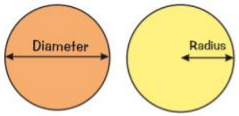
Knowledge Organiser: Year 9 Maths; Circles (Part 1)

Circles

There's a surprising number of circle terms you need to know — don't mix them up. Oh, and it's probably best to have a snack before starting this page. All the talk of pi can make you a bit peckish.

Radius and Diameter



The DIAMETER goes right across the circle, passing through the centre.
The RADIUS goes from the centre of the circle to any point on the edge.

The DIAMETER IS EXACTLY DOUBLE THE RADIUS

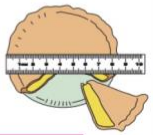
So if the radius is 4 cm, the diameter is 8 cm,
and if the diameter is 24 m, the radius is 12 m.

Area, Circumference and π

There are two more important formulas for you to learn — circumference and area of a circle.
The circumference is the distance round the outside of the circle (its perimeter).

1) CIRCUMFERENCE $= \pi \times$ diameter
$= \pi \times$ radius $\times 2$

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



2) AREA $= \pi \times (\text{radius})^2$

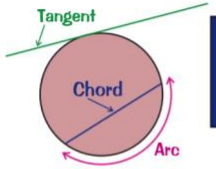
$A = \pi \times r^2$

$\pi = 3.141592.... = 3.142$ (approx)

The big thing to remember is that π (called "pi") is just an ordinary number (3.14159...) which is often rounded off to 3.142. You can just use the π button on your calculator (which is way more accurate).

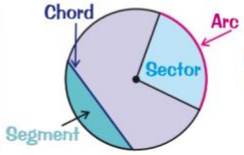
So a circle with radius 6 cm has a circumference of $2 \times \pi \times r = 2 \times \pi \times 6 =$ 37.7 cm (1 d.p.) and an area of $\pi \times r^2 = \pi \times 6^2 =$ 113.1 cm^2 (1 d.p.).

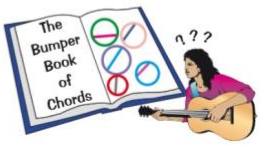
Tangents, Chords, Arcs, Sectors and Segments



A TANGENT is a straight line that just touches the outside of a circle.
A CHORD is a line drawn across the inside of a circle.
AN ARC is just part of the circumference of a circle.

A SECTOR is a wedge-shaped area (like a slice of cake) cut right from the centre.
SEGMENTS are the areas you get when you cut a circle with a chord.

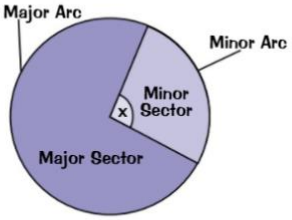




Arc Lengths and Areas of Sectors

GRADE 5

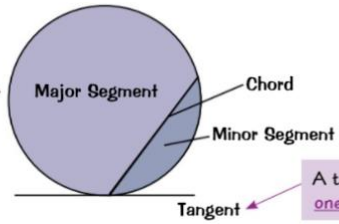
These next ones are a bit more tricky — before you try and learn the formulas, make sure you know what a sector and an arc are (I've helpfully labelled the diagram below — I'm nice like that).



Area of Sector $= \frac{x}{360} \times$ Area of full Circle

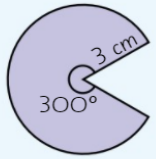
Length of Arc $= \frac{x}{360} \times$ Circumference of full Circle

You also need to know what a segment, a chord and a tangent are.



A tangent just touches one point of the circle.

EXAMPLE: In the diagram on the right, a sector with angle 60° has been cut out of a circle with radius 3 cm. Find the exact area of the shaded shape.



Use the formula to find the area of the shaded sector:

area of sector $= \frac{x}{360} \times \pi r^2 = \frac{300}{360} \times \pi \times 3^2$

$= \frac{5}{6} \times \pi \times 9 = \frac{15}{2}\pi$ cm^2

'Exact area' means leave your answer in terms of π.

3D Shapes — Volume

Another page on volumes now — my generosity knows no limits.

Volumes of Spheres

GRADE 5

VOLUME OF SPHERE $= \frac{4}{3}\pi r^3$

A hemisphere is half a sphere. So the volume of a hemisphere is just half the volume of a full sphere, $V = \frac{2}{3}\pi r^3$.

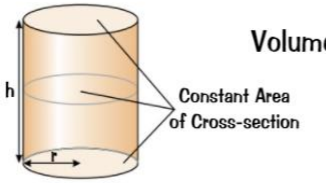
Knowledge Organiser: Year 9 Maths; Circles (Part 2)

Volumes of Prisms

GRADE 3

A PRISM is a solid (3D) object which is the same shape all the way through — i.e. it has a CONSTANT AREA OF CROSS-SECTION.

