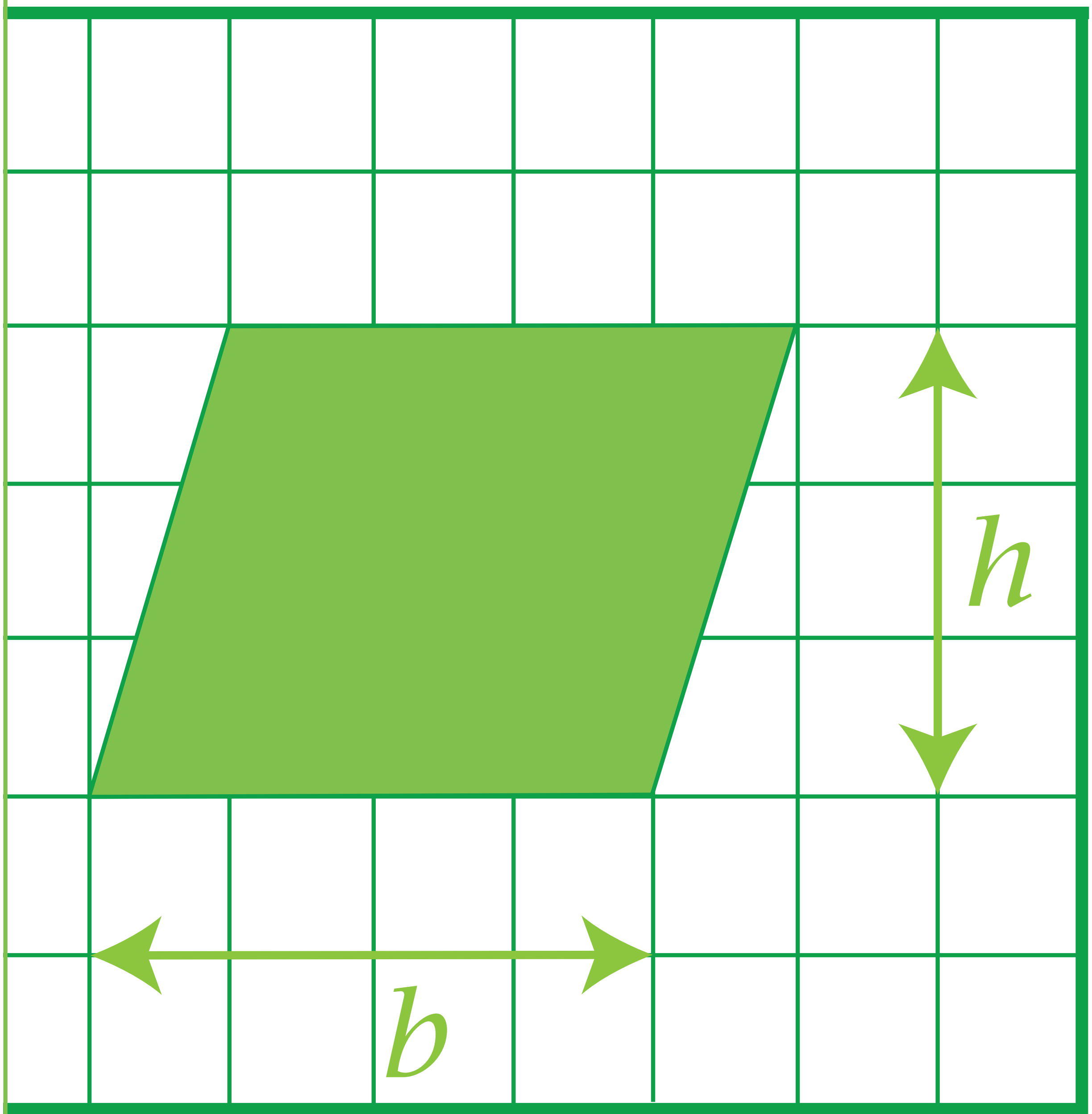
# LITERACY FOUNDATIONS MATH




## LEVEL 4
## GEOMETRY

## To the Student

This resource covers topics from the British Columbia Ministry of Education's Literacy Foundations Math Level 4. You may find this resource useful if you're a Literacy Foundations Math student, or a K–12 student in grades 7 – 9.

We have provided learning material, exercises, and answers for the exercises, which are located at the back of each set of related lessons. We hope you find it helpful.

## Literacy Foundations Math Prescribed Learning Outcomes

The Literacy Foundations Math Prescribed Learning Outcomes (PLOs) are grouped into four areas: Number (A), Patterns and Relations (B), Shape and Space (C), and Statistics and Probability (D). For a complete list of the PLOs in Level 5, search for Literacy Foundations Math curriculum on the BC Ministry of Education's website.

## PLOs Represented in This Resource

The PLOs represented in this Level 4 resource are as follows:

### Number

A6, A7, A9, A11 – A18

### Patterns and Relations

All topics, B1 – B3

### Shape and Space

C1 – C5, C7
*C3 topics are represented with the exception of angle construction

### Statistics and Probability

D2

## PLOs Not Represented in This Resource

The PLOs for which no material is included in this resource are as follows:

### Number

There is no material for A1 – A5, read and write numbers, place value, and patterns for multiplying by 10, etc.; A8, compare decimal numbers; nor A10, patterns for multiplying and dividing by 1/10, etc.

### Shape and Space

There is no material for C3, construct angles.

### Statistics and Probability

There is no material for D1, graph data to solve problems.

