

Calculating Area, Perimeter and Volume

You will be given a formula table to complete your math assessment; however, we strongly recommend that you memorize the following formulae which will be used regularly in your program.

Area of a square = s^2

Area of a triangle = $\frac{1}{2}b \cdot h$ or $\frac{b \cdot h}{2}$

Area of a rectangle = $l \cdot w$

Area of a parallelogram = $b \cdot h$

Area of a trapezoid = $\frac{1}{2} h (a + b)$

Area of a circle = πr^2

Volume of a cylinder = $\pi r^2 h$

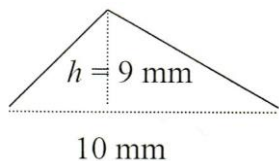
Area of a cube = area of one face x number of faces

**NOTE* The symbol \cdot means multiply, so $l \cdot w$ is the same as saying $l \times w$*

Area (Polygons)

A polygon is a geometric figure with 3 or more sides. The area of a polygon is the number of squares (of a particular unit) that it takes to cover the surface of the shape. Formulae are used to calculate the area.

Example 1: Find the area of a triangle which has a base of 10 mm and a height of 9 mm.



$$A = \frac{1}{2} b \times h$$

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

$$A = \frac{1}{2} (10 \text{ mm} \times 9 \text{ mm})$$

$$A = \frac{10 \text{ mm} \times 9 \text{ mm}}{2}$$

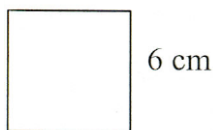
$$A = \frac{1}{2} (90 \text{ mm}^2)$$

$$A = \frac{90 \text{ mm}^2}{2}$$

$$A = 45 \text{ mm}^2$$

$$A = 45 \text{ mm}^2$$

Example 2: Find the area of a square that has a side with a length of 6 cm.

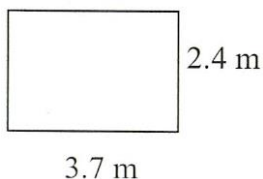


$$A = s^2$$

$$A = (6 \text{ cm})^2$$

$$A = 36 \text{ cm}^2$$

Example 3: Find the area of a rectangle that has a length of 3.7 m and a width of 2.4 m.

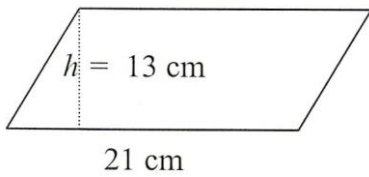


$$A = l \times w$$

$$A = (3.7 \text{ m}) \times (2.4 \text{ m})$$

$$A = 8.88 \text{ m}^2$$

Example 4: Find the area of a parallelogram that has a base of 21 cm and a height of 13 cm.



$$A = b \times h$$

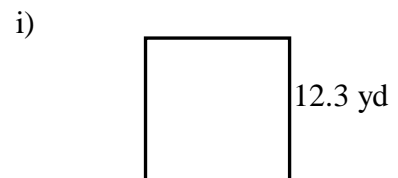
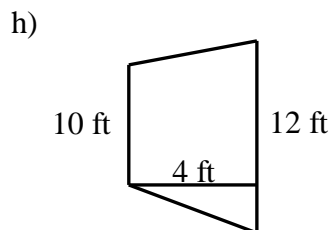
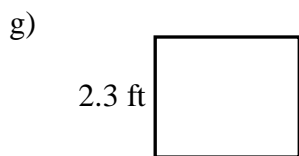
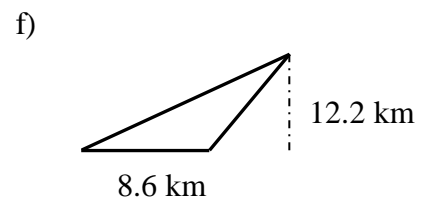
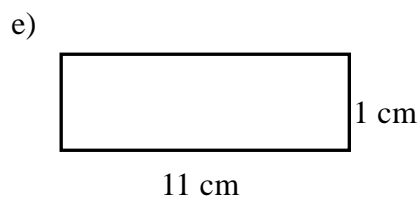
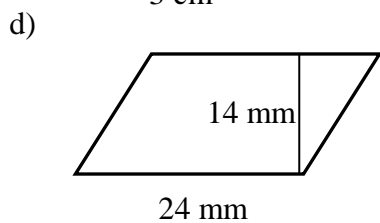
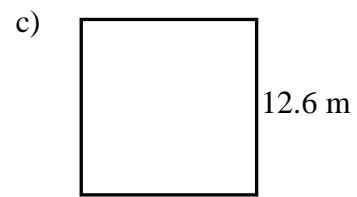
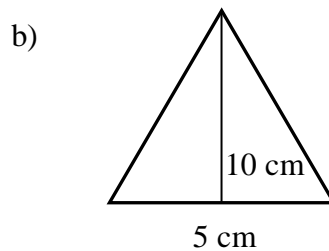
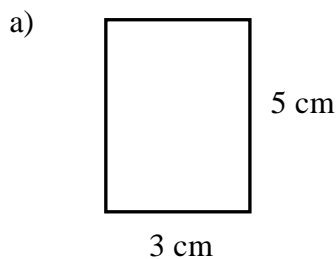
$$A = (21 \text{ cm}) \times (13 \text{ cm})$$

