Area and Volume

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5-01 Perimeter

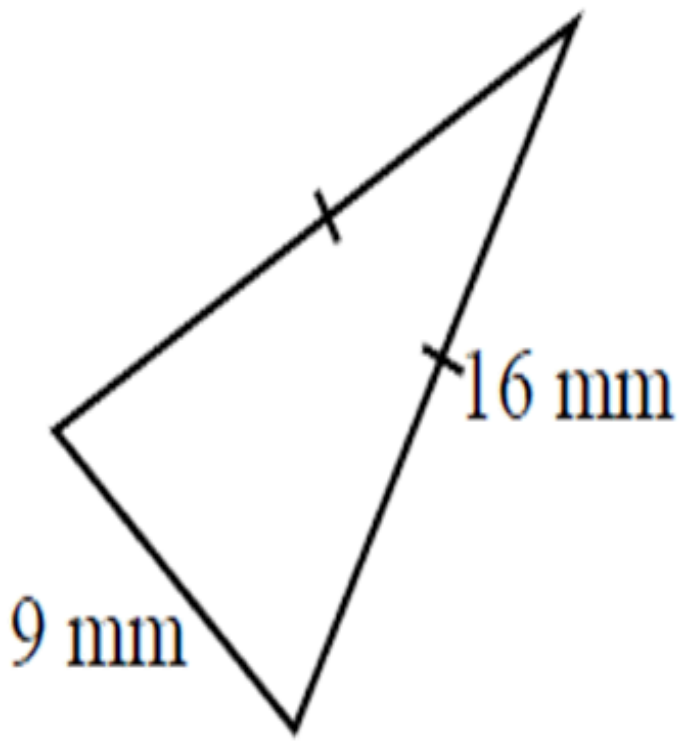
What's perimeter?

- Perimeter of a shape is the distance around the shape
- Remember the track events at the Sports Carnival?

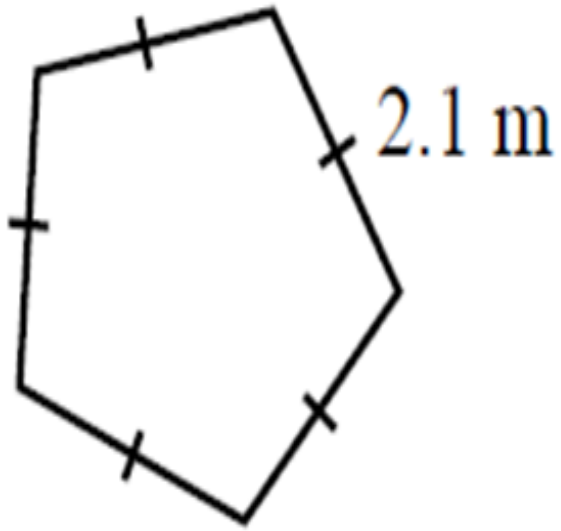
Examples

Find the perimeter of the following shapes:

a)

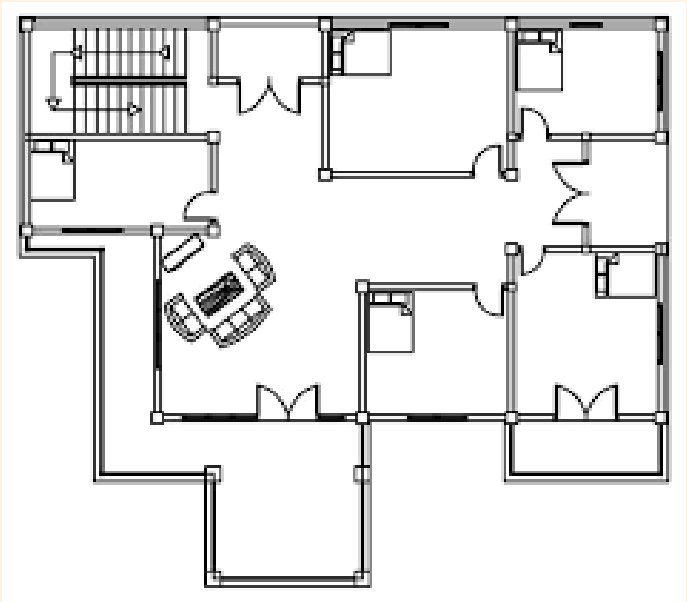


b)



Perimeter of Composite Shapes

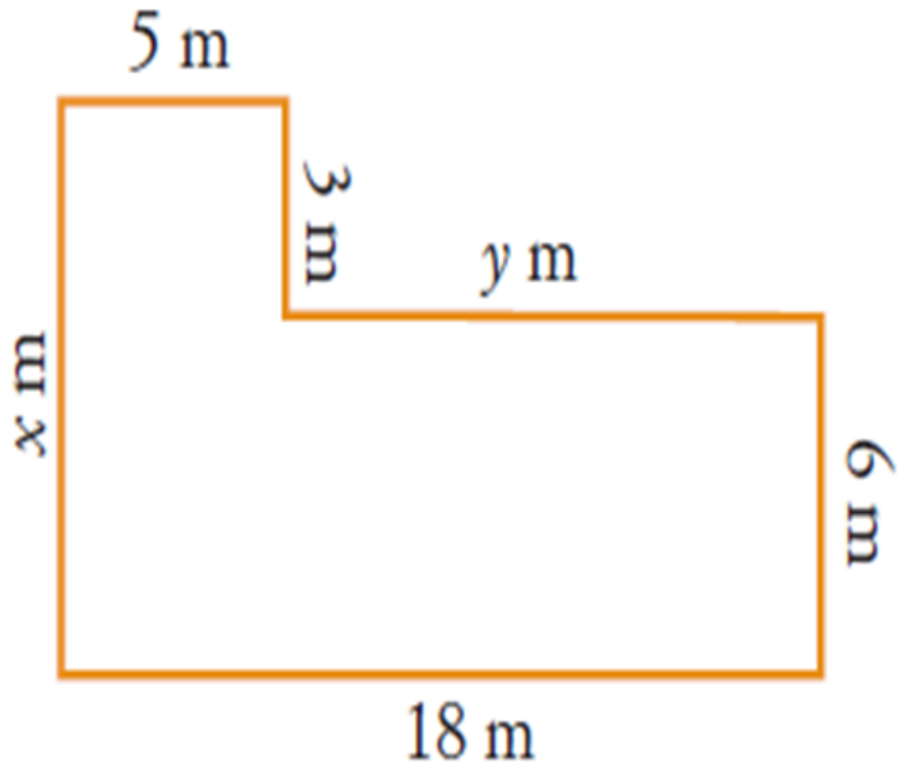
- What's a composite shape?
  - any shape that is made up of two or more shapes
- We see what lengths are on the outside - some sides may now be shared
- Composite shape in real life:



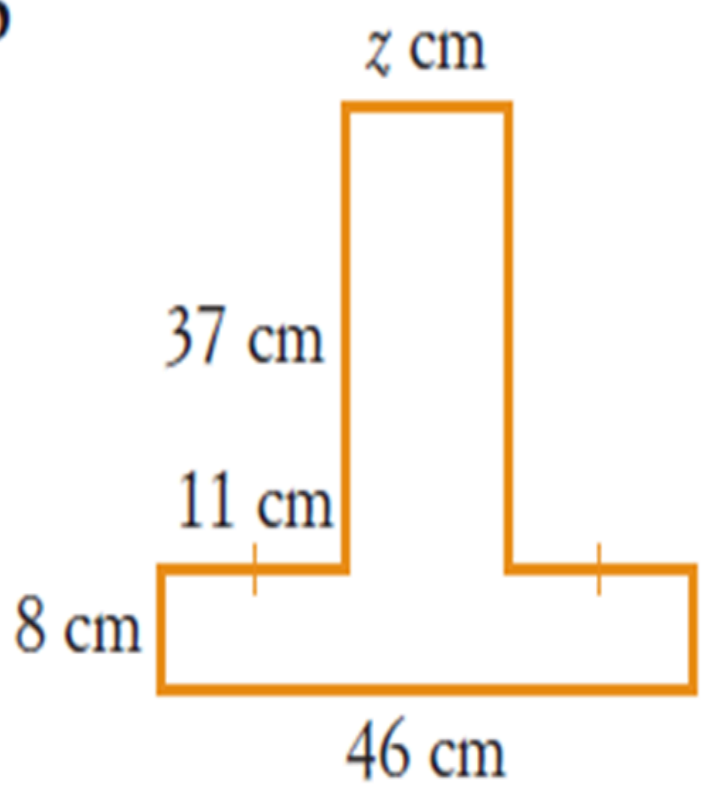
Examples

Find x, y and z, then find the perimeter of the following shapes:

a

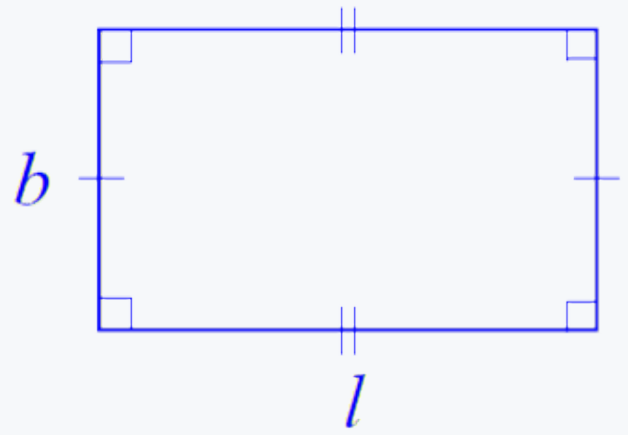
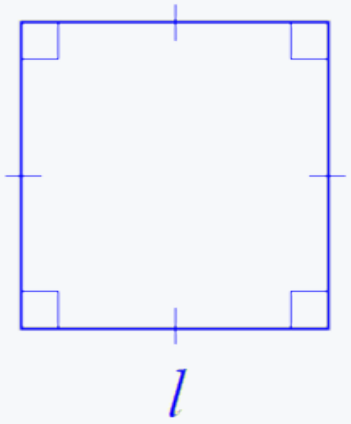


b



Area of Rectangles and Squares

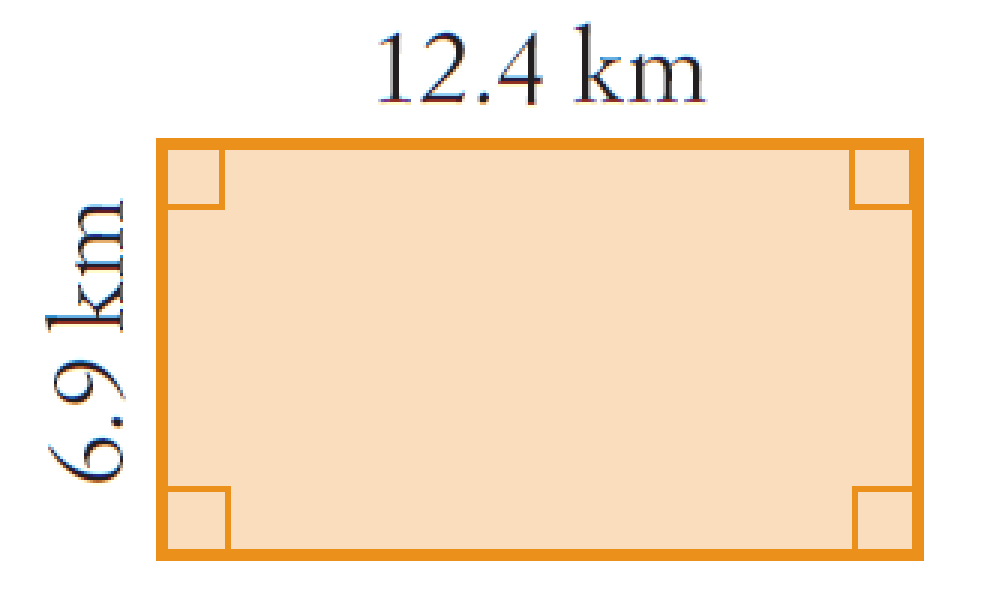
- Quick check: What's an area?