## Acknowledgements and Copyright

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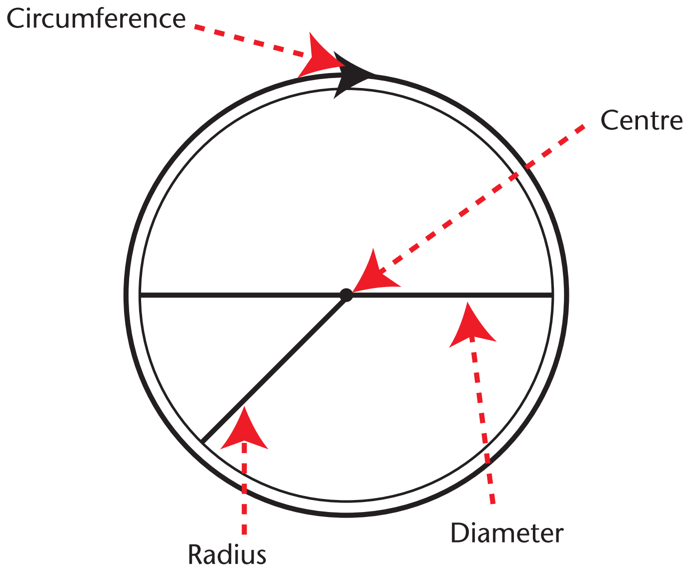
# Lesson 1
# Circles

## Learning Outcomes

**By the end of this lesson you will be better able to describe:**

- identify the centre, radius, diameter, and circumference of a circle
- explain the relationships between parts of a circle




**Circumference** is the distance around the outside of the circle. You may remember that the distance around other shapes is called perimeter. Circumference is the perimeter of a circle.

The **centre** is the middle of the circle. Every place on the circumference of the circle is the exact same distance from the centre of the circle.

The **radius** is the distance from the centre of the circle to the circumference. **Radii** is the plural of radius.

The **diameter** is the distance from a point on the circumference, through the centre, across to another point on the circumference. The word diameter comes to English from Greek and means 'to measure across'. A diameter cuts the circle into two halves.

A diameter is the same length as two radii. If the radius of a circle is 3 cm, the diameter is 6 cm. Using symbols, those two sentences look like this:

$$\begin{aligned} d &= 2 \times r \\ &= 2 \times 3\text{ cm} \\ &= 6\text{ cm} \end{aligned}$$

A radius is the same length as half of a diameter. If the diameter of a circle is 10 cm, the radius is 5 cm. Using symbols, those sentences look like this:

$$\begin{aligned} r &= \frac{1}{2} \times d \\ &= \frac{1}{2} \times 10\text{ cm} \\ &= 5\text{ cm} \end{aligned}$$

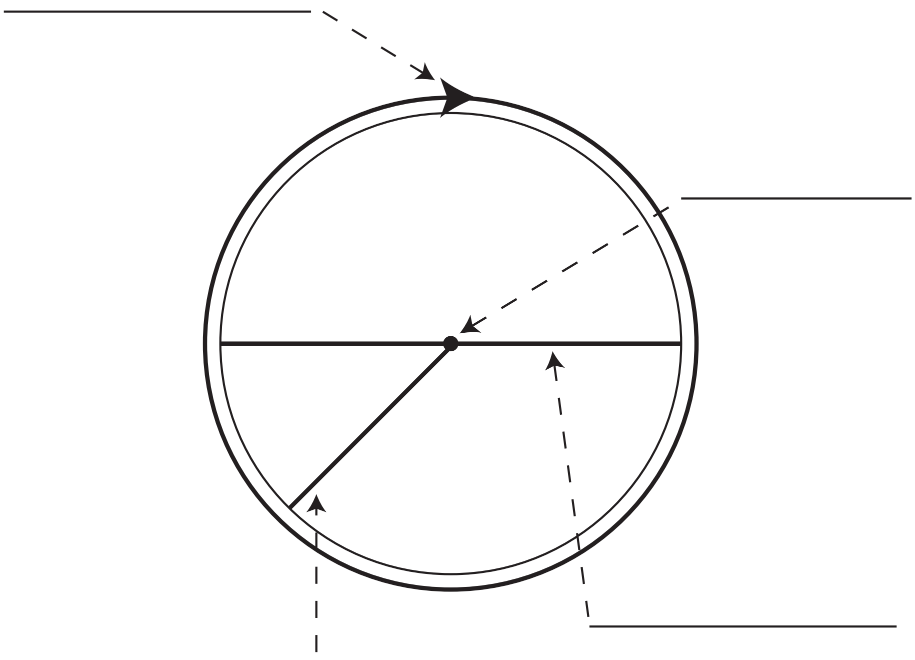
Doodle a few circles of different sizes on a sheet of paper. Mark the centres. Notice that your small circles have a small diameter and a small circumference. Your larger circles have a larger diameter and a larger circumference. The diameter and the circumference are related—as one changes, so does the other. The circumference is approximately three times larger than the diameter. If the diameter of a circle is 4 cm, the circumference is approximately 12 cm.

$$\begin{aligned} C &\approx 3 \times d \\ &\approx 3 \times 4\text{ cm} \\ &\approx 12\text{ cm} \end{aligned}$$

You'll learn more about the relationship between circumference and diameter in your future math courses.