$$A = 273 \text{ cm}^2$$

**Notice that units in the answers are units² (squared)*

PRACTICE

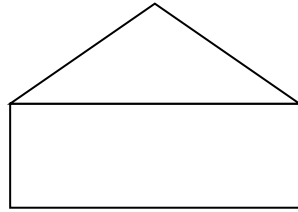
Find the area of the following shapes:



Note: There are no diagrams for j) to q).

- j) A square 35 ft on a side.
- k) A parallelogram with height of 14 in. and base 23 in.
- l) A rectangle with length of 8.8 m and width of 4.2 m.
- m) A triangle with height of 9 km and base of 5.2 km.
- n) A rectangle $\frac{3}{4}$ mile by $\frac{7}{8}$ mile.
- o) A triangle with a base of $\frac{3}{8}$ yard and height of $2\frac{1}{2}$ yd.
- p) A parallelogram with base of $9\frac{1}{2}$ ft and height of $8\frac{1}{4}$ ft.
- q) A trapezoid with one base of 6 m and one base of 4 m. The height is 8 m.

** Tip* If you are asked to find the area of an unusual shape, break it down into shapes that you recognize. For example, if you were asked to find the area of the shape below, find the area of the triangle (roof) and then the house (rectangle). When you add the 2 areas together, you will have the total area.*



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|------------------------------------------------------------|--------------------------------------------------------------|--------------------------|------------------------------------------------------------|-------------------------|
| a) 15 cm ² | b) 25 cm ² | c) 158.76 m ² | d) 336 mm ² | e) 11 cm ² |
| f) 52.46 km ² | g) 5.29 ft ² | h) 44 ft ² | i) 151.29 yd ² | j) 1225 ft ² |
| k) 322 in ² | l) 36.96 m ² | m) 23.4 km ² | n) $\frac{21}{32}$ mi ² or 0.66 mi ² | |
| o) $\frac{15}{32}$ yd ² or 0.47 yd ² | p) $78\frac{3}{8}$ ft ² or 78.375 ft ² | | q) 40 m ² | |

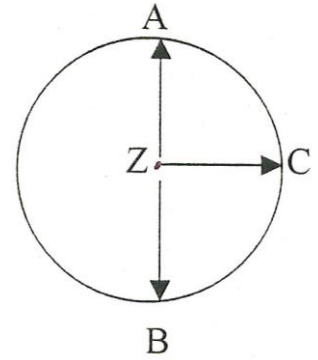
Circle Geometry

Circumference is the name for the perimeter (or distance around the outside) of a circle.

In this circle, the centre is Z. A, B, and C are points on the circle.

Radius: The distance from the centre of the circle to any point on the circle is called the radius (**r**). (ZA is a radius. ZB and ZC are too).

Diameter: The distance from any point on the circle, passing through the centrepoint and continuing on to the outer edge of the circle (**d**). (AB is the diameter of the circle to the right.)



To find the circumference (or perimeter) of the circle, use one of the following formulae:

$$(1) C = \pi d \quad \text{OR} \quad (2) C = 2\pi r$$

π is called pi and is about **3.14** or $\frac{22}{7}$

Example A: If the circle has a radius of 5 cm, then

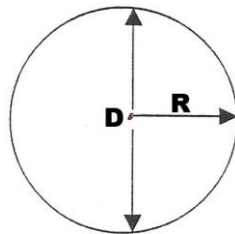
| (1) $C = \pi d$ | (2) $C = 2\pi r$ |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| The diameter would be twice the radius (or $5 \text{ cm} \times 2 = 10 \text{ cm}$) $C = (3.14)(10 \text{ cm})$ $C = 31.4 \text{ cm}$. | The radius is 5 cm So $C = (2)(3.14)(5)$ $C = 31.4 \text{ cm}$ |

Both formulae work equally well. You may choose either one.