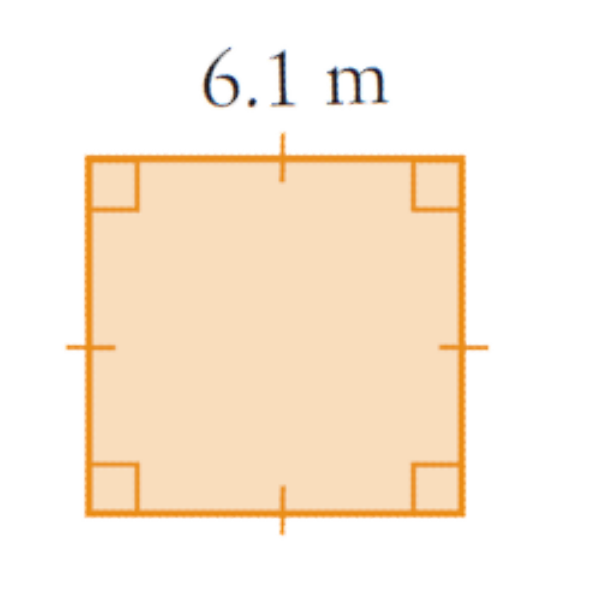
Rectangle	Square
$A = l \times b$	$A = l^2$
	

where A is the Area, l is the length, b is the breadth

Examples

Find the areas of the following to 1 decimal place:

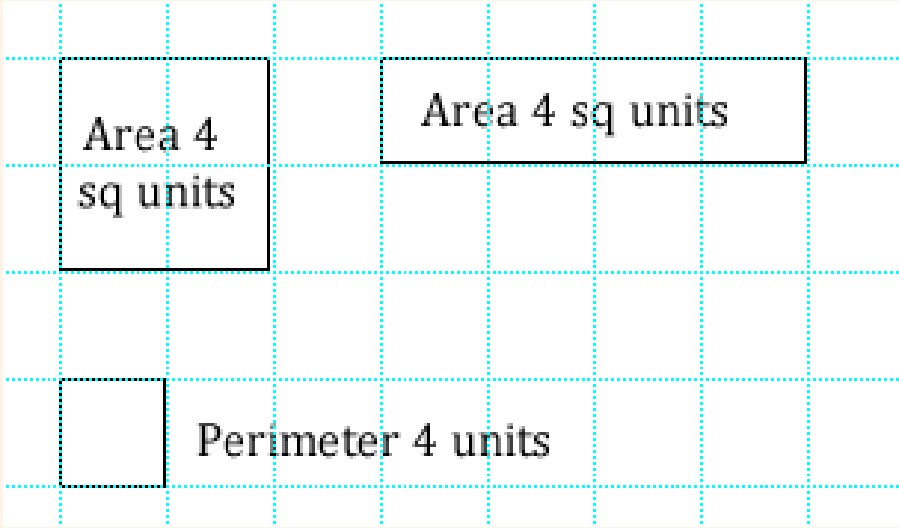




Dicey Perimeters, Dicey Areas

How to play:

1. Player 1 throws the two dice and finds their product.
2. Player 1 must then draw as many rectangles/squares as possible which have either an area or a perimeter equal to the product. Player 1 scores 1 point for each correct shape.
3. Player 2 throws the dice, finds their product and draws as many shapes as possible in the same way.
4. After 3 tosses each, the Player with the highest score wins



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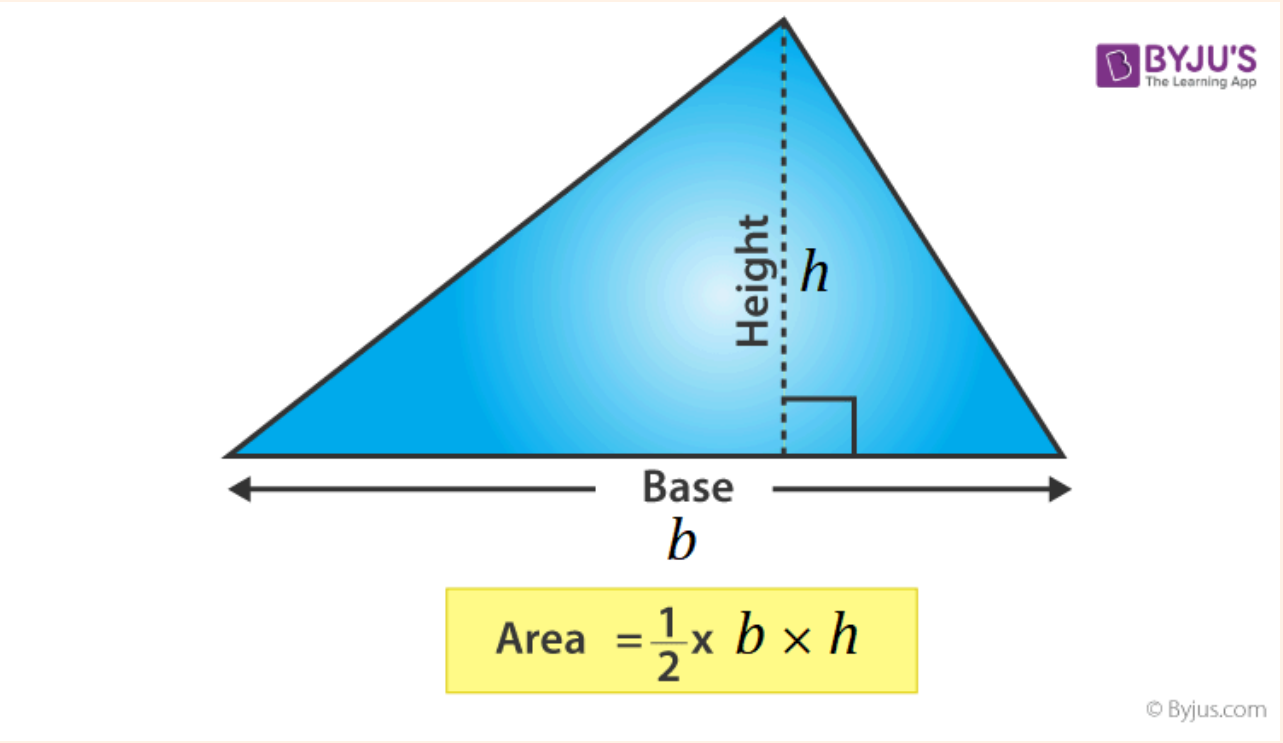


Area of a triangle

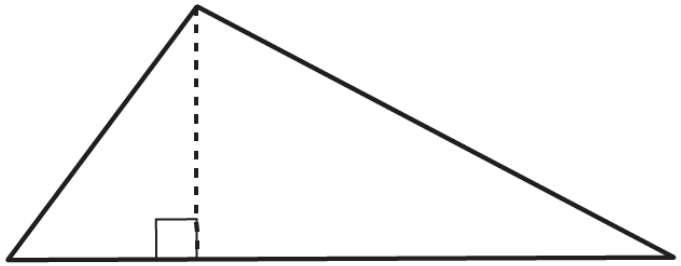
Take notes on this

Formula: A = $\frac{1}{2}bh$

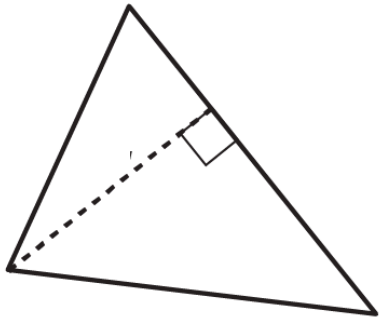
Explanation: Area = $\frac{1}{2}$ base × height**

- Key point: Perpendicular height
- Also important: $\frac{1}{2}$
  - A triangle is half of a rectangle: Visualize

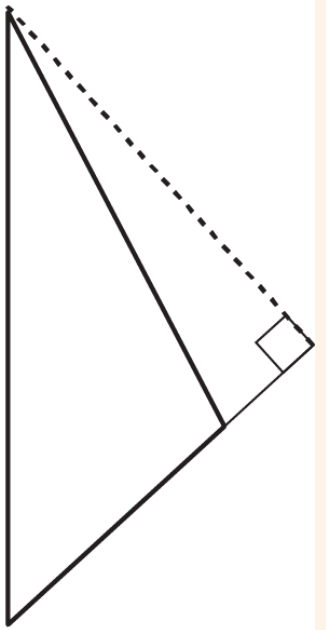
A



B

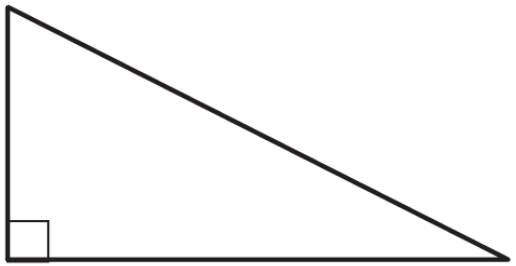


C

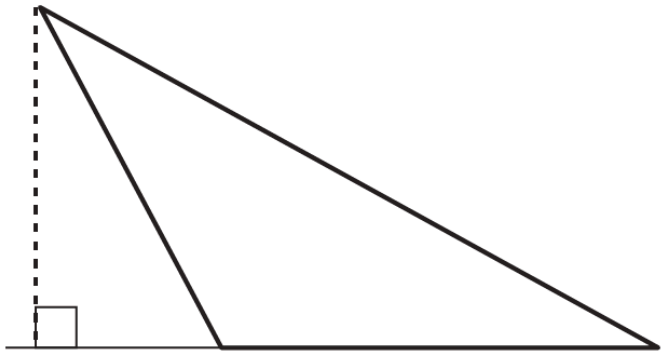


Can you find the base?

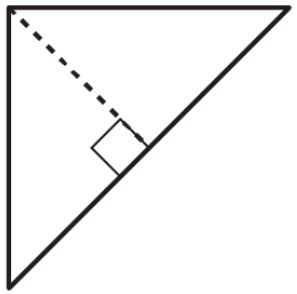
D



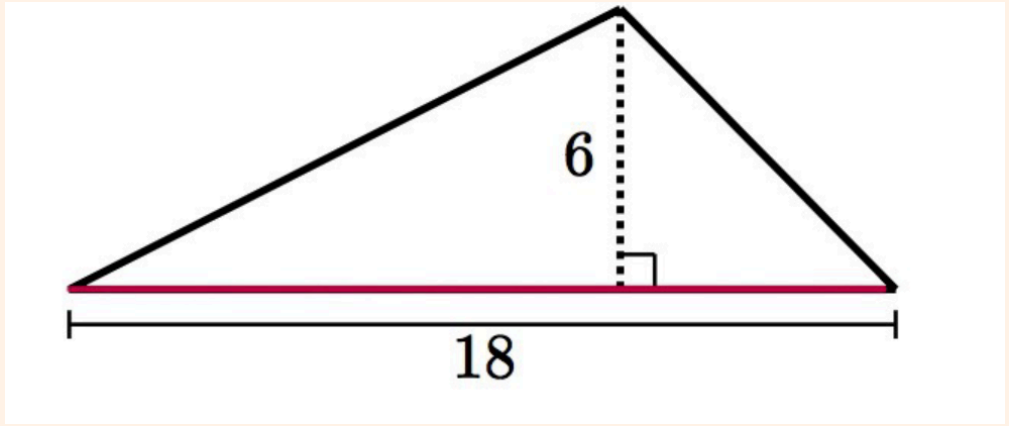
E

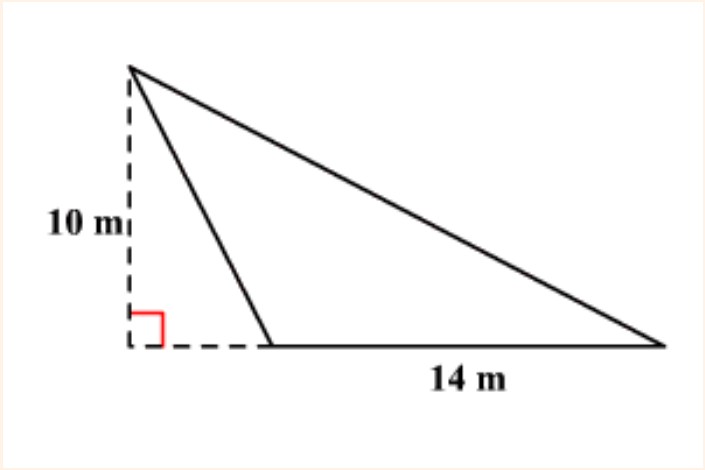


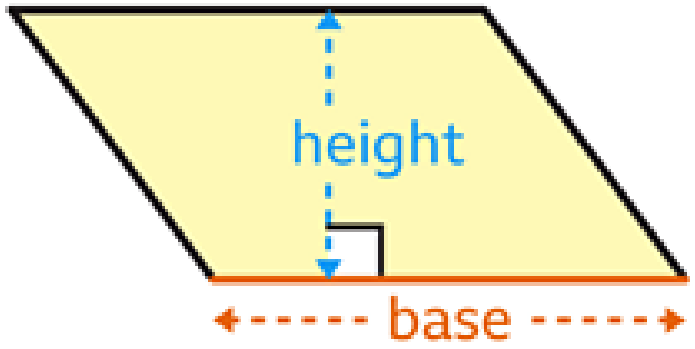
F

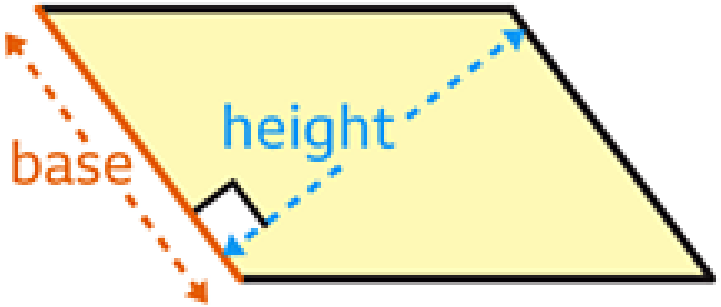


Find the Area

a) 

b) 



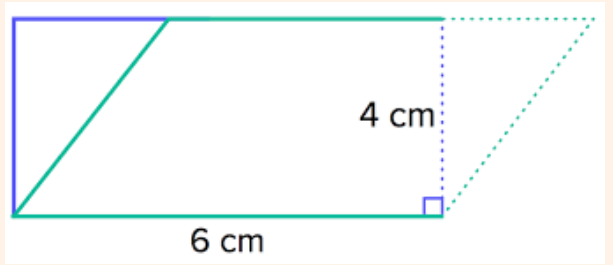


Area of a Parallelogram

Take notes on this

Area of a parallelogram = base × height

Why?