## Exercises 1.1

1. Label the parts of the circle.



2. Find the diameter for each circle.
   a. r = 11 cm

   b. r = 6 cm

   c. r = 1.2 cm

d. $r = 3.0$ cm

e. $r = 4.6$ m

f. $r = 1.9$ mm

3. Find the radius for each circle.
   a. $d = 5$ cm

   b. $d = 14$ cm

   c. $d = 6.2$ cm

d. $d = 4.0$ m

e. $d = 12.4$ cm

f. $d = 9.2$ mm

4. Find the approximate circumference of a circle with each diameter:
   a. $d = 10.0$ cm

   b. $d = 6.7$ m

5. Find the approximate circumference of a circle with each radius:
   a. $r = 5.0$ cm

   b. $r = 2.3$ m

   c. $r = 7.0$ mm

**Turn to the Answer Key at the end of the module to check your work.**

Lesson 2

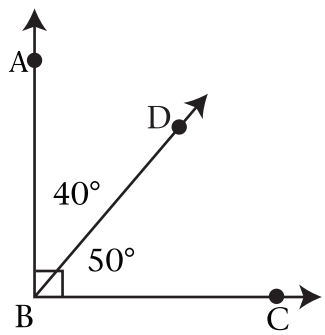
# Angles and Triangles

## Learning Outcomes

**By the end of this lesson you will be better able to describe:**

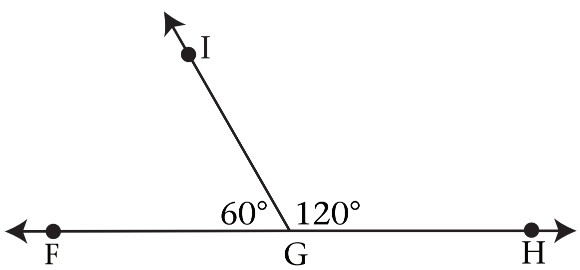
- complementary and supplementary angles
- vertically opposite angles
- right angles and right triangles
- acute angles and acute triangles
- obtuse angles and obtuse triangles

**Complementary angles** are a pair of angles whose sum is 90° and form a right angle.



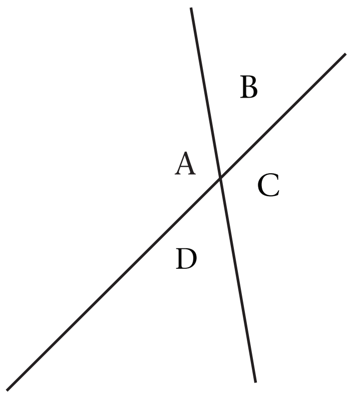

$\angle ABC + \angle DBC = 90°$

**Supplementary angles** are a pair of angles whose sum is 180° and form a straight line.

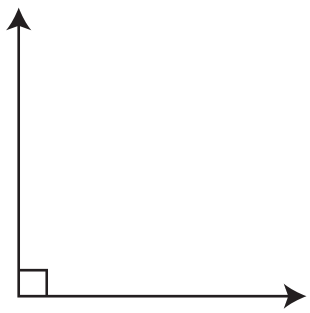



$\angle FGI + \angle IGH = 180°$

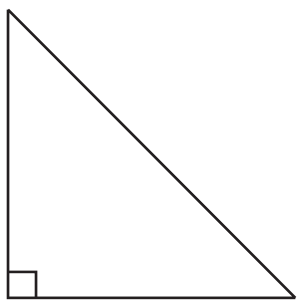
**Vertically opposite angles** are equal to each other. In this diagram, ∠A and ∠C are vertically opposite. So are ∠B and ∠D. Whenever two straight lines cross each other, two pairs of vertically opposite angles are formed.



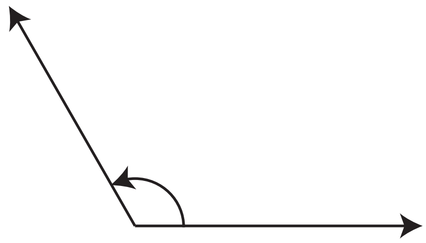

A **right angle** measures exactly 90º. Right angles are indicated in diagrams with a small square at the vertex of the angle.



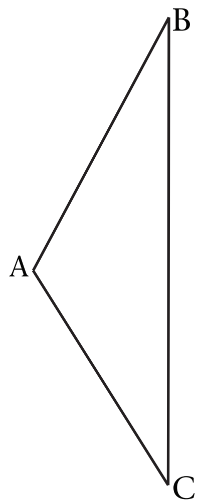
A **right triangle** is a triangle that contains a right angle.



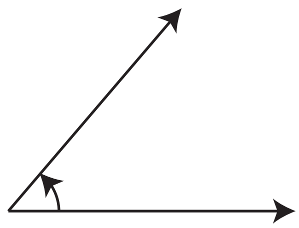
An **obtuse angle** measures more than 90º but less than 180º.



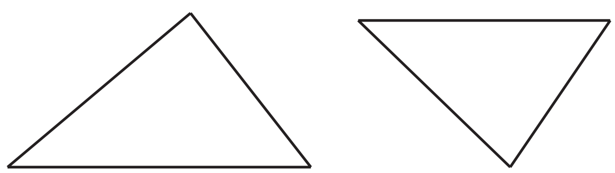
An **obtuse triangle** is a triangle that contains an obtuse angle.




An **acute angle** measures less than 90º.



In an **acute triangle**, all of the angles are acute.