Now let's practice:

- A circle has a diameter of 20 m. What is the circumference?
- A circle has a radius of 7 km. What is the circumference?
- Find the circumference for the following circles:
 - radius(**r**) = 14 cm
 - diameter (**d**) = 60 mm
 - radius (**r**) = 15 m

(use $\pi = 3.14$ or $\frac{22}{7}$)



ANSWERS - Please note that answers may vary depending on the value used for π (Pi)

- $C = \pi d$; $C = (3.14)(20)$; $C = 62.8 \text{ m}$ 2) $C = 2\pi r$; $C = (2)(3.14)(7)$; $C = 43.96 \text{ km}$
- 3) a) $C = 2\pi r$; $C = (2)\left(\frac{22}{7}\right)(14) = 88 \text{ cm}$ b) $C = \pi d$; $C = 3.14(60) = 188.4 \text{ mm}$
- c) $C = 2\pi r$; $C = (2)(3.14)(15)$; $C = 94.2 \text{ m}$

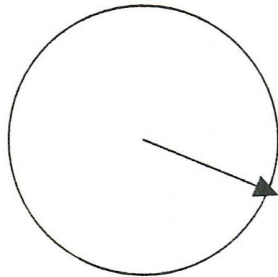
Area (Circles)

To find the area of a circle, use the formula

$$A = \pi r^2$$

A = area of the circle: $\pi = \text{pi} \approx 3.14$ or $\frac{22}{7}$

r = the radius of the circle



r = the radius of the circle = **10 cm**

so

$$A = \pi r^2$$

$$A = 3.14 \times (10)^2$$

$$A = 3.14 \times 100$$

$$A = 314 \text{ cm}^2$$

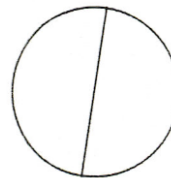
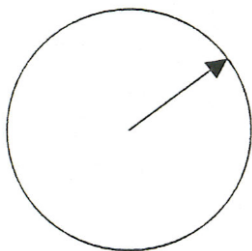
***notice:** answers are units²

Now let's practice:

A: Find the circumference and the area of the following circles:

(1) the radius = 4 km

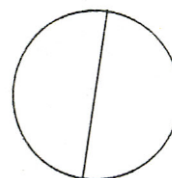
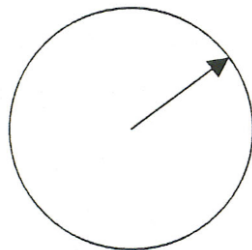
(2) the diameter = 10 m



B: Find the circumference and the area of the following circles:

(1) the radius = 14 in.

(2) the diameter = 20 mm



ANSWERS - - Please note that answers may vary depending on the value used for π (Pi)

A: 1) $C = 2\pi r$; $C = 2(3.14)(4)$: $C = 25.12$ km

$A = \pi r^2$ $A = (3.14)(4)^2 = 50.24$ km²

2) $C = \pi d$; $C = (3.14)(10)$; $C = 31.4$ m

$A = \pi r^2$ $A = (3.14)(5)^2 = 78.5$ m²

B: 3) $C = 2\pi r$; $C = 2(3.14)(14) = 87.92$ in

$A = \pi r^2$ $A = (3.14)(14)^2 = 615.44$ in²

4) $C = \pi d$; $C = (3.14)(20) = 62.8$ mm

$A = \pi r^2$ $A = (3.14)(10)^2 = 314$ mm²

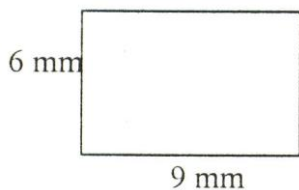
Perimeter

The perimeter of a polygon is the distance around the outside of the figure, or the sum of the length of each of its sides. Sometimes formulae are used in calculating the perimeter to make things easier. The most common formulae used are as follows:

Perimeter of a Rectangle or a Parallelogram: $P = 2 \cdot (l + w)$ **or** $P = 2 \cdot l + 2 \cdot w$