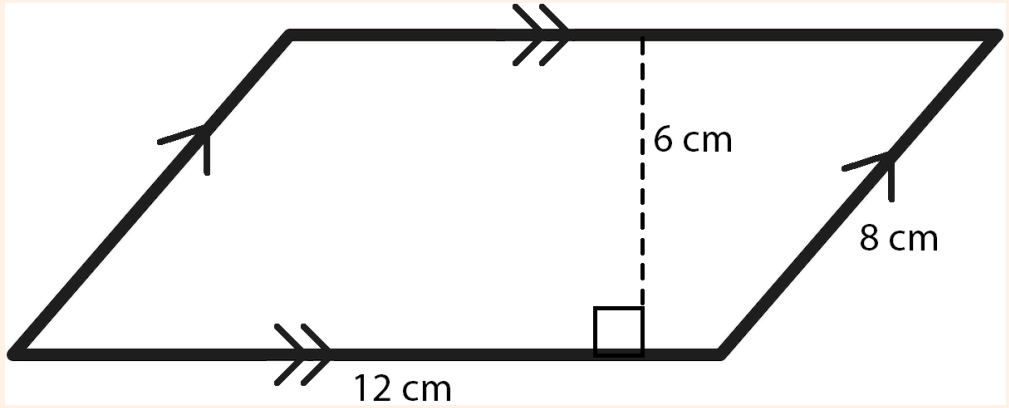
- 

  Secret Rectangle

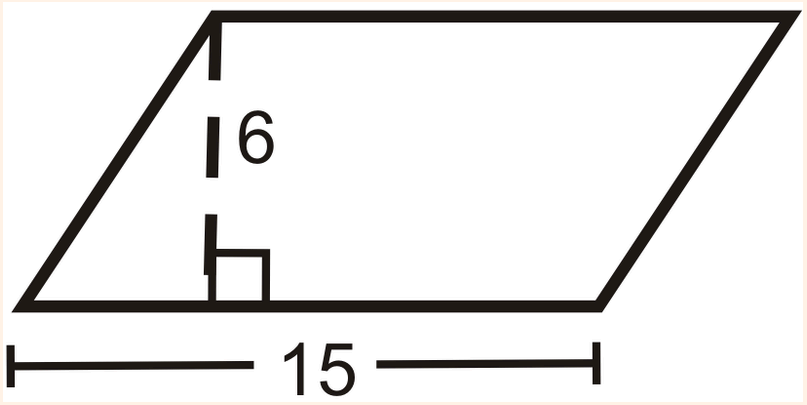
Formula: A = bh

Find the area

a)



b)



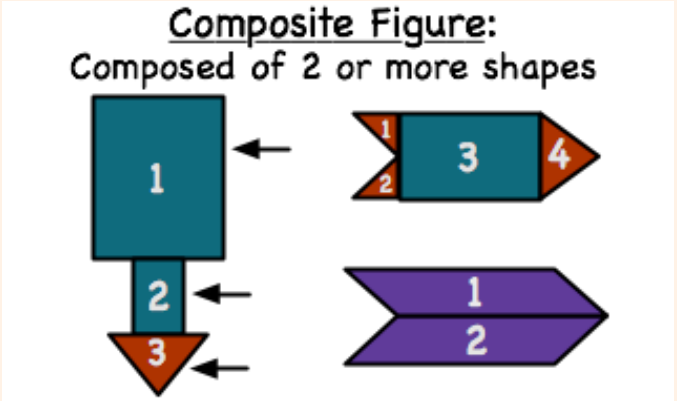
Composite Shapes

Take notes on this

Composite shape: any shape that is made up of two or more geometric shapes

For example: Any polygon can be broken down into triangles

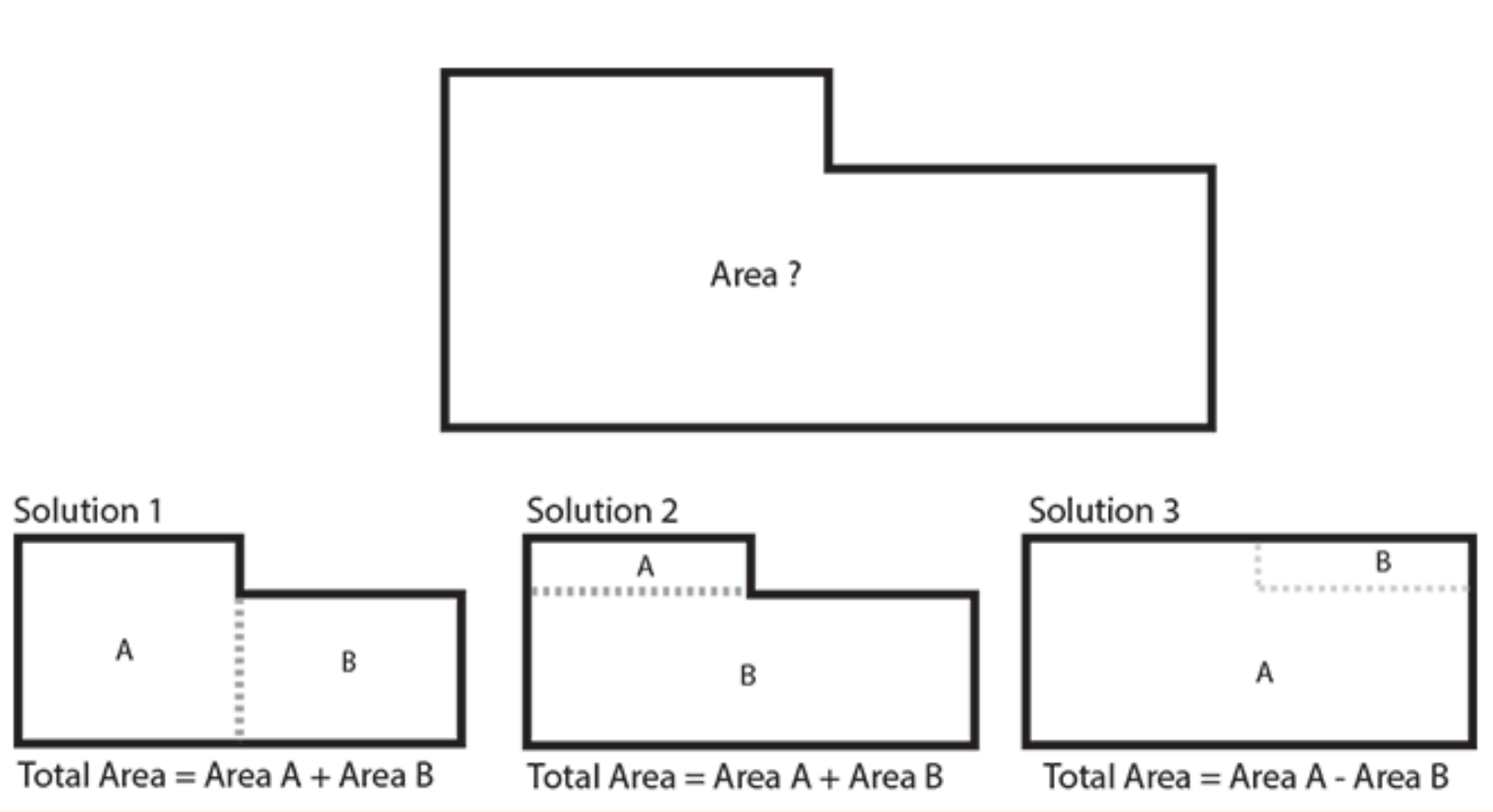
- This fact is used by GPUs (Graphical Processing Units) to create graphics for video games



Area of Composite Shapes

Take notes on this

To find the area of a composite shape, we break it down into shapes we know (example)



Steps to Find Areas of Composite Shapes

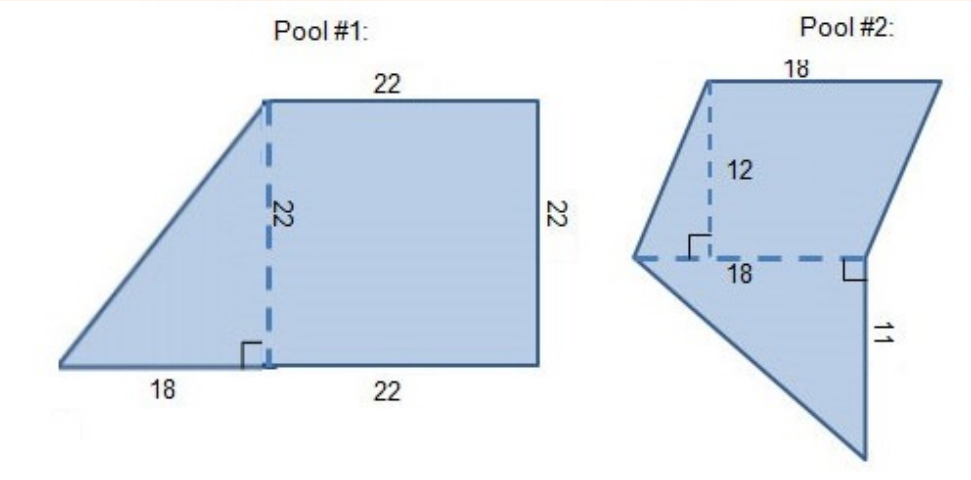
Take notes on this

This can be by adding *or* subtracting shapes (see below)

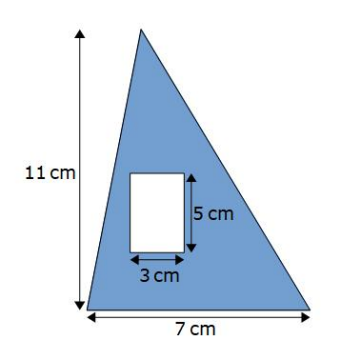
- Divide shape diagram with lines (no overlapping shapes)
- Label sides/heights with dimensions
- Calculate areas (give them names like A_1)
- Add up all areas to find the total

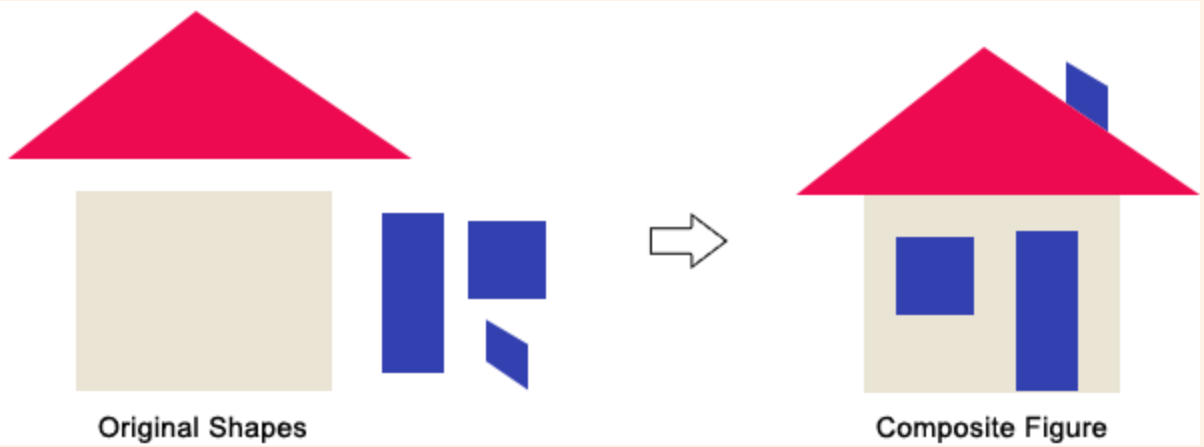
Examples

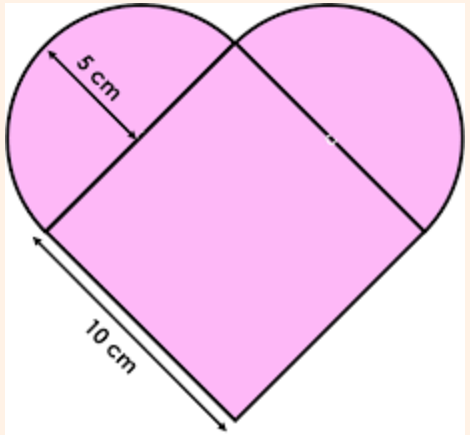
Q1. Which pool is the biggest?