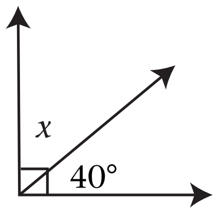


## Exercises 2.1

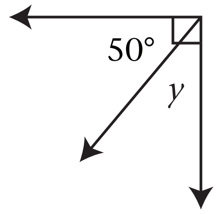
1. Suppose ∠ABC is 36°. What is the size of:
   a. its complement: ______________________________
   b. its supplement: ______________________________

2. Calculate the measure of each complementary angle.

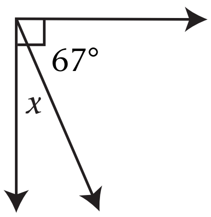
a.



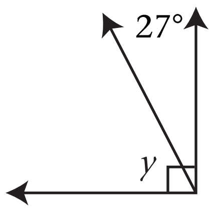

b.




c.

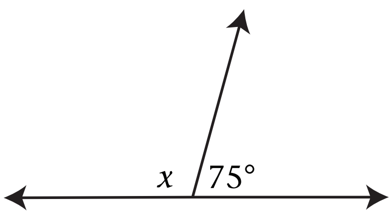



d.




3. Calculate the measure of each supplementary angle.

a.

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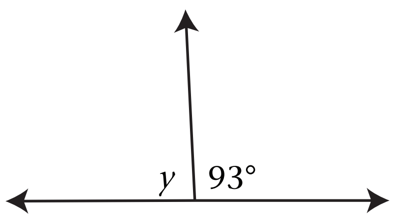

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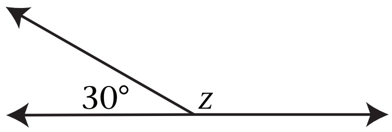


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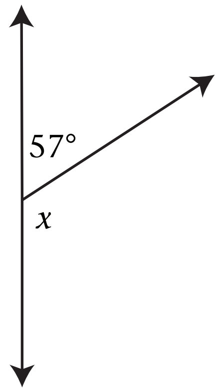
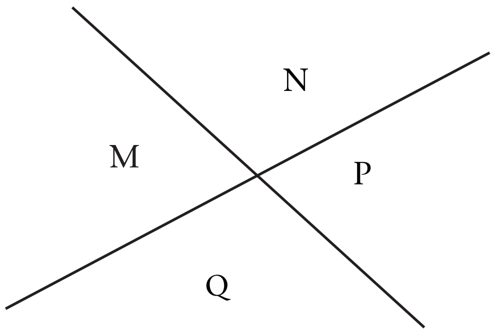



4. Name the pairs of vertically opposite angles in this diagram.



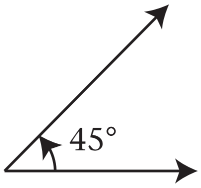

5. In the diagram above, ∠M = 72°

   a. Without using a protractor, find the measure of angle P.
   State your reasoning.

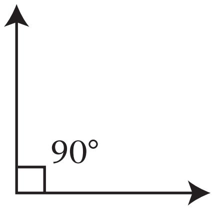
   b. Without using a protractor, find the measure of angle N.
   State your reasoning.

6. Describe each of the following angles as acute, obtuse, or right

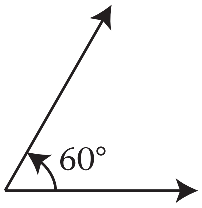
a.



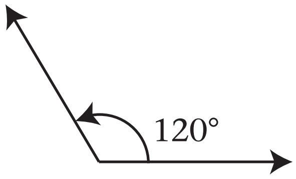

b.



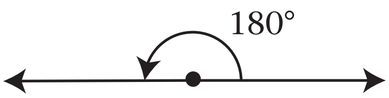

c.



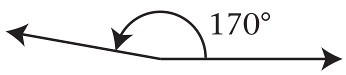

d.




e.

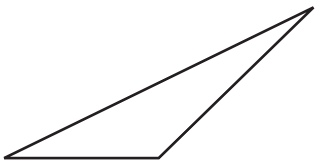



f.

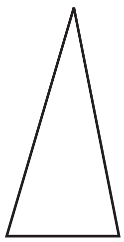



7. Describe each of the following triangles as acute, obtuse, or right.

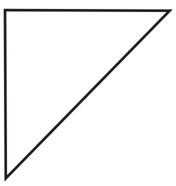
a.



b.



c.



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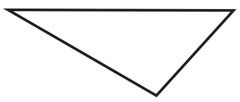


**Turn to the Answer Key at the end of the module to check your work.**

# Lesson 3

# Area and Volume

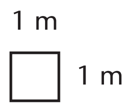
## Learning Outcomes

**By the end of this lesson you will be better able to:**

- calculate the area of a rectangle, a parallelogram, and a triangle
- calculate the volume of a right rectangular prism

Area is the amount of surface within a shape.

Area is measured in square units such as "square metres ($m^2$)" and "square centimetres" ($cm^2$). You can think of **area** as the number of square units that cover a closed figure.




The standard metric unit of area is the square metre. This is the area contained in a square that is 1 metre by 1 metre (or m × m). Using what we know about exponents, m × m can also be written as $m^2$. We say "1 square metre" when we see the unit 1 $m^2$.

To measure large areas of land, the square kilometre is used.
To measure small areas, you might use the square millimetre.

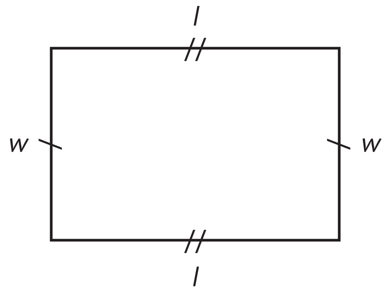
**Remember**: Measurements must always include a unit of measurement. Your answer will not be complete if you do not include the unit of measurement. For example, "5" does not mean the same as "5 m" or "5 $m^2$." Always be sure to include a unit of measurement whenever you are recording measurements.

| | |
|---|---|
| 1 $mm^2$ | 1 square millimetre |
| 1 $cm^2$ | 1 square centimetre |
| 1 $m^2$ | 1 square metre |
| 1 $km^2$ | 1 square kilometre |

## Area of a Rectangle

To find the area of a rectangle, multiply the length by the width.