Perimeter of a Square: $P = 4 \cdot s$

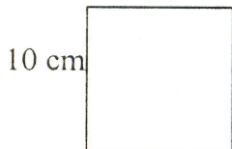
Example 1: Find the perimeter of a rectangle that is 6 mm by 9 mm



$$\begin{aligned} P &= 6 \text{ mm} + 6 \text{ mm} + 9 \text{ mm} + 9 \text{ mm} & \text{or} & \quad P = 2 \cdot (l + w) \\ &= 30 \text{ mm} & & \quad = 2 \cdot (6 \text{ mm} + 9 \text{ mm}) \\ & & & \quad = 2 \cdot (15 \text{ mm}) \\ & & & \quad = 30 \text{ mm} \end{aligned}$$

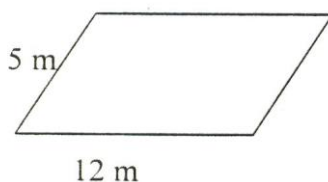
$$\begin{aligned} \text{or} \quad P &= 2l + 2w \\ &= 2(9 \text{ mm}) + 2(6 \text{ mm}) \\ &= 18 \text{ mm} + 12 \text{ mm} \\ &= 30 \text{ mm} \end{aligned}$$

Example 2: Find the perimeter of a square with a side that is 10 cm long



$$\begin{aligned} P &= 10 \text{ cm} + 10 \text{ cm} + 10 \text{ cm} + 10 \text{ cm} & \text{or} & \quad P = 4s \\ &= 40 \text{ cm} & & \quad = 4(10 \text{ cm}) \\ & & & \quad = 40 \text{ cm} \end{aligned}$$

Example 3: Find the perimeter of a parallelogram that has a length of 12m and a width of 5m

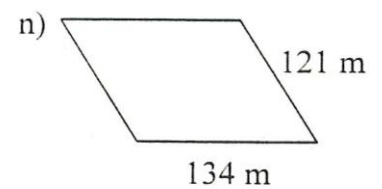
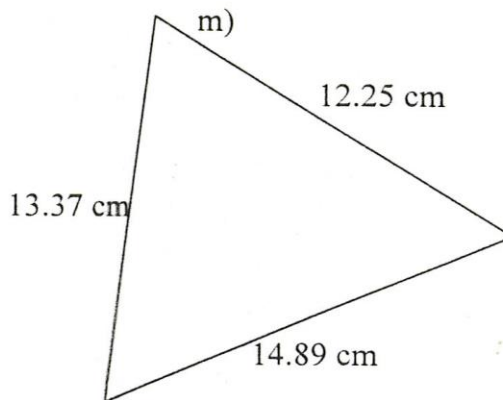
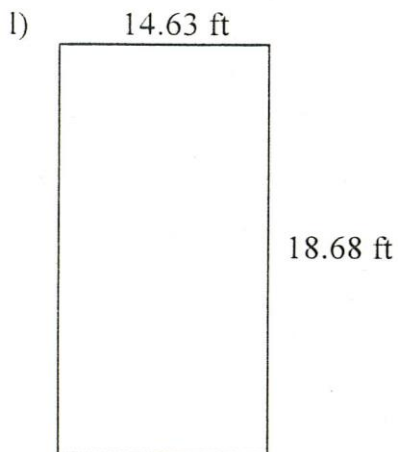
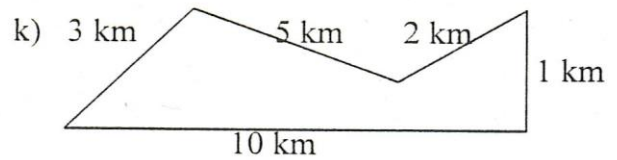
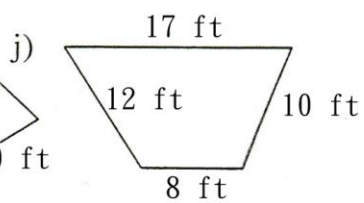
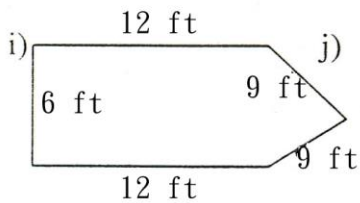
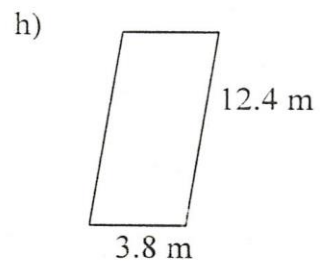
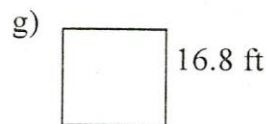
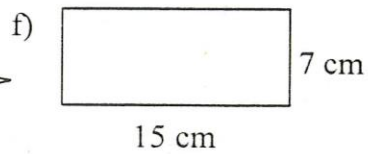
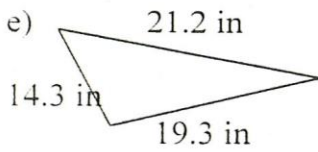
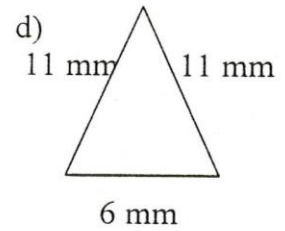
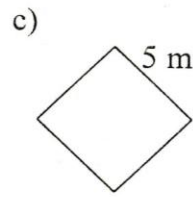
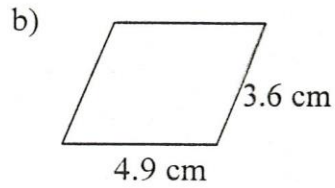
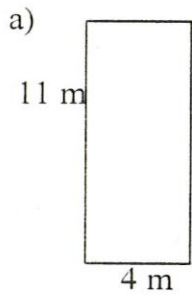