Q2. Find the blue area:




Original Shapes
Composite Figure


5 cm
10 cm

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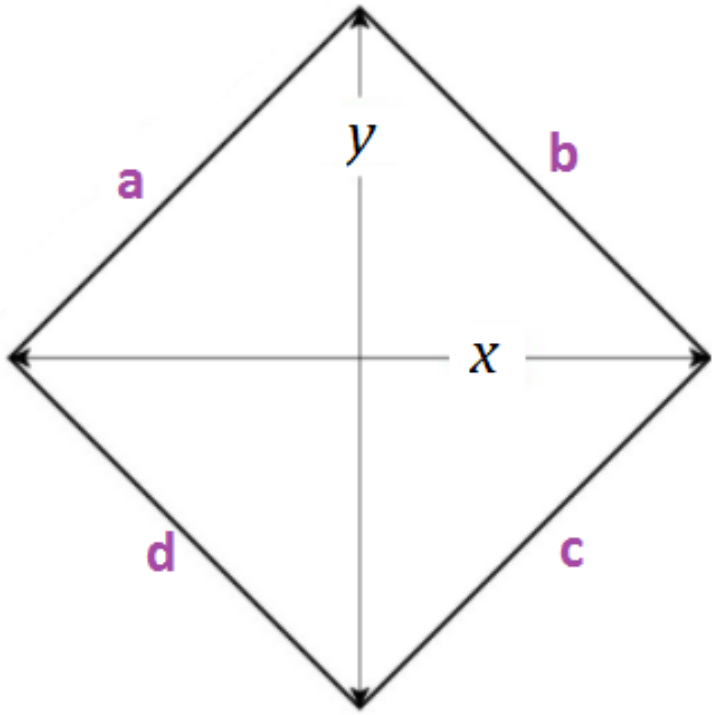
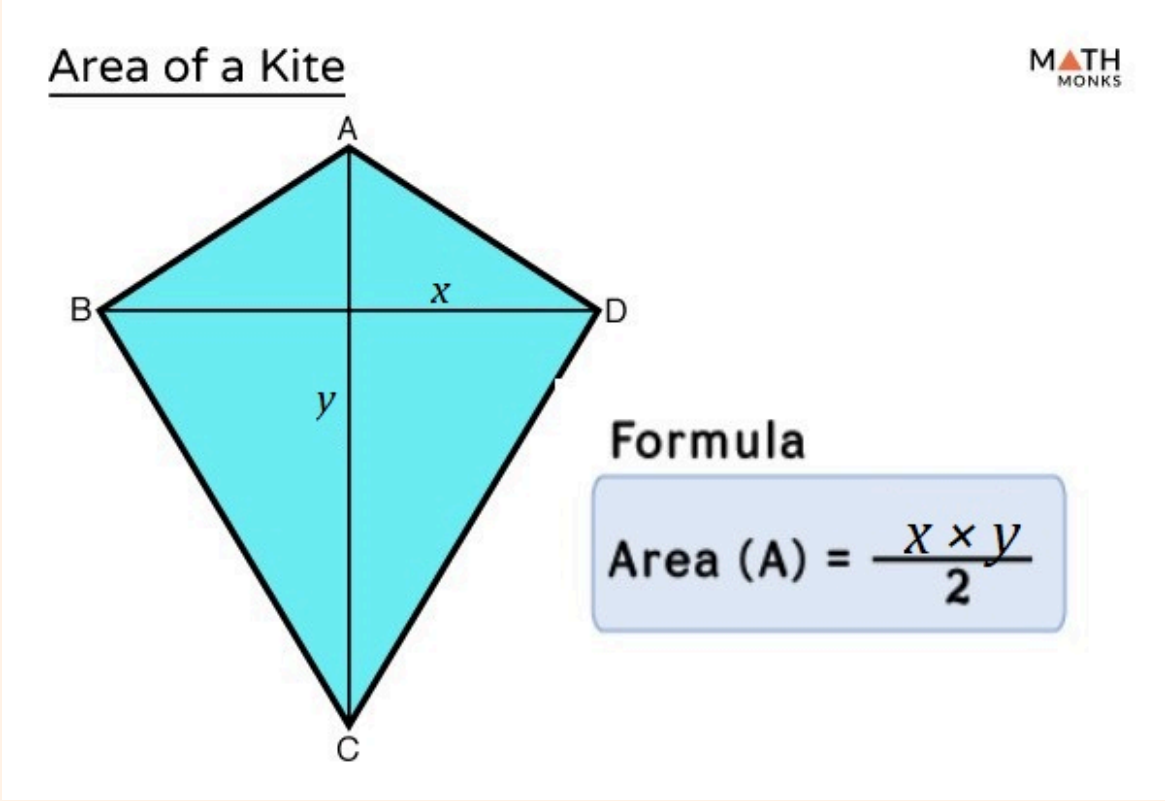
Areas of a Rhombus and Kite

Take notes on this



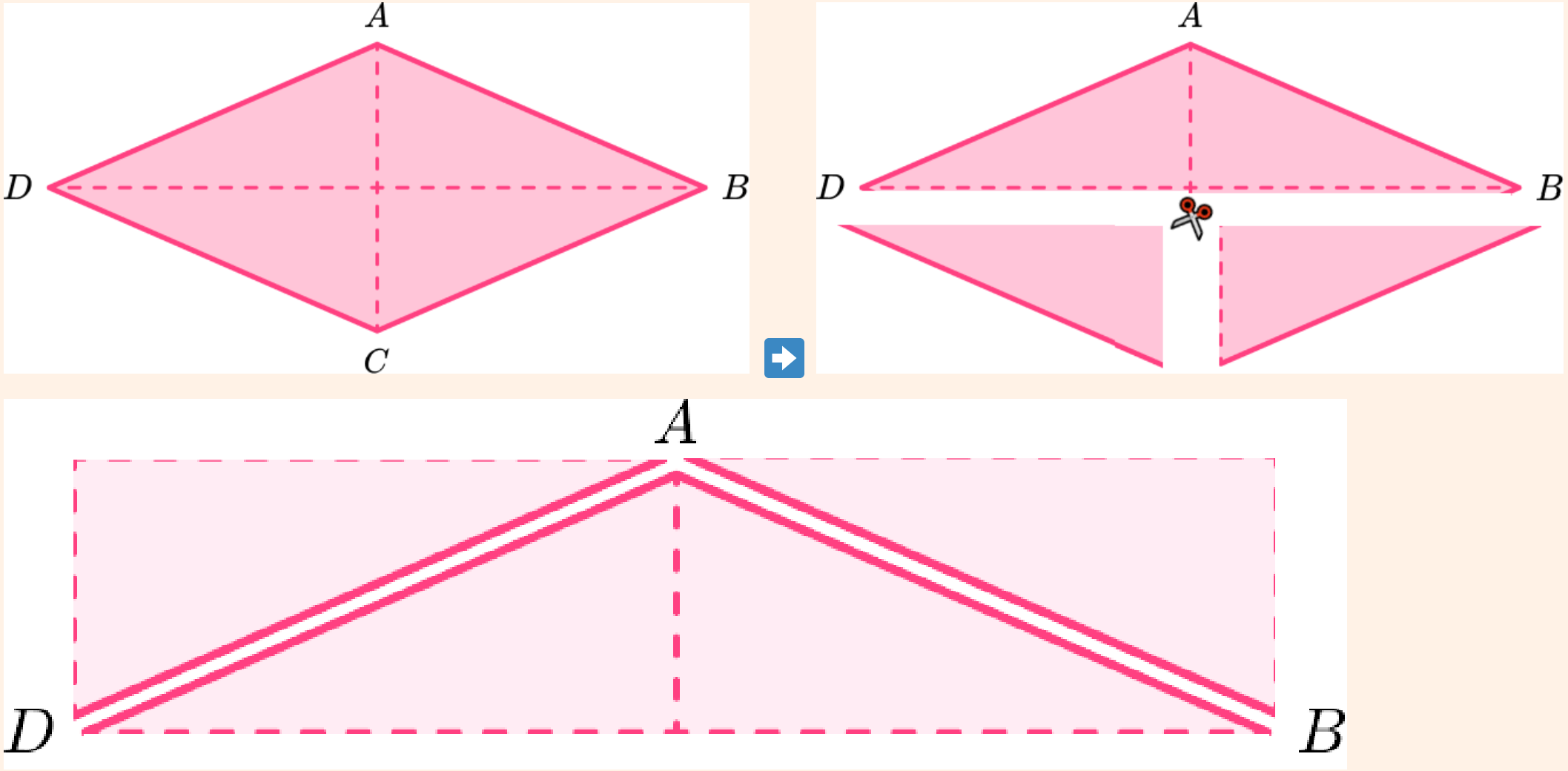
$$\text{Area} = \frac{x \times y}{2}$$

rhombus



How Are A Rhombus And Kite Similar?

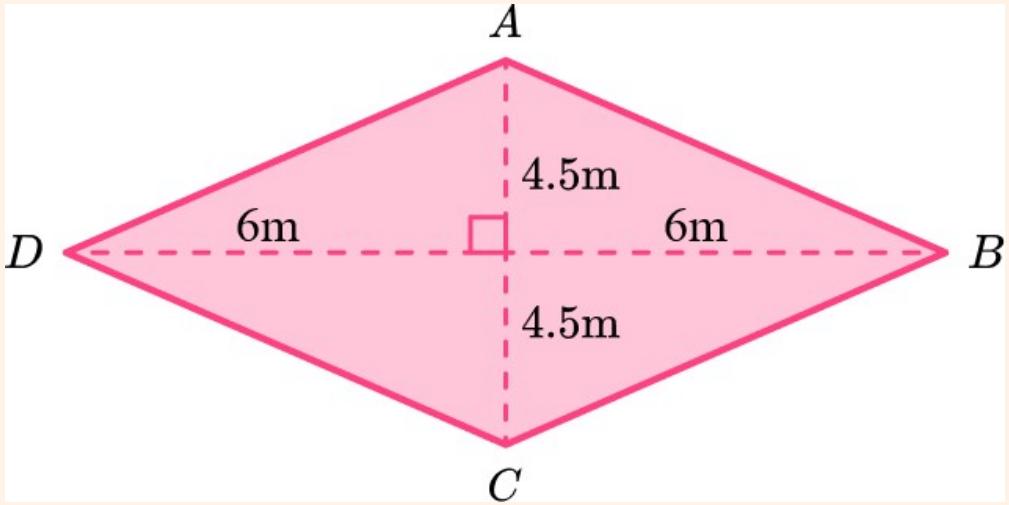
Rearranging: Area of a Rhombus



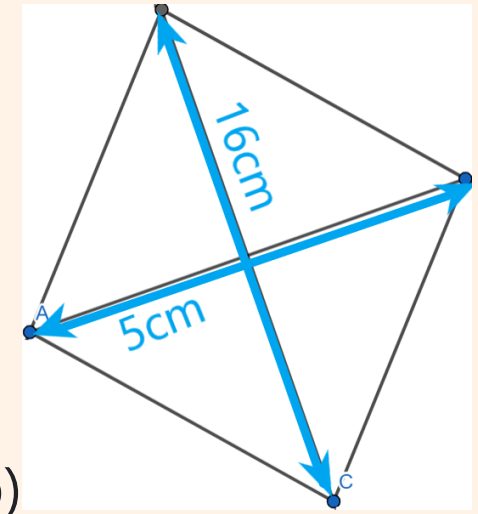
Secret Rectangle

Find the area

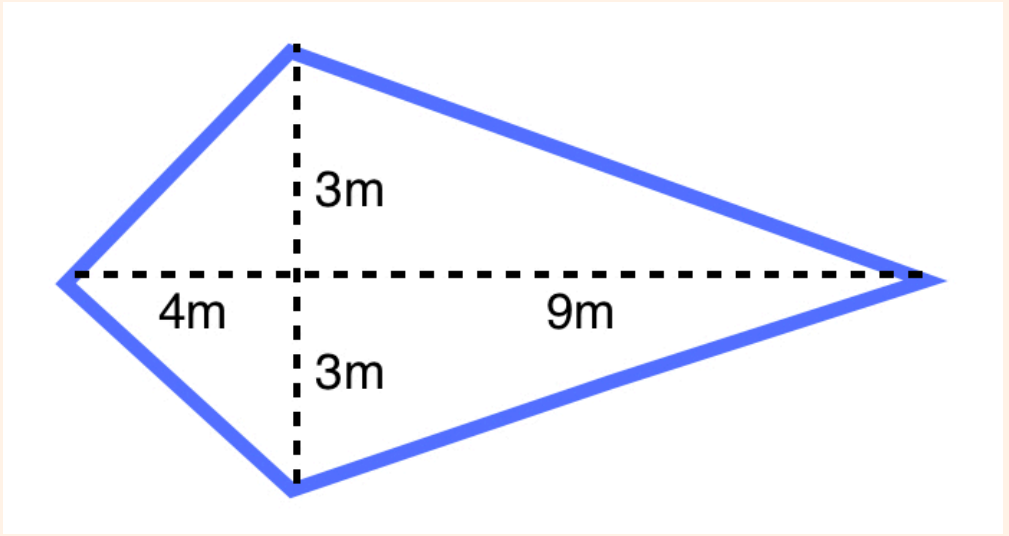
a)



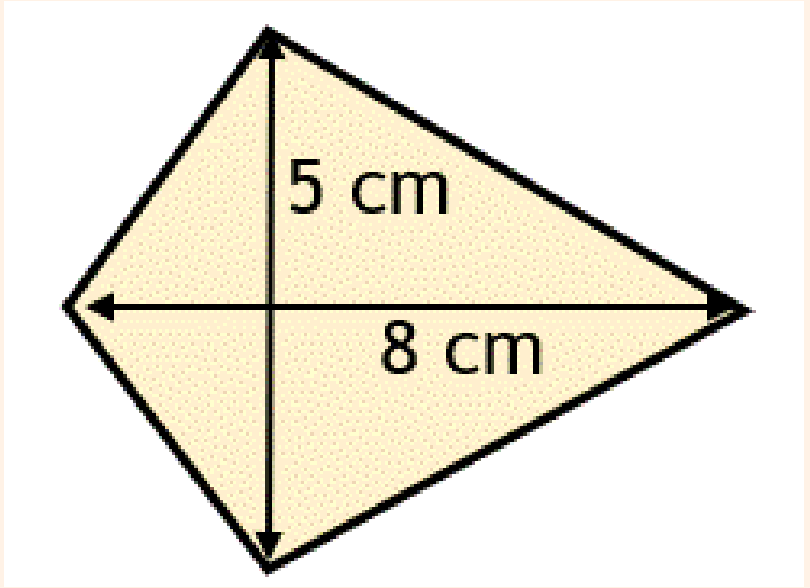
b)



c)



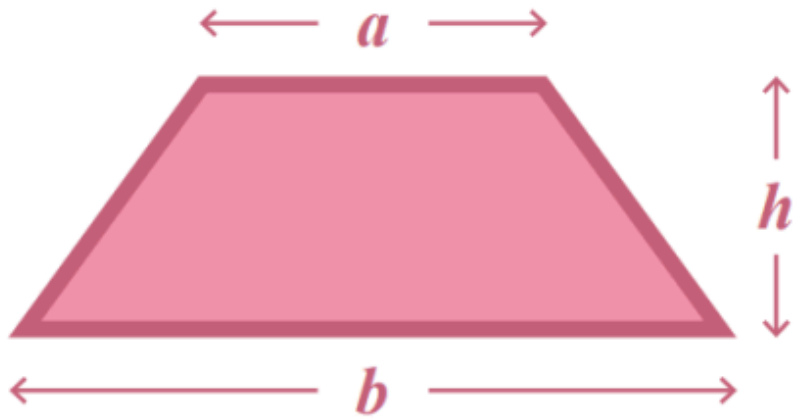
d)