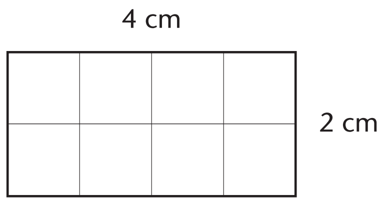
Using the symbols of mathematics, that sentence can be written like this:




Area of a rectangle = $l \times w$

$A = lw$

Find the area of this rectangle. First, copy down the formula you will be using. Then fill in the measurements for this specific rectangle. Finally, calculate the answer and report the answer in a sentence.




$A = lw$

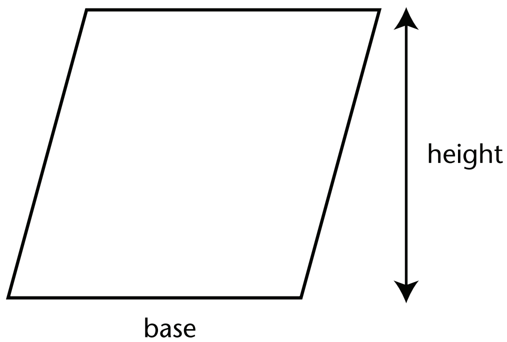
$A = 4 \text{ cm} \times 2 \text{ cm}$

$A = 8 \text{ cm}^2$

The area is 8 $\text{cm}^2$.

## Area of a Parallelogram

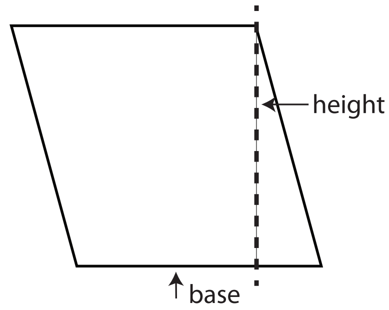
A parallelogram looks like a rectangle that has been pushed over a bit.



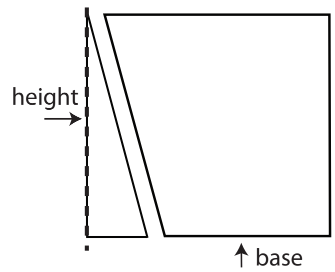

We describe the size of a rectangle by its length and its width. The size of a parallelogram is described by its **base** and its **height**.

The height is NOT the length of the slanted side! The height is the length of the shortest path from the bottom to the top of the shape. The height and the base are perpendicular to each other. That means that they form a right angle where they meet.

To determine the area of a parallelogram, imagine cutting the shape along its height.

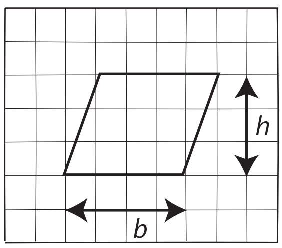



Rearrange the pieces so the two slanted sides touch.




The parallelogram is now a rectangle, and the area can be calculated by multiplying the base and the height.

The parallelogram below has a base of 4 units and a height of 3 units. Calculate the area using the formula.



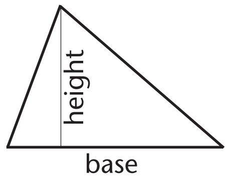

Area = base × height.

Area = 4 units × 3 units

Area = 12 square units

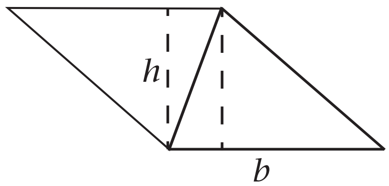
The area of the parallelogram is 12 units$^2$.

## Area of a Triangle




The size of a triangle can be described by its **base** and **height**, just like a parallelogram.

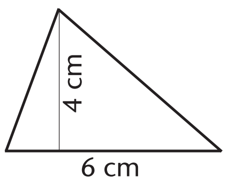
To determine the area of a triangle, imagine combining two identical triangles.




The two triangles form a parallelogram with the same base and height as the original triangle. The area of the triangle is half of the area of the parallelogram

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

The triangle below has a base of 6 cm and a height of 4 cm.



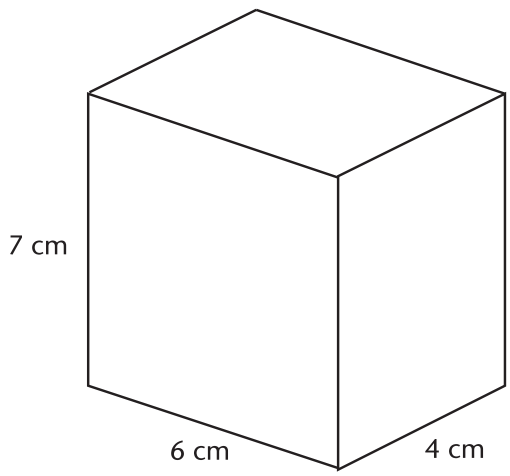

$$A = \frac{b \times h}{2}$$
$$A = \frac{6 \times 4}{2}$$
$$A = \frac{24}{2}$$
$$A = 12\ cm^2$$

## Volume of a Right Rectangular Prisms

The volume of an object is a measurement of the amount of space occupied by the object.