$$\begin{aligned} P &= 2(l + w) & \text{or} & \quad P = 2l + 2w \\ &= 2(12 \text{ m} + 5 \text{ m}) & & \quad = 2(12 \text{ m}) + 2(5 \text{ m}) \\ &= 2(17 \text{ m}) & & \quad = 24 \text{ m} + 10 \text{ m} \\ &= 34 \text{ m} & & \quad = 34 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{or} \quad P &= 5 \text{ m} + 12 \text{ m} + 5 \text{ m} + 12 \text{ m} \\ &= 34 \text{ m} \end{aligned}$$

PRACTICE

Find the perimeter of the following shapes:



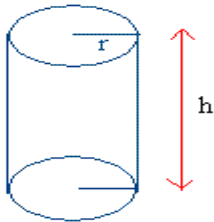
ANSWERS

- a) 30 m b) 17 cm c) 20 m d) 28 mm e) 54.8 in f) 44 cm
g) 67.2 ft h) 32.4 m i) 48 ft j) 47 ft k) 21 km l) 66.62 ft
m) 40.51 cm n) 510 m

Volume

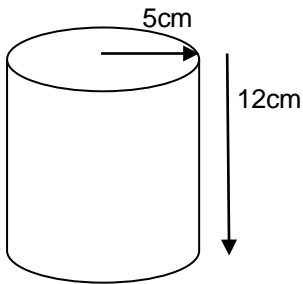
Volume is the amount of space that a substance or object occupies, or that is enclosed within a container. To calculate the volume of a cylinder (a can or piece of pipe), use the following formula:

Volume of a cylinder = $\pi r^2 h$



Example 1:

Find the volume of a cylinder having a radius of 5 cm and a height of 12 cm.



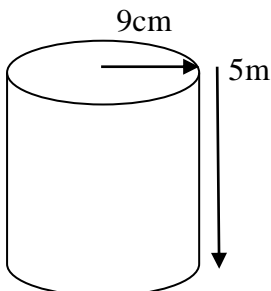
Volume of a cylinder = $\pi r^2 h$

$\pi = 3.14$ $r^2 = 5 \times 5$ $h = 12$

$3.14 \times 25 \times 12 = 942 \text{ cm}^3$

Example 2:

Find the volume of a cylinder having a radius of 9 cm and a height of 5m.



Volume of a cylinder = $\pi r^2 h$

$\pi = 3.14$ $r^2 = 9 \times 9$ $h = 5m (500cm)$

$3.14 \times 81 \times 500 = 127170 \text{ cm}^3 = 0.12717\text{m}^3$ **

PRACTICE

Find the volume of the following cylinders:

1. Radius 3" Height 2 ft
2. Radius 12 cm Height 1 m
3. Radius 1' 3" Height 3 ft 1 in.

** When converting a squared or cubed number – be careful!

To convert cm^2 to m^2 , we divide by 100 and 100 again

To convert cm^3 to m^3 , we divide by 100 then another hundred and then a third hundred

To convert square inches to square feet, we divide by 12 and then 12 again

To convert cubed inches to cubed feet, we divide by 12 (three times)

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1. $3.14 \times 9 (3 \times 3) \times 24 = 678.24$ inches cubed or 0.3925 feet cubed
2. $3.14 \times 144 (12 \times 12) \times 100 = 45216 \text{ cm}^3$ or 45.216 m^3
3. $3.14 \times 225 (15 \times 15) \times 37 = 26140.5$ inches cubed or 15.12 feet cubed