Area of a Trapezium

Take notes on this

$$\frac{1}{2}(a + b) \times h \quad \text{or} \quad \frac{(a + b) \times h}{2}$$

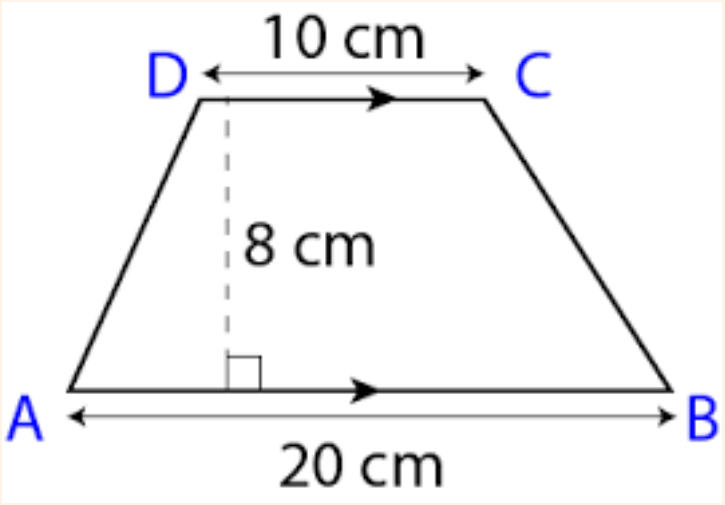


Visualize

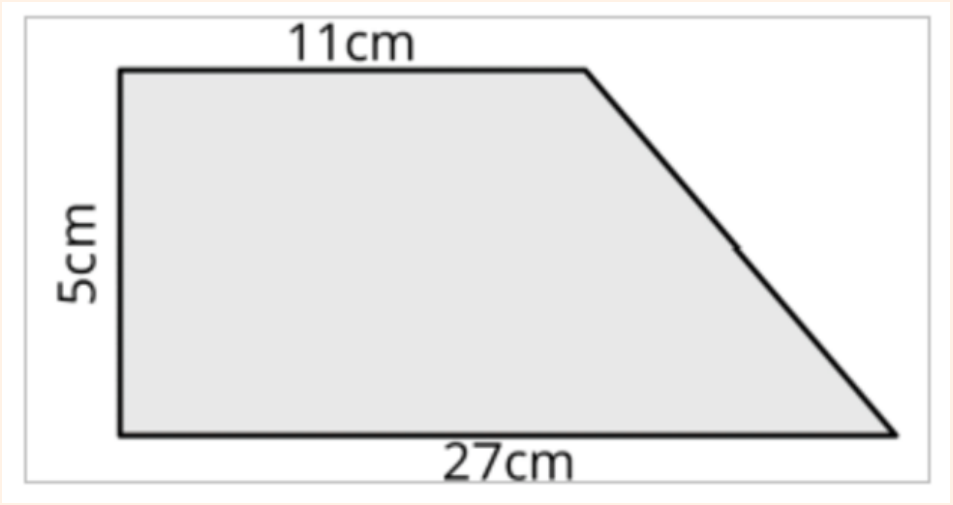
1. The trapezium is half of a parallelogram, whose area is base × height
2. The trapezium can be split into two triangles: one with the top as a base, one with the bottom as a base

Find the area

a)



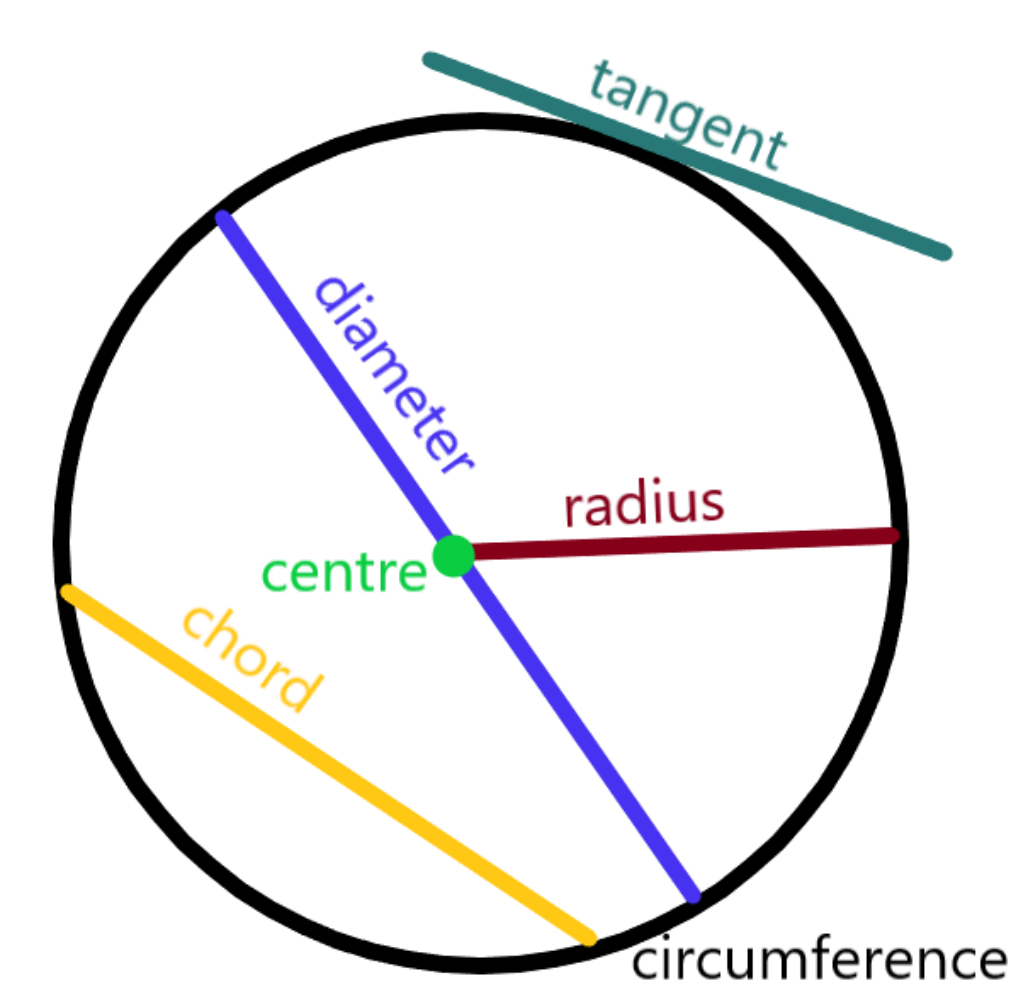
b)



- 5-07 Parts of a circle
- 5-08 Circumference of a circle

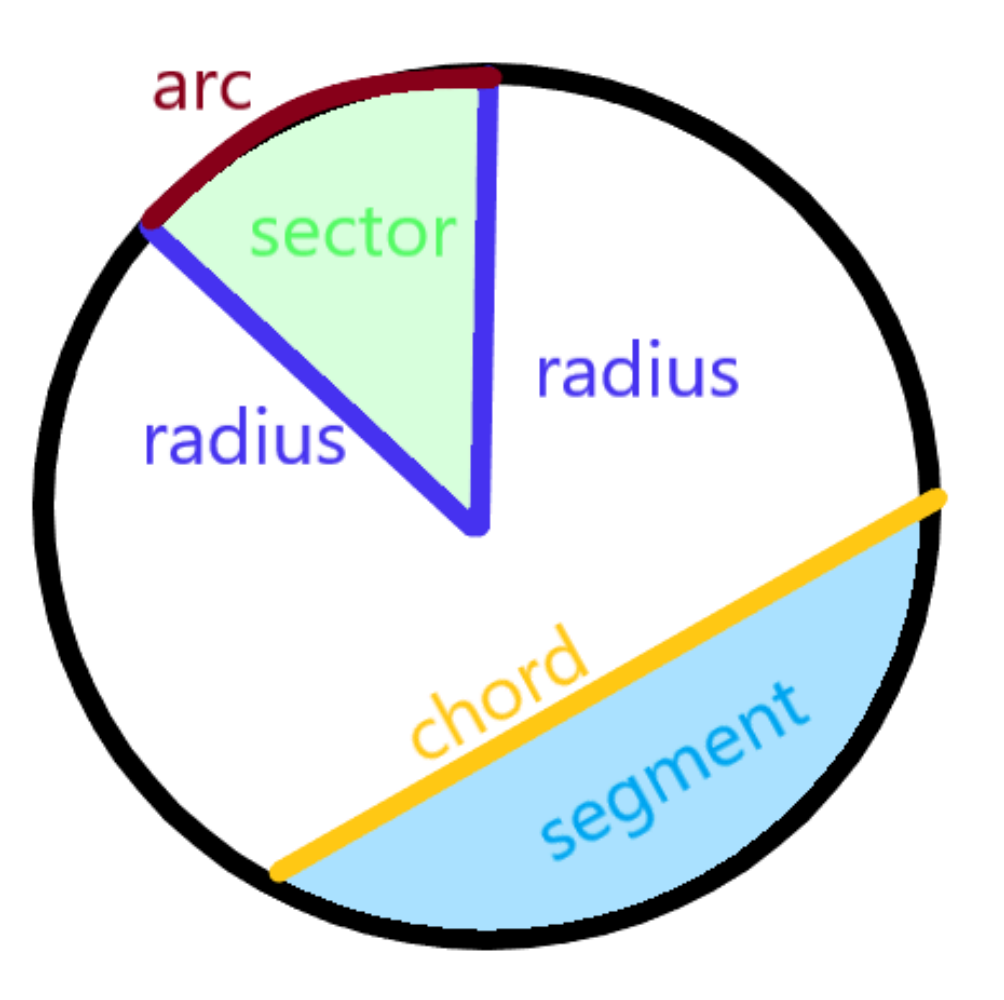
Parts of a circle: distances

Take notes on this



Parts of a circle: areas

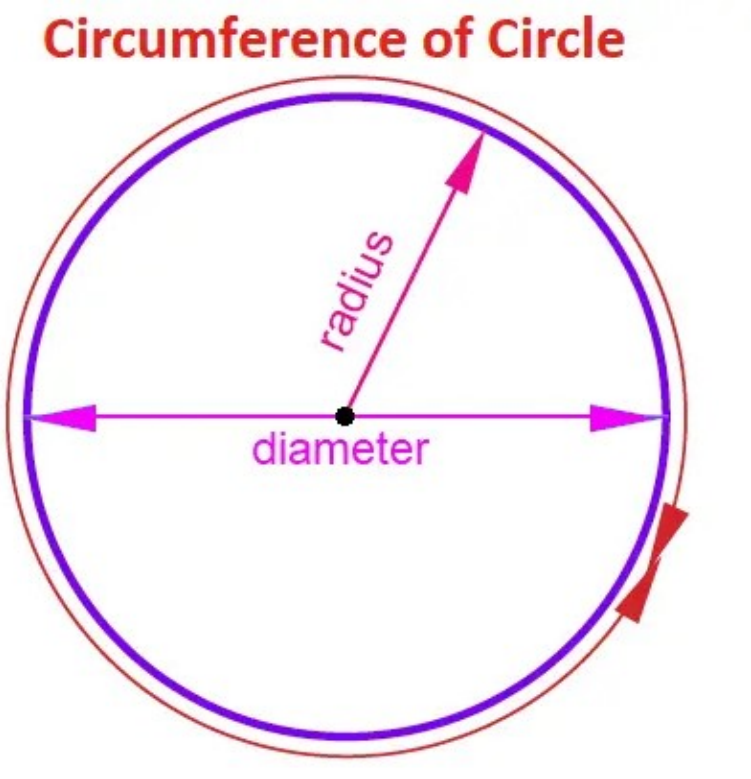
Take notes on this



Circumference: 🤔

How does the circumference change if the circle is bigger?

- What about the diameter and circumference? Do they change together?

