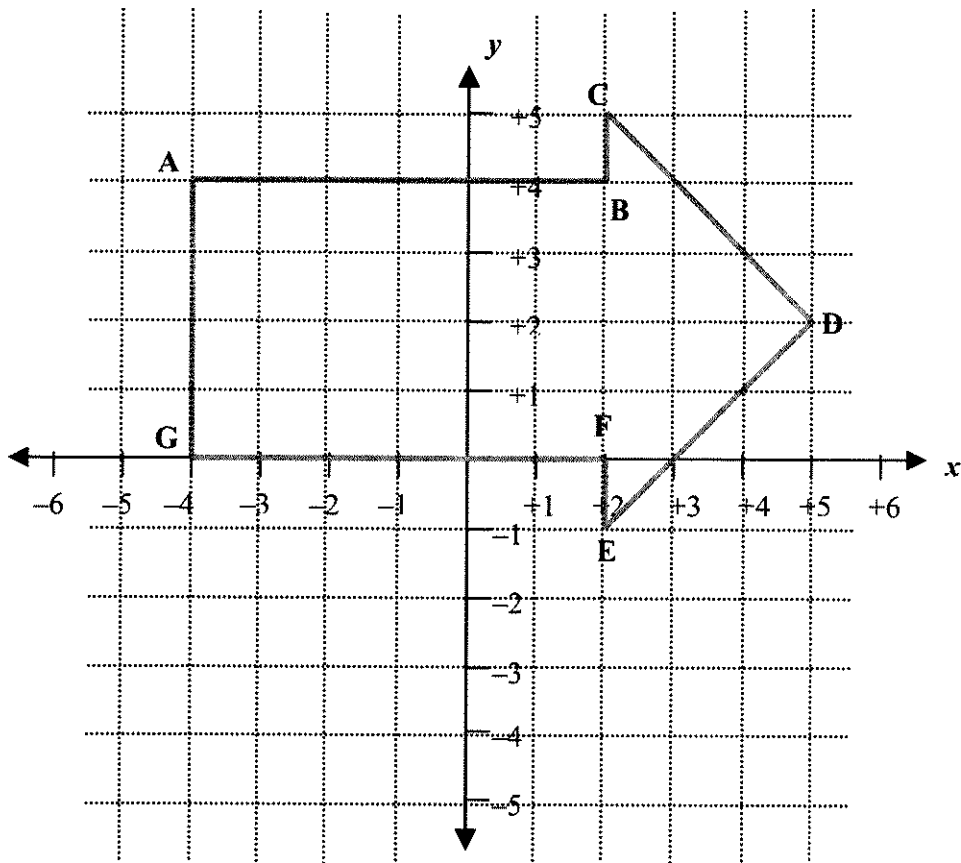
7. Plot the following ordered pairs and join them in order.  
Connect the last ordered pair to the first ordered pair.

$(-3,+1)$   $(-1,+1)$   $(-1,+5)$   $(+1,+5)$   $(+1,+1)$   $(+3,+1)$   $(0,-5)$



What shape is created by the connecting of ordered pairs?

8. Give the coordinates of each point in the shape below.



A \_\_\_\_\_

E \_\_\_\_\_

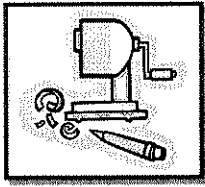
B \_\_\_\_\_

F \_\_\_\_\_

C \_\_\_\_\_

G \_\_\_\_\_

D \_\_\_\_\_



## Practice: Coordinate Plane Grid