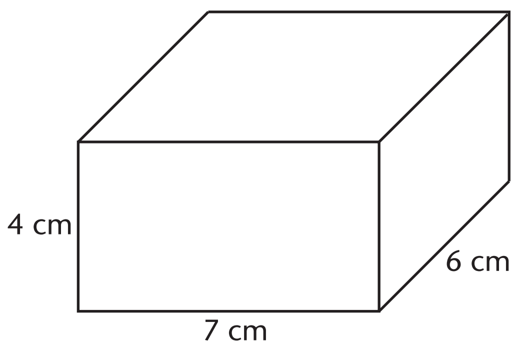
A right rectangular prism is a mathematician's phrase that means 'a box'.

In a right rectangular prism, you find volume by multiplying $l \times w \times h$.




Imagine pouring sand into the rectangular prism. The sand covers the area of 4 cm × 6 cm and fills up through the height of 7 cm.

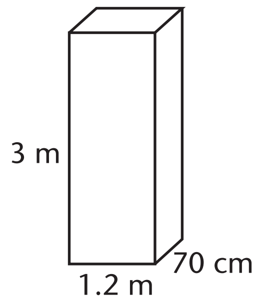
Volume = (4 cm × 6 cm) × 7 cm
Volume = 168 $cm^3$




The same rectangular prism is turned so that it is standing on a different face. Again, imagine the prism slowly being filled with sand. The sand covers the area of 6 cm × 7 cm, and fills up through the height of 4 cm.

Volume = (6 cm × 7 cm) × 4 cm
Volume = 168 $cm^3$

All of the measurements have the same units. If there is more than one unit of measurement used in the question, you will need to choose a unit of measurement and convert all of the measurements in the problem.




In this diagram, measurements are given using centimetres and metres. Before calculating the volume of the box, convert 70 cm to metres.

$$70 \text{ cm} = 0.7 \text{ m}$$

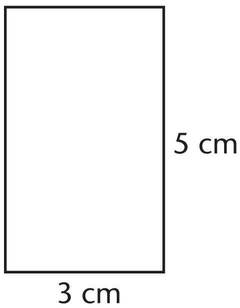
Now find the volume just like in the earlier examples.

$$\begin{aligned} \text{Volume} &= l \times w \times h \\ &= 1.2 \text{ m} \times 0.7 \text{ m} \times 3 \text{ m} \\ &= 2.52 \text{ m}^3 \end{aligned}$$

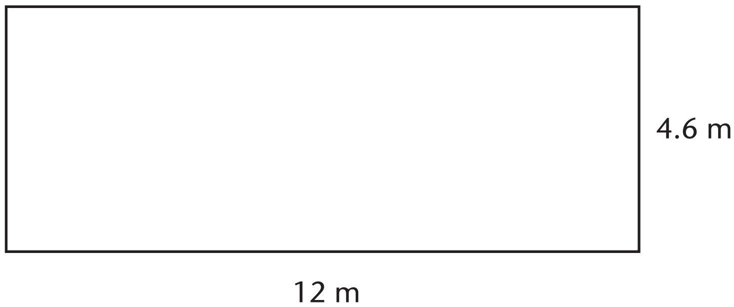
## Exercises 3.1

1. Find the area of each shape.

a.




b.

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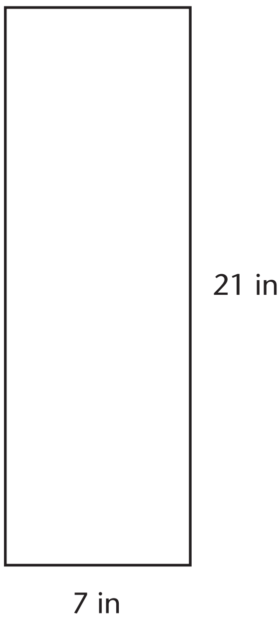
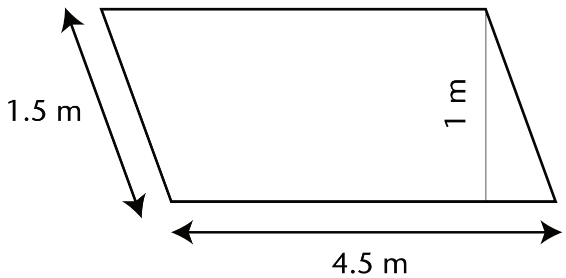
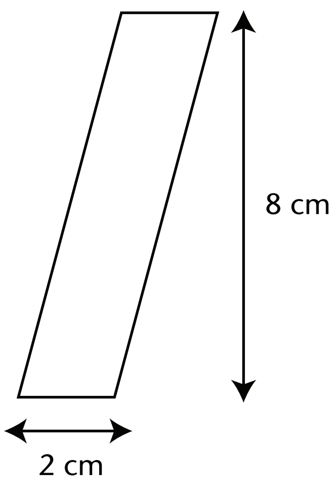


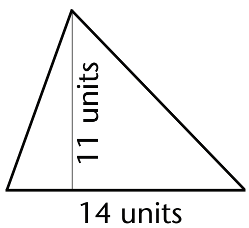

d.



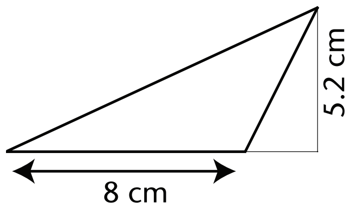

e.