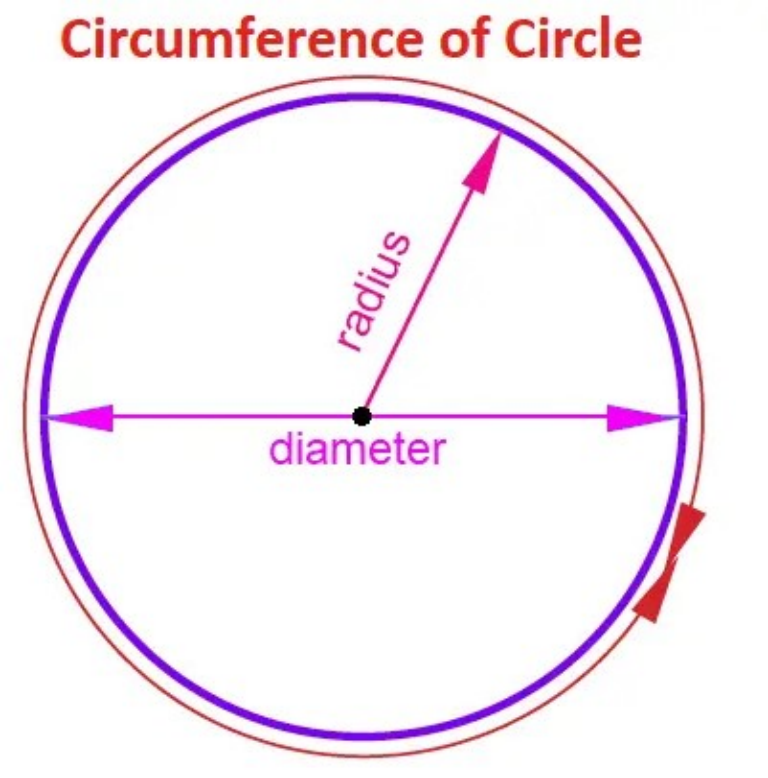


Introducing: Pi π

- This is an irrational number: goes on forever, but approximately 3.14
- Archimedes approximated pi by drawing 2 polygons with *96* sides: inside a circle and outside
- Universal constant: relationshp between diameter and circumference

π is on your calculator:

- Let's find it now
- in most calculators, it's on the *bottom* near the *right* of the numbers ⬇️



Circumference Formula

Take notes on this

$$\text{Circumference} = d \times \pi$$

$$\text{Circumference} = 2 \times \pi \times r$$

Where, d = diameter, r = radius

(remember we said earlier: diameter = $2\times$ radius)

and $\pi \approx 3.14$

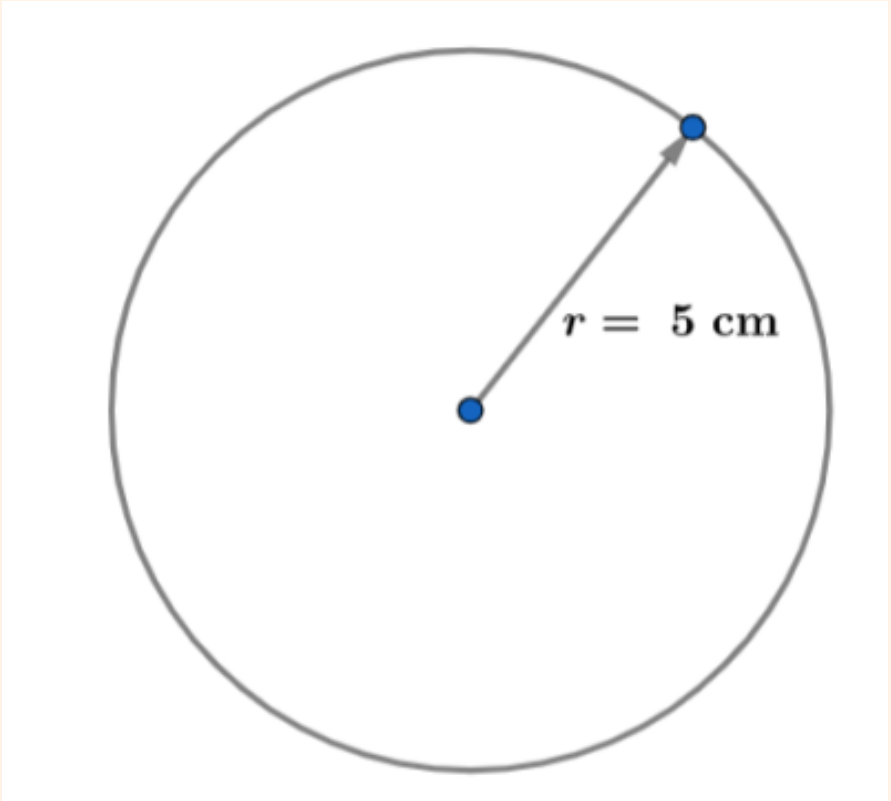
Examples

Find the circumference of the following circles

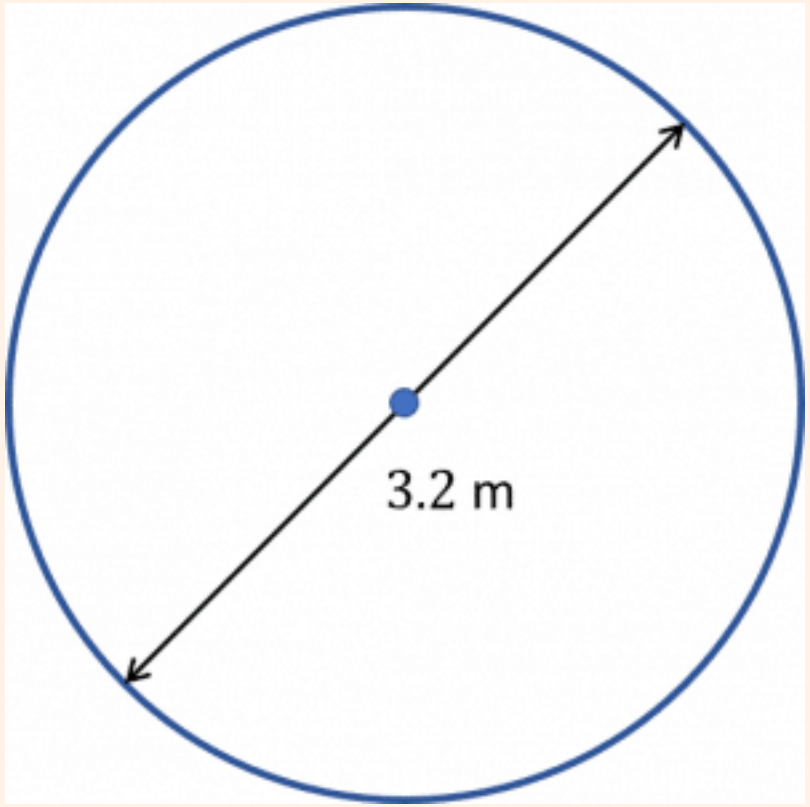
i. In exact form

ii. Rounded to two decimal places

a)



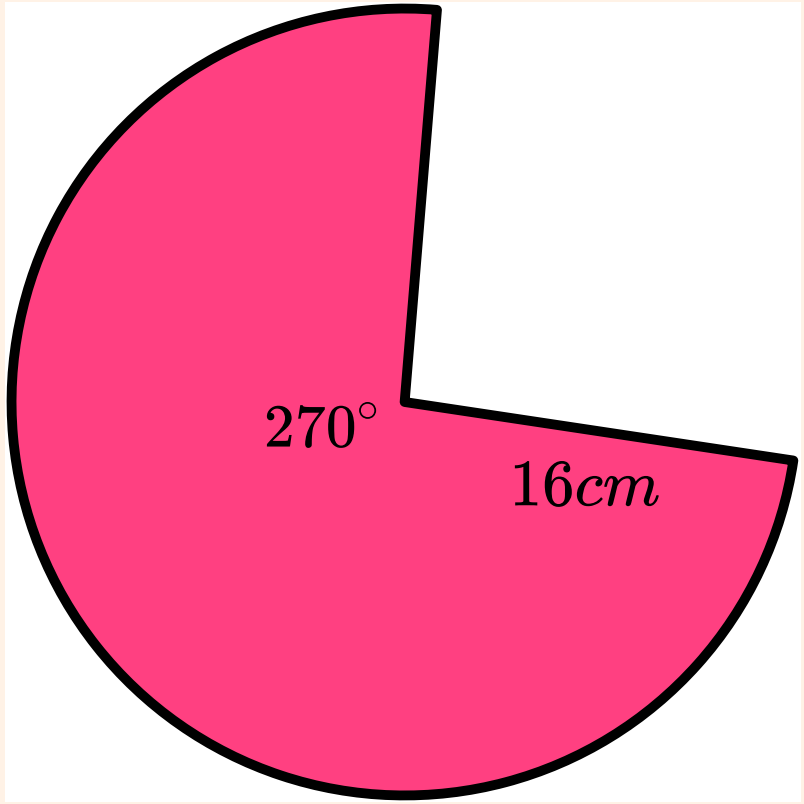
b)



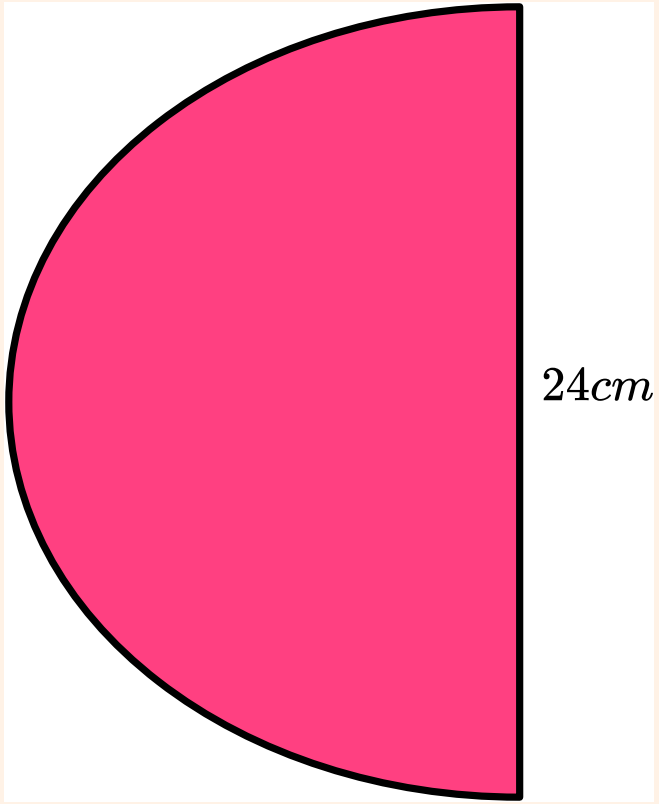
New Examples

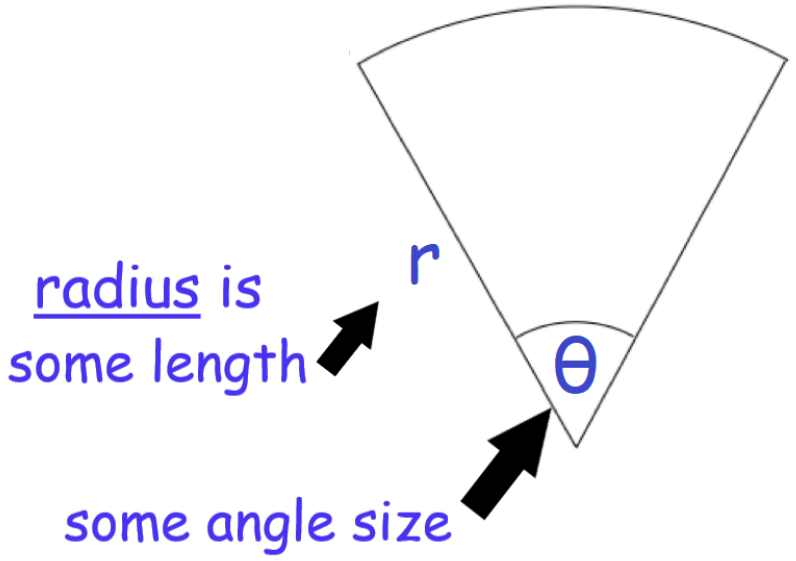
Find the perimeter of the following:

a)



b)





Perimeter of a Sector

Take notes on this

Remember: Circumference = $\pi \times 2 \times r$

Arc-length = $\frac{\theta}{360^\circ} \times \pi \times 2 \times r$

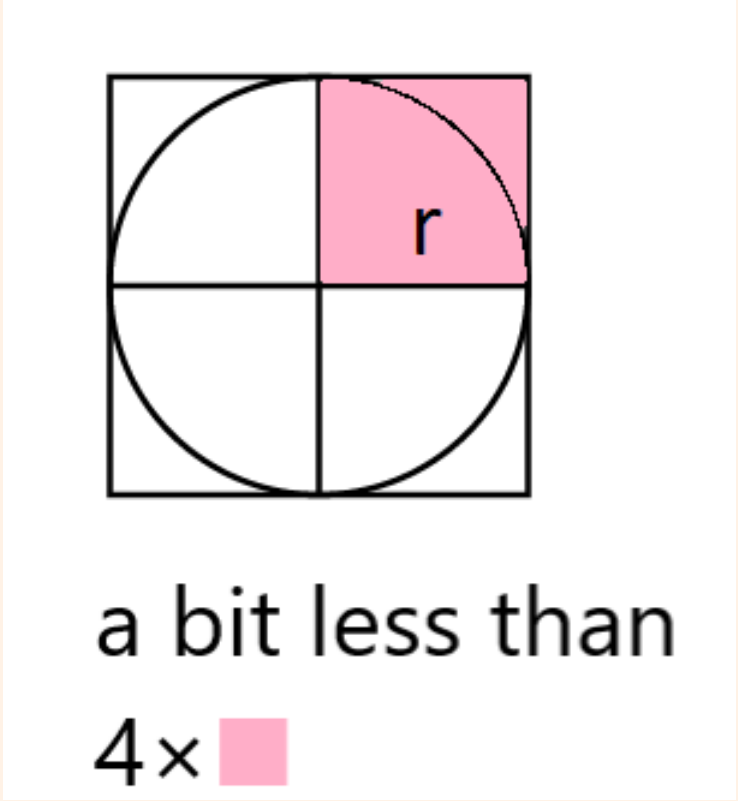
Perimeter = arc-length + $2 \times r$

where r is the radius and θ is the angle of the sector

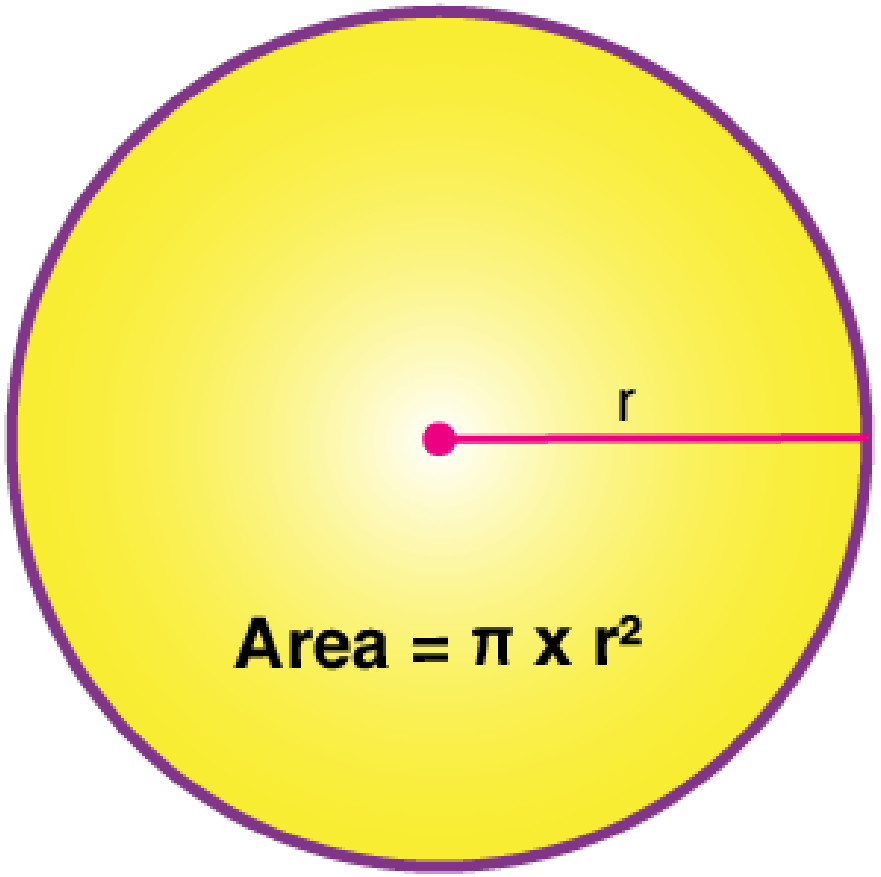
Note: θ is not 0: it is a Greek symbol that just looks similar

- 5-09 Area of a circle

Area of a Circle



And guess what, 3.14 is a bit less than 4 too!



