Calculate exactly with multiples of π

You need to be able to calculate the area and circumference of circles, as well as compound shapes containing parts of circles, without using a calculator, leaving your answer 'π'.

In algebra, we can collect like terms. For example:

$$3a + 5a = 8a$$
$$3 \times 5a = 15a$$

We can do the same with π. For example:

$$2\pi + 6\pi = 8\pi$$
$$4 \times 3\pi = 12\pi$$

Check that you are able to:

- *identify the radius and diameter of a circle*
- *state the formulae for the area and circumference of circles*
- *state other area formulae*
- *simplify basic algebraic expressions*
- *break down compound shapes into smaller geometric shapes.*

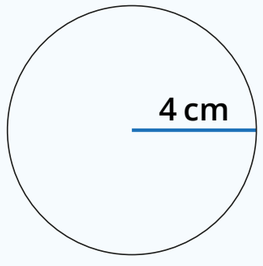
You need to remember the formulae to work out the area and the circumference of a circle:

Area of a circle, $A = \pi r^2$ Circumference of a circle, $C = \pi d$

If we leave our answers '**in terms of π**', the answer is not rounded. This means that it is a more accurate (or exact) way to give an answer.

Find the area and circumference of the following circles:

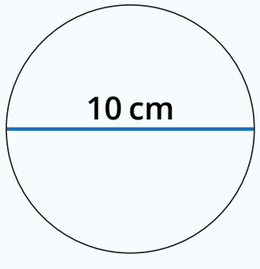
Example 1



Area $= \pi r^2$
$= \pi \times 4^2$
$= 16\pi$ cm^2

Circumference $= 2\pi r$
$= 2 \times \pi \times 4$
$= 8\pi$ cm

Example 2



The diameter is 10 cm, so the radius is 5 cm.

Area $= \pi r^2$
$= \pi \times 5^2$
$= 25\pi$ cm^2

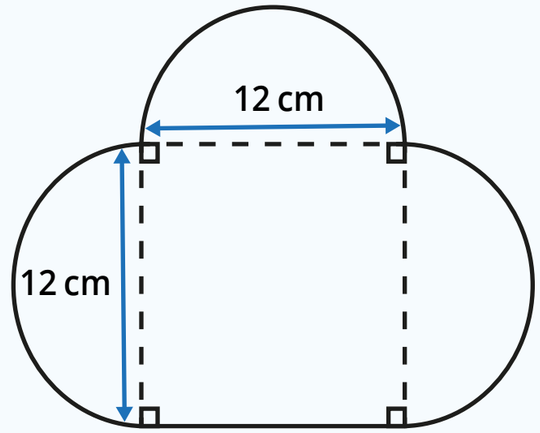
Circumference $= 2\pi r$
$= 2 \times \pi \times 5$
$= 10\pi$ cm

We can use the same approach with calculations on compound shapes.

Step 1: Break down the compound shape into simpler geometric shapes (including circles and parts of circles).

Step 2: Calculate, leaving your answer '**in terms of π**'.

Example: Calculate the area and perimeter of the following compound shape.



The shape is made from 3 semicircles and a square.

Area of circle $= \pi r^2$
$= \pi \times 6^2$
$= 36\pi$ cm^2

Circumference of circle, $C = 2\pi r = \pi d$
$= \pi \times 12$
$= 12\pi$ cm

Area of semicircle $= 18\pi$ cm^2

Area of square $= 12 \times 12$
$= 144$ cm^2

Circumference of semicircle $= 6\pi$ cm

Perimeter of shape
$= 6\pi + 6\pi + 6\pi + 12$
$= 18\pi + 12$ cm

Total area
$= 18\pi + 18\pi + 18\pi + 144$
$= 54\pi + 144$ cm^2

REMEMBER!

Giving an answer in terms of π is a more accurate (or exact) way to give an answer to a circle calculation.