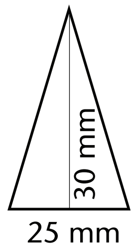

f.



g.

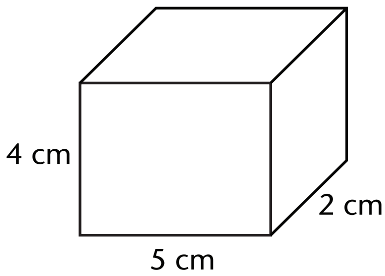



h.

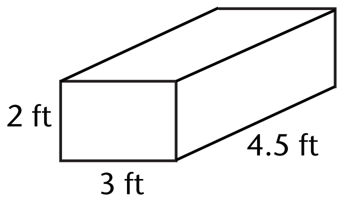



2. Find the volume of each object.

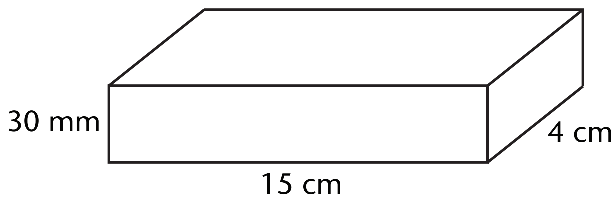
a.




b.




c.




**Turn to the Answer Key at the end of the module to check your work.**

## Lesson 4

# Cartesian Plane

## Learning Outcomes

**By the end of this lesson you will be better able to:**

- identify the features of the Cartesian Plane.
- use ordered pairs to describe the location of points in the Cartesian plane.
- plot points in the Cartesian plane

René Descartes was home sick in bed in the early 1600s. He watched a fly crawl around on the ceiling. René noticed that he could describe the fly's position no matter where it was by giving its distance from the corner of the room in two directions.

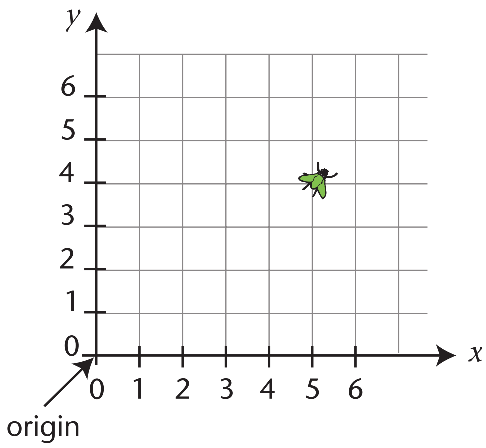
There are many situations where we need to clearly describe the location of an object. Video game designers, architects, and your GPS system all use René Descartes' bug-finding idea to precisely describe information about location.

A flat surface is called a plane. We call René's bug-finder the **Cartesian plane**.

The corner of the room is the **origin**. That just means the place where we start. All of our descriptions of distances will be measured from this spot.

The horizontal direction is called ***x***. The horizontal number line is called the ***x*-axis**.

The vertical direction is called ***y***. The vertical number line is called the ***y*-axis**.




The fly is called a **point**.

To describe the location of the fly, we ALWAYS give the distance in the ***x*** direction first. This fly is located 5 units to the right of the origin and 4 units above the origin. The fly is at (5,4).

The first number describes the distance in the *x* direction. This number is called the ***x*-coordinate**. The ***x***-coordinate of the location of the fly is 5.

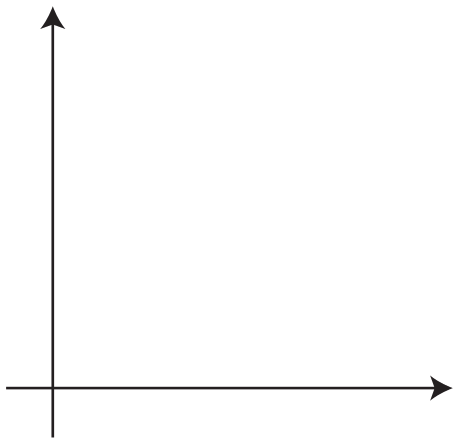
The second number describes the distance in the *y* direction. This number is called the ***y*-coordinate**. The *y*-coordinate of the location of the fly is 4.

When we write the two coordinates together, they are ALWAYS in round brackets. The two numbers are separated by a comma. The **coordinates** of the location of the fly are (5,4).

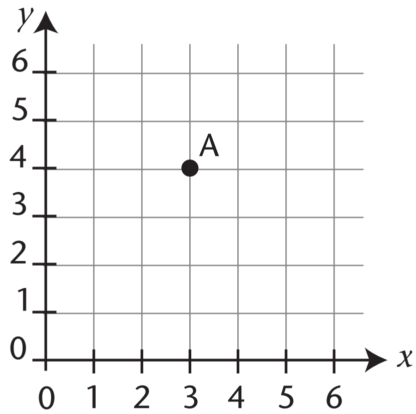
Sometimes we call coordinates a coordinate pair or an **ordered pair**. The Cartesian plane is just one example of a **coordinate system**.