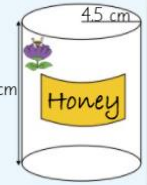
Cylinder
(circular prism)



Volume of Cylinder = area of circle × height

$V = \pi r^2 h$

EXAMPLE: Honey comes in cylindrical jars with radius 4.5 cm and height 12 cm.
Dan has a recipe that needs 1 litre of honey. How many jars should he buy?



First, work out the volume of the jar — just use the formula above:

$V = \pi r^2 h = \pi \times 4.5^2 \times 12 = 763.4070\ldots\ cm^3$

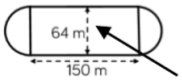
1 litre = 1000 cm^3 (see p.66), so he needs to buy 2 jars of honey.

Compound shapes including circles

Circumference
π x diameter

← Compound shapes are not always area questions. For Perimeter you will need to use the circumference

Spotting diameters and radii



This dimension is also the diameter of the semi circles

Arc lengths = π x 64
= 64 π

Don't need to halve this because there are 2 ends which make the whole circle

Arc lengths + Straight lengths = total perimeter

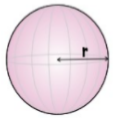
= 64 π + 150 + 150
= (300 + 64 π) m
OR = 501.1 m

Still remember to split up the compound shape into smaller more manageable individual shapes first

Surface Area Formulas

GRADE 5

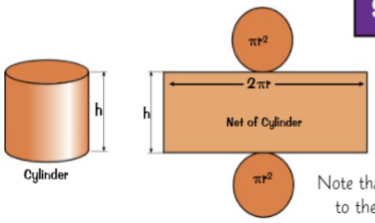
1) SPHERES, CONES AND CYLINDERS have surface area formulas that you need to be able to use.
2) Luckily you don't need to memorise the sphere and cone formulas — you'll be given them in your exam.
3) But you must get lots of practice using them, or you might slip up when it comes to the exam.



Surface area of a SPHERE = $4\pi r^2$

curved area of cone (*l* is the slant height) + area of circular base

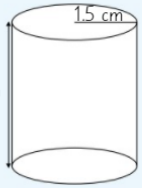
Surface area of a CONE = $\pi rl + \pi r^2$



Surface area of a CYLINDER = $2\pi rh + 2\pi r^2$

Note that the length of the rectangle is equal to the circumference of the circular ends.

EXAMPLE: Find the surface area of the cylinder on the right to 1 d.p.

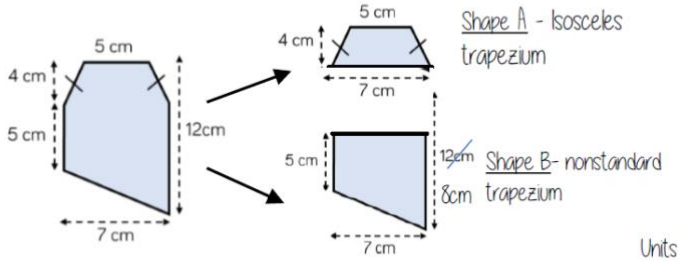


Just put the measurements into the formula and work it out very carefully in stages:

Surface area of cylinder = $2\pi rh + 2\pi r^2$
$= (2 \times \pi \times 1.5 \times 5) + (2 \times \pi \times 1.5^2)$
$= 47.123\ldots + 14.137\ldots = 61.261\ldots = 61.3\ cm^2$

Compound shapes

To find the area compound shapes often need splitting into more manageable shapes first. Identify the shapes and missing sides etc. first.



Shape A + Shape B = total area

$\frac{(5+7) \times 4}{2} + \frac{(5+8) \times 7}{2} = 24 + 45.5 = 69.5 cm^2$

Units

How do we use Knowledge Organisers in Mathematics?

How can you use knowledge organisers at home to help us?

- **Retrieval Practice:** Read over a section of the knowledge organiser, cover it up and then write down everything you can remember. Repeat until you remember everything.
- **Flash Cards:** Using the Knowledge Organisers to help on one side of a piece of paper write a question, on the other side write an answer. Ask someone to test you by asking a question and seeing if you know the answer.
- **Mind Maps:** Turn the information from the knowledge organiser into a mind map. Then reread the mind map and on a piece of paper half the size try and recreate the key phrases of the mind map from memory.
- **Sketch it:** Draw an image to represent each fact; this can be done in isolation or as part of the mind map/flash card.
- **Teach it:** Teach someone the information on your knowledge organiser, let them ask you questions and see if you know the answers.

How will we use knowledge organisers in Mathematics?

Knowledge organisers will be used before I complete a Learning Check or Common Assessment. I will spend part of the lesson looking over each of the key topics of the half term before completing the Learning Check or Common Assessment.
I will also use these at home to complete my own independent learning and revision of these key topics.

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