

Section 1: Shape, geometrical constructions, circle theorem

Solutions to Exercise

1. Diameter = 12 cm so radius = 6 cm.

$$\begin{aligned}
 \text{Circumference} &= 2\pi r \\
 &= 2\pi \times 6 \\
 &= 37.7 \text{ cm (3 s.f.)}
 \end{aligned}$$

$$\begin{aligned}
 \text{Area} &= \pi r^2 \\
 &= \pi \times 6^2 \\
 &= 113 \text{ cm}^2 \text{ (3 s.f.)}
 \end{aligned}$$

2. (i) Volume = $\pi r^2 h$
- $$\begin{aligned}
 &= \pi \times 5^2 \times 8 \\
 &= 628 \text{ cm}^3 \text{ (3 s.f.)}
 \end{aligned}$$

(ii) Area of each circular end = $\pi 5^2$

$$\begin{aligned}
 &= \pi \times 5^2 \\
 &= 25\pi
 \end{aligned}$$

When curved surface is opened out, it forms a rectangle whose length is the same as the circumference of the circular end.

$$\begin{aligned}
 &= 2\pi r \\
 &= 2\pi \times 5
 \end{aligned}$$

Length of rectangle = 10π

Height of rectangle = 8 cm

Area of rectangle = $10\pi \times 8$

$$= 80\pi$$

Total surface area = $80\pi + 2 \times 25\pi$

$$= 130\pi$$

$$= 408 \text{ cm}^2 \text{ (3 s.f.)}$$

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3. Using Pythagoras' theorem:

$$a^2 + 10^2 = 26^2$$

$$a^2 + 100 = 676$$

$$a^2 = 576$$

$$a = 24$$

$$\begin{aligned}\text{Perimeter of triangle} &= 10 + 26 + 24 \\ &= 60 \text{ cm}\end{aligned}$$

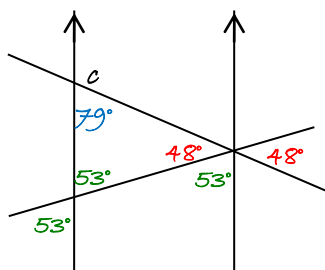
$$\begin{aligned}\text{Area of triangle} &= \frac{1}{2} \times \text{base} \times \text{height} \\ &= \frac{1}{2} \times 24 \times 10 \\ &= 120 \text{ cm}^2\end{aligned}$$

Notice that this is a
Pythagorean triple:
10, 24, 26 is a multiple of

4. A nonagon can be divided into 7 triangles, so the sum of the internal angles is $7 \times 180^\circ = 1260^\circ$.

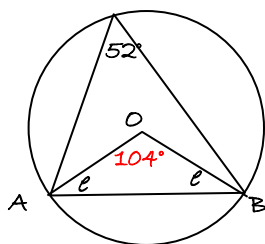
$$\text{Each interior angle is } \frac{1260}{9} = 140^\circ.$$

5. (i) Angle a is vertically opposite to 48° , so $a = 48^\circ$.
Angle b corresponds to the 53° angle, so $b = 53^\circ$.
The vertically opposite angle to 53° is also 53° , so the third angle in the triangle can now be found to be $180^\circ - 53^\circ - 48^\circ = 79^\circ$.



$$\text{So angle } c = 180^\circ - 79^\circ = 101^\circ.$$

- (ii) The angle at the centre is twice the angle at the circumference,
so $d = 2 \times 52^\circ = 104^\circ$.
 OA and OB are both radii, so triangle OAB is isosceles and therefore the angles at A and B are equal. So angle $e = \frac{1}{2}(180^\circ - 104^\circ) = \frac{1}{2} \times 76 = 38^\circ$



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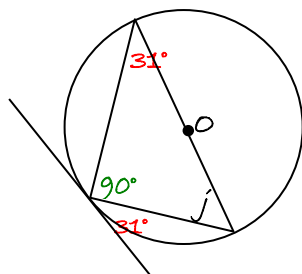
(iii) Opposite angles in a cyclic quadrilateral add up to 180°

$$\text{so } f = 180^\circ - 116^\circ = 64^\circ$$

$$\text{and } g = 180^\circ - 83^\circ = 97^\circ.$$

(iv) The angle in a semicircle is a right angle, so $h = 90^\circ$.

using the alternate segment theorem, $i = 31^\circ$.



using angles in a triangle, $j = 180^\circ - 90^\circ - 31^\circ = 59^\circ$.

6. The semicircle with radius AC has area $\frac{\pi \times 3^2}{2} = 4.5\pi$.

This semicircle has a smaller semicircle (diameter AC) added on to it.

It has another smaller semicircle (diameter BC) taken out of it.

These two semicircles are the same size so the area of the shape is 4.5π .

7. Quadrilateral ABCD is a cyclic quadrilateral so $\angle ADC + \angle ABC = 180^\circ$.

ABCD is a kite so $\angle ADC = \angle ABC$.

Therefore $\angle ADC = \angle ABC = 90^\circ$.

This means that each of $\angle ADC$ and $\angle ABC$ is the angle in a semicircle so AC is a diameter.