Area of a Circle

Take notes on this

Area of circle = $\pi \times r^2$

where r is the radius and $\pi \approx 3.14$

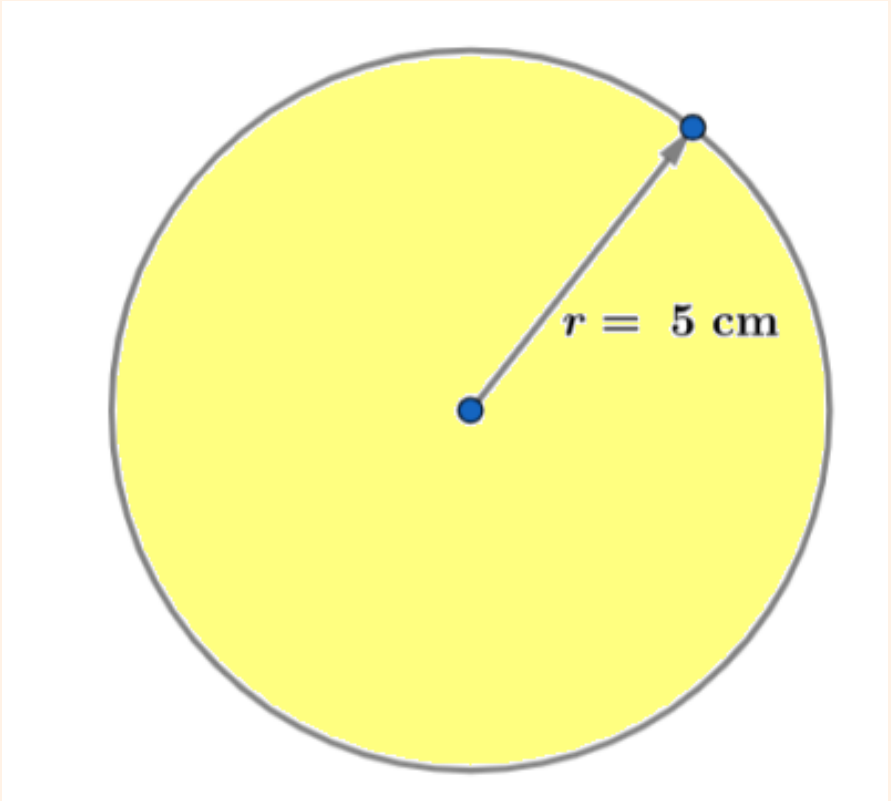
Examples

Q. Find the area of the following circles:

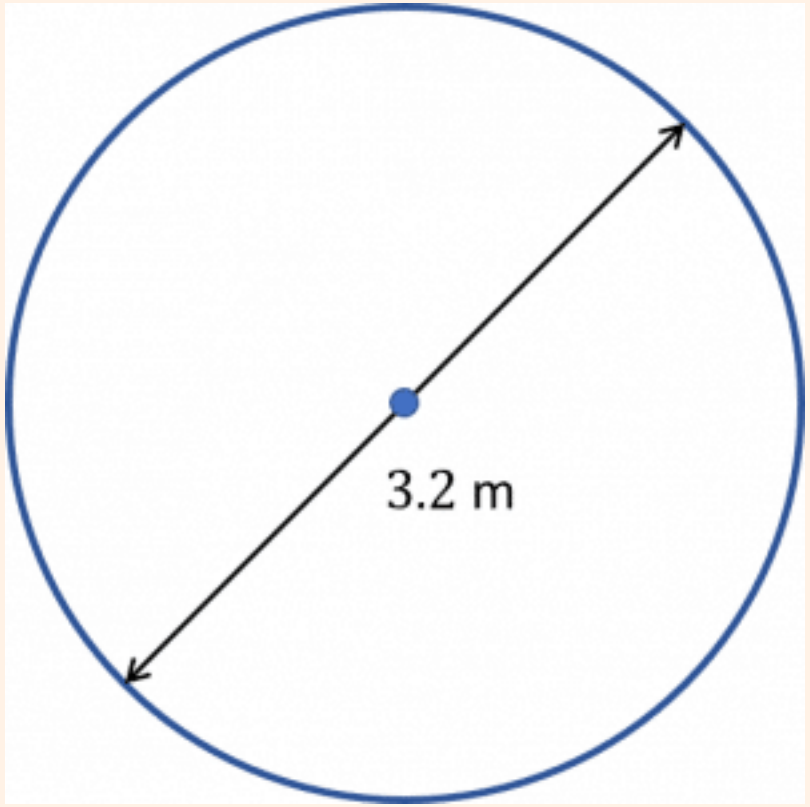
i. In terms of π (also called exact form)

ii. To three decimals places

a)

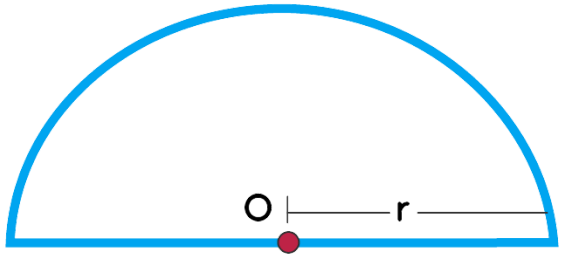


b)

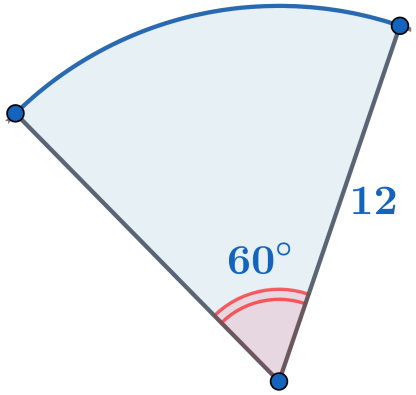


What if we have a fraction of a circle?

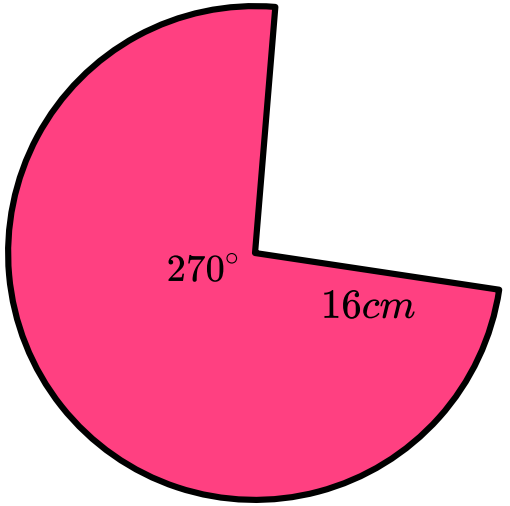
Half of a circle?

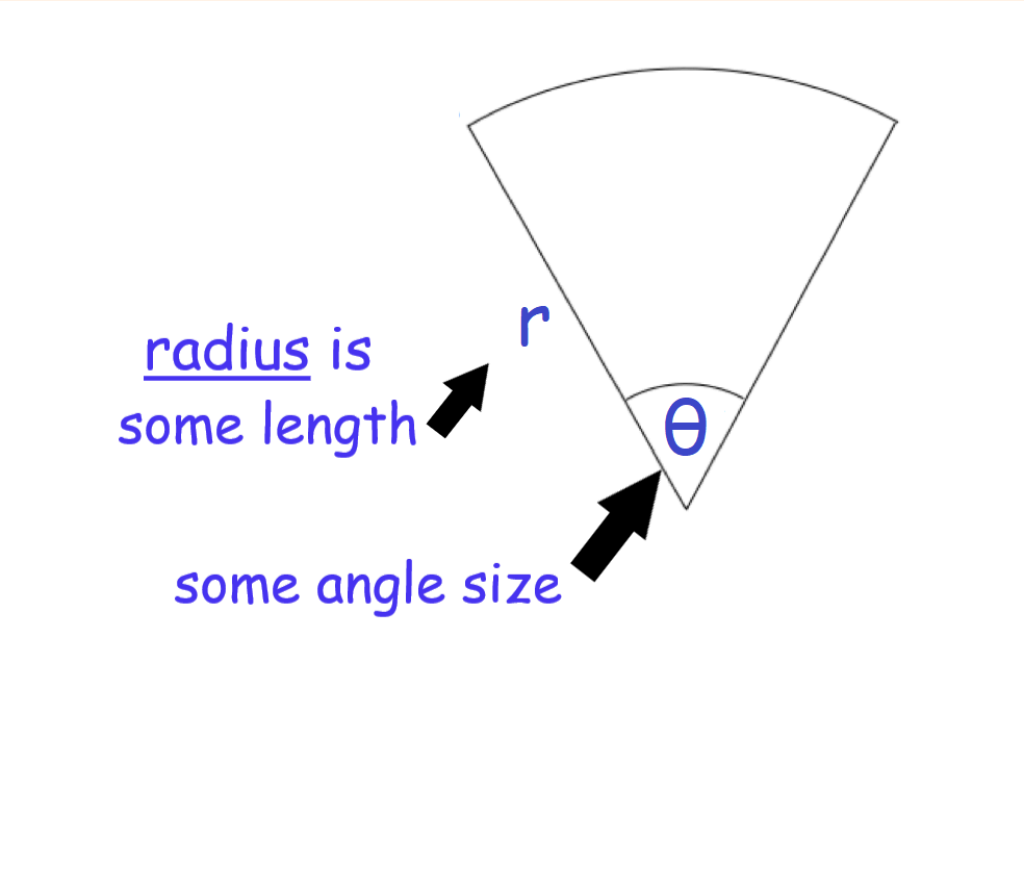


$\frac{1}{6}$ of a circle?



$\frac{3}{4}$ of a circle?





Area of a Sector

Take notes on this

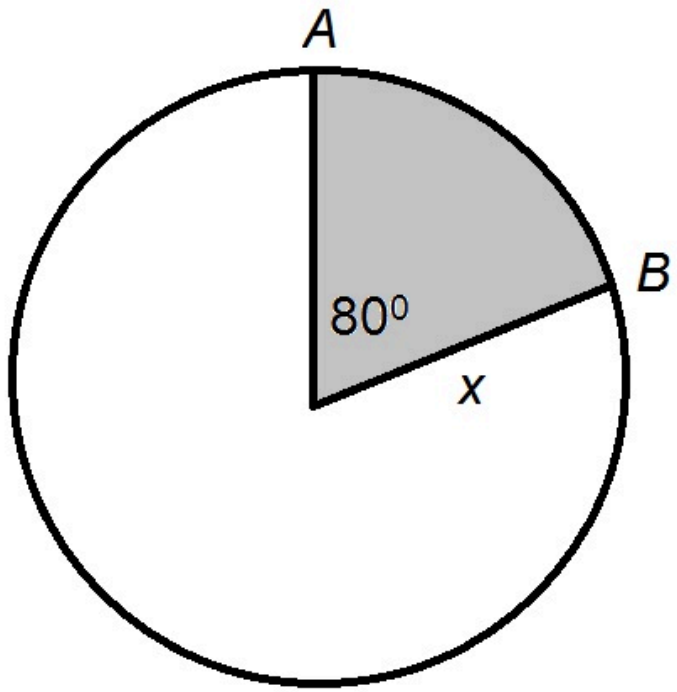
Area of a sector = $\frac{\theta}{360^\circ} \times \pi \times r^2$