## Exercises 4.1

1. Label the origin.
   Label the ***x***-axis.
   Label the ***y***-axis.

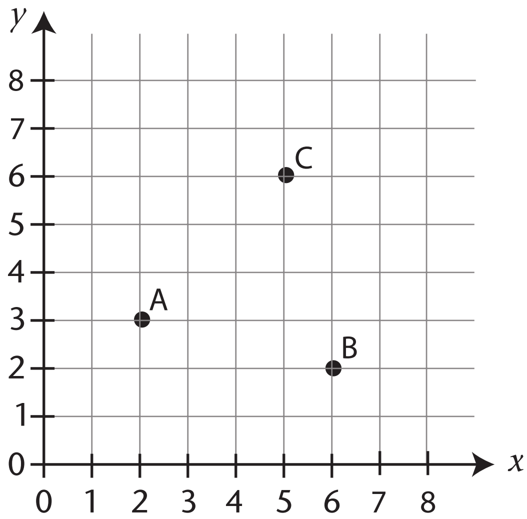


2. a. What is the *x*-coordinate of point A?
   b. What is the *y*-coordinate of point A?
   c. What are the coordinates of point A?




3. The Cartesian plane is an example of a ______________________________ system.

4. Describe the location of each point.

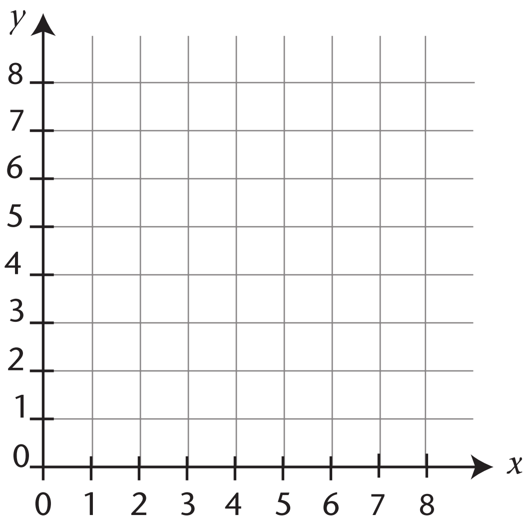



A ( , )

B ( , )

C ( , )

5. Place each point on the Cartesian plane.




D (1, 7)

E (2, 2)

F (5, 3)

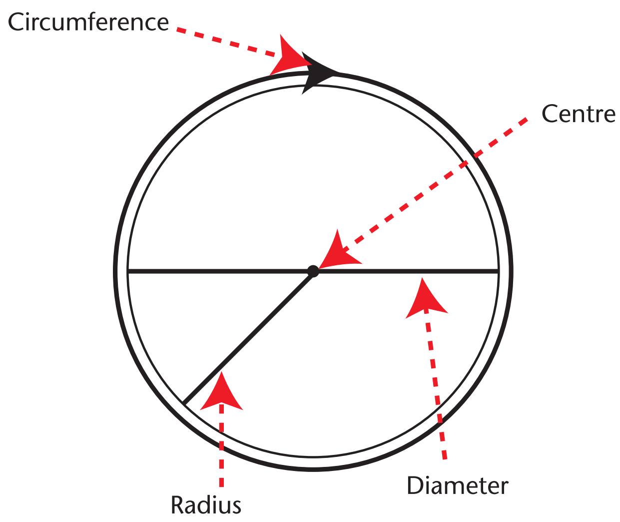
**Turn to the Answer Key at the end of the module to check your work.**

# Answer Key

## Lesson 1: Circles

### Exercises 1.1

1.




2. a. 22 cm
   b. 12 cm
   c. 2.4 cm
   d. 6.0 cm
   e. 9.2 m
   f. 3.8 mm
3. a. 2.5 cm
   b. 7 cm
   c. 3.1 cm
   d. 2 m
   e. 6.2 cm
   f. 4.6 mm
4. Find the approximate circumference of a circle with each diameter:
   a. 30 cm
   b. 20.1 m

5. a. 30 cm
   b. 13.8 m
   c. 42 mm

## Lesson 2: Angles and Triangles

### Exercises 2.1

1. a. its complement: 54° (90 – 36)
   b. its supplement: 144° (180 – 36)
2. a. 50°
   b. 40°
   c. 23° (90 – 67)
   d. 63° (90 – 27)
3. a. 105° (180 – 75)
   b. 87°
   c. 150°
   d. 123°
4. ∠M and ∠P are vertically opposite angles
   ∠N and ∠Q are vertically opposite angles
5. a. Vertically opposite angles are equal. ∠P measures 72°
   b. ∠M and ∠N are supplementary angles. Together they form a straight line (180°). ∠N measures 108°
6. a. acute  b. right
   c. acute  d. obtuse
   e. straight  f. obtuse
7. a. obtuse  b. acute
   c. right  d. obtuse

# Lesson 3: Area and Volume

## Exercises 3.1

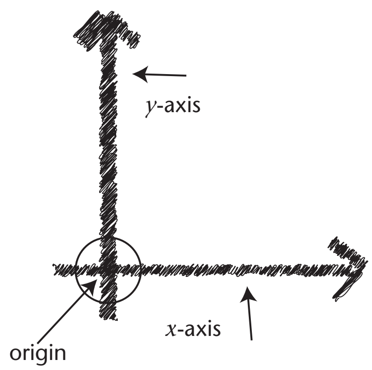
1. a. 15 $cm^2$ b. 55.2 $m^2$
   c. 147 $in^2$ d. 4.5 $m^2$
   e. 16 $cm^2$ f. 77 $units^2$
   g. 20.8 $cm^2$ h. 375 $mm^2$

2 a. 40 $cm^3$
   b. 27 $ft^3$
   c. 180 $cm^3$

# Lesson 4: Cartesian Plane

## Exercises 4.1

1.




2. a. 3
   b. 4
   c. (3, 4)

3. The Cartesian plane is an example of a **coordinate** system.

4. A (2, 3)

   B (6, 2)

   C (5, 6)

5.