where r is the radius and θ is the angle of the sector

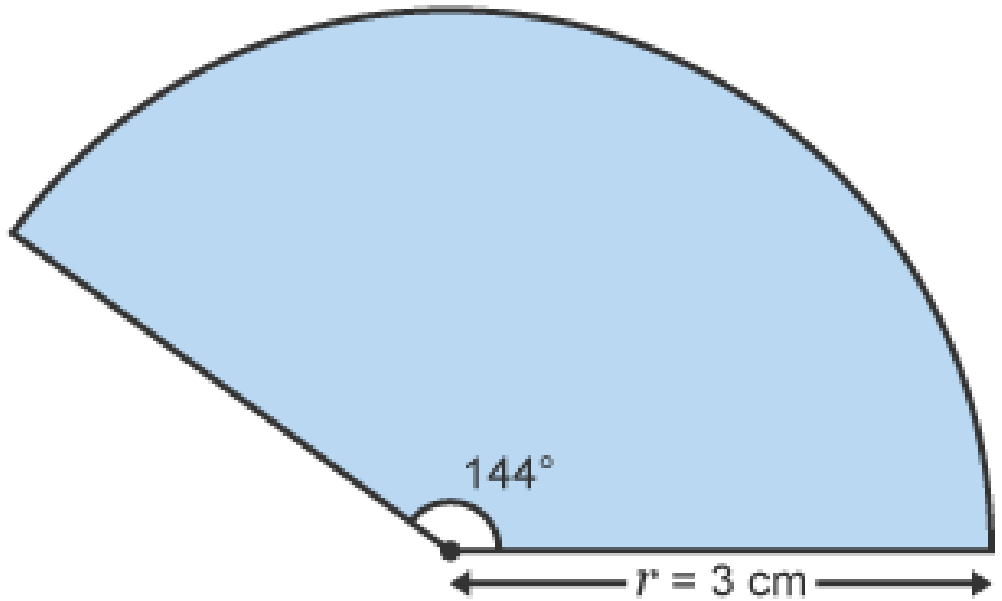
Examples

Q. Find the area of the following circles:

a. In terms of π (also called exact form)



b. To two decimals places

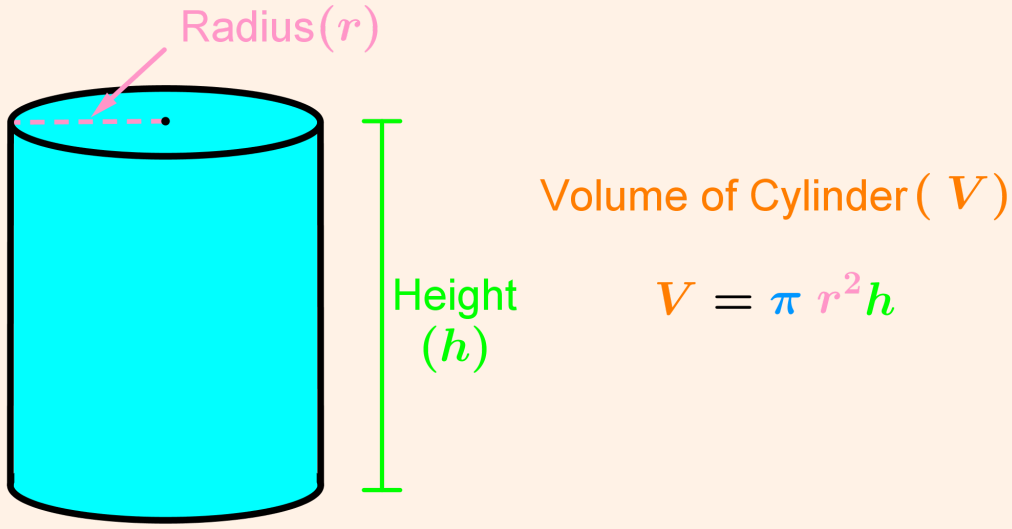


- 5-12 Volume of a cylinder

Cylinder

What is a cylinder?

- Like a circular 'prism': its cross-section is the same circle all the way through



Formula

Take notes on this

Cylinder Volume = $\pi \times\ r^2 \times h$

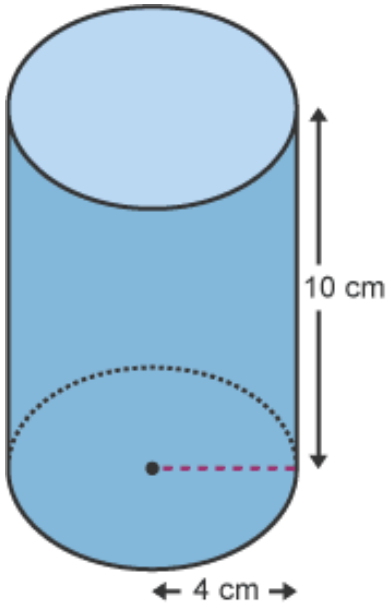
where *r* is the radius and *h* is the height

Examples

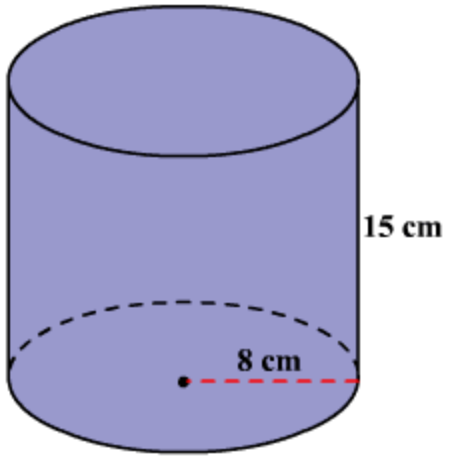
Find the volume of the following cylinders

i. in terms of π

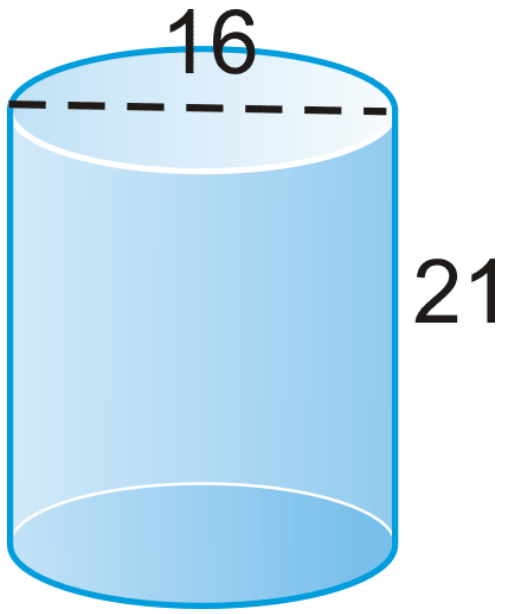
ii. Correct to 2 decimal places



a)



b)

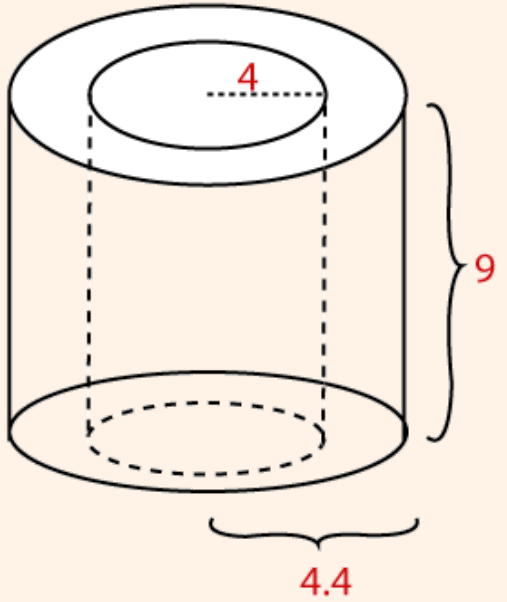


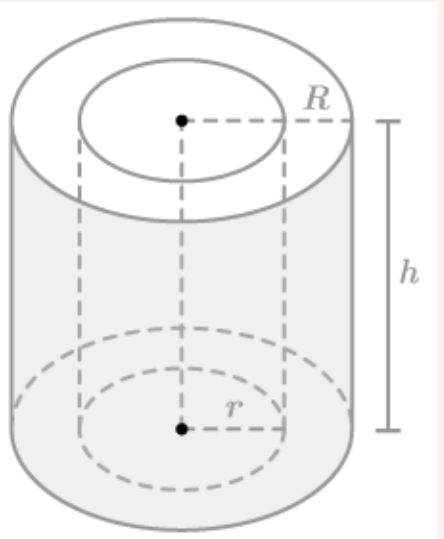
c)

A Challenge: Hollow Cylinders

Find the volume of the cylinder to the right.

- What's an example of a hollow cylinder in real life?





Formula

- Volume = $\pi \times h \times (R^2 - r^2)$
  where R is the outside radius, r is the inside radius and h is the height

- 5-11 Volume of a prism

Volume of Prisms

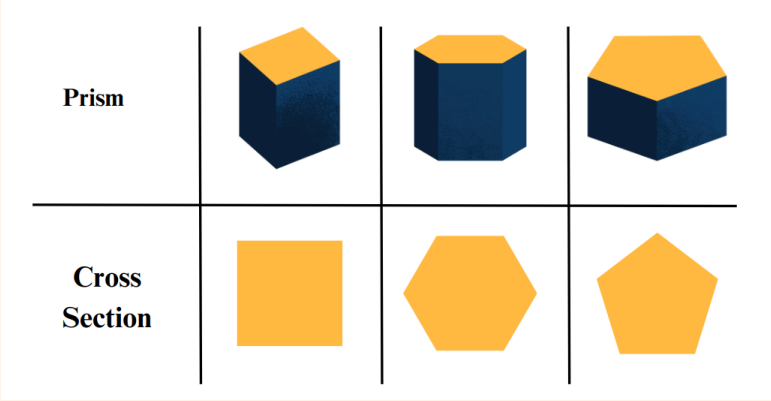
What is a prism?

- 3d shape: solid
- cross-section is a **polygon**
  - cross-section: what you get when you slice a shape like bread

Take notes on this

Prism: a solid with a **uniform polygonal cross-section**

Examples



Prisms in real life

Prisms are named after their cross-section, e.g. triangular, pentagonal

What kind of prisms are these?


- Triangular


- 🤔: What's another name for a square prism? For a rectangular prism?

- 5-13 Volume and capacity

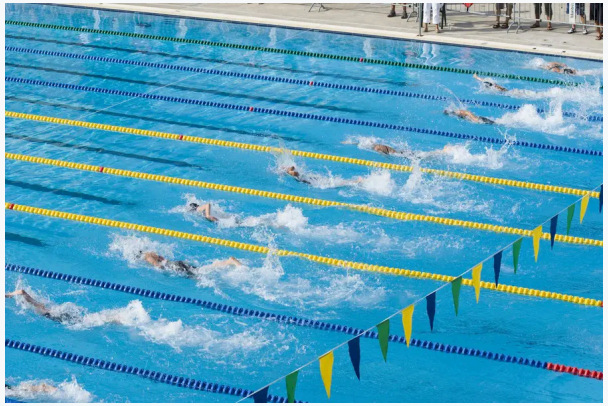
Capacity

What is capacity? What does it mean for a bottle to have more capacity?

Take notes on this

- **Capacity**: the amount of fluid a container can hold
  - usually measured in litres or millilitres
  - also measured in kilolitres and megalitres

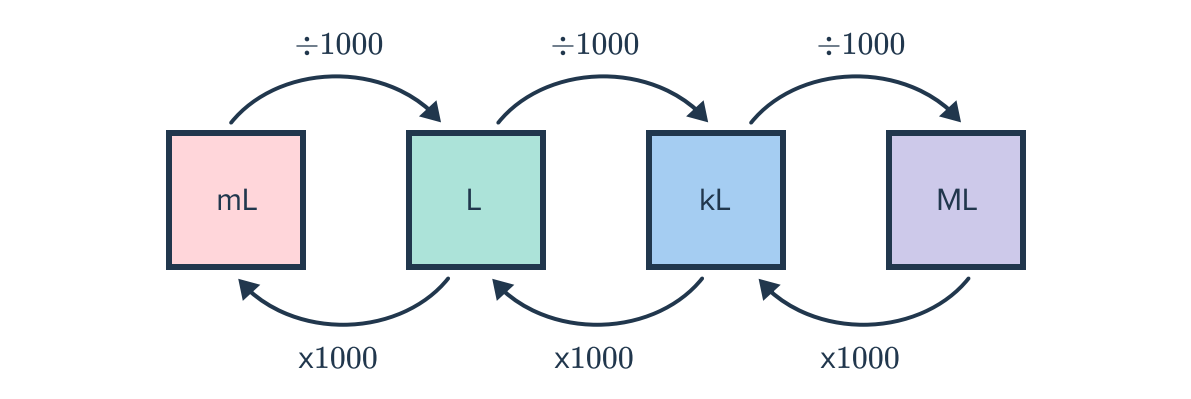
Real-life Examples of Capacity

millLitre	Litre	kiloLitre	MegaLitre
1ml = an eyedropper	Milk comes in 1 Litre	4 full bathtubs = 1 kiloLitre	An Olympic swimming pool = 2.5 MegaLitres
			

- What's the capacity of your water bottles?

Converting between units

Take notes on this



Remember: a millilitre is smaller than a litre, so a big number of millilitres will be a small number of litres, not the other way around

1 L = 1000 mL

1 kL = 1000 L

1 ML = 1000 kL

= 1,000,000 L (1 million litres!)

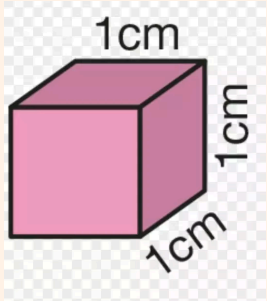
Converting to Capacity from Volume

We can also convert from volume to capacity

1 mL = 1 cm^3

1L = 1000 cm^3

1 kL = 1 m^3



Examples

Convert:

a) 6.7 L to mL

b) 55,000 cm^3 to L

c) 46000 L to kL

d) 1500 L to m^3