



1 The surface area of a sphere is $4\pi r^2$.

- Work out the surface area of a sphere with radius 5 cm. Give your answer in terms of π .
- Work out the surface area of a sphere with diameter 14 cm. Give your answer correct to 3 significant figures.

(3 marks)

a)

$$4\pi \times 5^2 = 4\pi \times 25$$

$$\boxed{100\pi \text{ cm}^2}$$

b) radius = $14 \div 2 = 7$

$$4\pi \times 7^2 = 196\pi$$

$$= 615.75...$$

$$\boxed{616 \text{ cm}^2}$$

2 A cone has base radius 6 cm and slant height 10 cm. Give your answers in terms of π .

- Work out the curved surface area of the cone.
- Work out the total surface area of the cone.

(3 marks)

a) $CSA = \pi r l$

$$\pi \times 6 \times 10 = 60\pi$$

$$\boxed{60\pi \text{ cm}^2}$$

b) Add the circular base

$$\pi \times 6^2 = 36\pi$$

$$60\pi + 36\pi = 96\pi$$

$$\boxed{96\pi \text{ cm}^2}$$

- 3 Three quarters of the surface area of a sphere is $108\pi \text{ cm}^2$.

Work out the diameter of the sphere.

(4 marks)

If $\frac{3}{4}$ of the surface area is 108π , the full surface area =

$$108\pi \div 3 \times 4 = 144\pi \text{ cm}^2$$

Surface area of a sphere = $4\pi r^2$, so $4\pi r^2 = 144\pi$

$$r^2 = 36, \text{ so } r = 6 \text{ cm}$$

$$\text{Diameter} = 2 \times 6 = 12 \text{ cm}$$

$$\boxed{12 \text{ cm}}$$

- 4 A cone has base radius 5 cm and perpendicular height 12 cm.

a. Work out the slant height of the cone.

b. Work out the total surface area of the cone. Give your answer correct to 3 significant figures.

(4 marks)

a) Pythagoras

$$l^2 = 5^2 + 12^2 = 169$$

$$\boxed{l = 13 \text{ cm}}$$

b)

$$\text{CSA} = \pi \times 5 \times 13 = 65\pi$$

$$\text{base} = \pi \times 5^2 = 25\pi$$

$$\text{total} = 90\pi = 282.74\dots$$

$$\boxed{283 \text{ cm}^2}$$

- 5 A solid hemisphere has volume $18\pi \text{ cm}^3$.

Work out the total surface area of the hemisphere.

Give your answer in terms of π .

(4 marks)

Volume of a hemisphere = $\frac{2}{3} \times \pi \times r^3$, so $\frac{2}{3} \times \pi \times r^3 = 18\pi$

$$r^3 = 18 \times \frac{3}{2} = 27, \text{ so } r = 3 \text{ cm}$$

Total surface area = curved surface + flat circular face =

$$2\pi r^2 + \pi r^2 = 3\pi r^2$$

$$\text{Total surface area} = 3 \times \pi \times 9 = 27\pi \text{ cm}^2$$

$$\boxed{27\pi \text{ cm}^2}$$

- 6 A solid toy is made from a hemisphere joined to the circular base of a cone. Both have radius 4 cm. The cone has perpendicular height 3 cm.

Work out the total surface area of the toy. Give your answer correct to 3 significant figures.

(4 marks)

$$\text{slant} = \sqrt{4^2 + 3^2} = 5$$

$$\text{cone CSA} = \pi \times 4 \times 5 = 20\pi$$

$$\text{hemisphere CSA} = 2\pi \times 4^2 = 32\pi$$

Joined faces are not on the outside

$$\text{total} = 52\pi = 163.36\dots$$

$$\boxed{163 \text{ cm}^2}$$

- 7 The volume of a solid hemisphere is $144\pi \text{ cm}^3$.

Work out the total surface area of the hemisphere. Give your answer in terms of π .

(4 marks)

$$\frac{2}{3}\pi r^3 = 144\pi$$

$$r^3 = 144 \times \frac{3}{2} = 216$$

$$r = 6$$

$$\text{curved: } 2\pi \times 36 = 72\pi$$

$$\text{flat: } \pi \times 36 = 36\pi$$

$$\boxed{108\pi \text{ cm}^2}$$

- 8 A solid cone has base radius 6 cm.

The total surface area of the cone is $96\pi \text{ cm}^2$.

Work out the vertical height of the cone.

(4 marks)

Total surface area of a cone = $\pi r^2 + \pi rl$, where l is the slant height

$$\pi \times 36 + \pi \times 6 \times l = 96\pi, \text{ so } 36 + 6l = 96$$

$$6l = 60, \text{ so } l = 10 \text{ cm}$$

$$\text{By Pythagoras, height} = \sqrt{10^2 - 6^2} = \sqrt{64} = 8 \text{ cm}$$

$$\boxed{8 \text{ cm}}$$

9

A sphere has radius 6 cm. A cone has base radius 6 cm. The curved surface area of the cone is equal to the surface area of the sphere.

a. Work out the slant height of the cone.

b. Work out the perpendicular height of the cone. Give your answer correct to 3 significant figures.

(4 marks)

$$\text{sphere: } 4\pi \times 6^2 = 144\pi$$

$$\text{cone: } \pi \times 6 \times l = 144\pi$$

$$6l = 144$$

$$l = 24 \text{ cm}$$

$$h^2 = 24^2 - 6^2 = 540$$

$$h = \sqrt{540} = 23.23\dots$$

$$23.2 \text{ cm}$$

10

A large cone has base radius 9 cm and slant height 15 cm. A smaller cone is cut off the top, leaving a frustum. The cone that was cut off has base radius 3 cm.

Work out the total surface area of the frustum. Give your answer correct to 3 significant figures.

(5 marks)

$$\text{scale factor} = \frac{3}{9} = \frac{1}{3}$$

$$\text{small slant} = 15 \div 3 = 5$$

$$\text{frustum CSA} = \pi \times 9 \times 15 - \pi \times 3 \times 5 = 120\pi$$

$$\text{bottom circle} = \pi \times 9^2 = 81\pi$$

$$\text{top circle} = \pi \times 3^2 = 9\pi$$

$$\text{total} = 210\pi = 659.7\dots$$

$$660 \text{ cm}^2$$

11 A large cone has base radius 9 cm and vertical height 12 cm.

A smaller, similar cone of base radius 3 cm and vertical height 4 cm is removed from the top of the large cone, leaving a frustum.

Calculate the curved surface area of the frustum.

Give your answer correct to 3 significant figures.

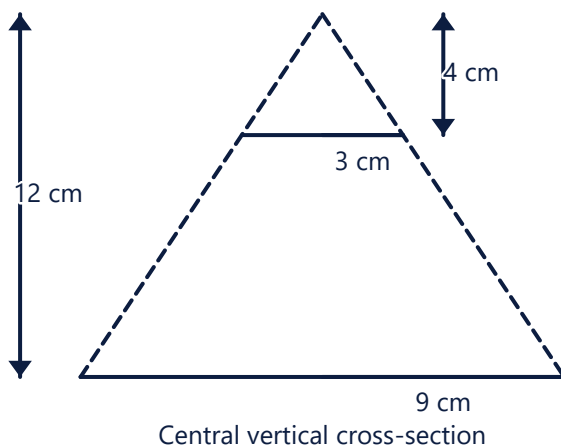


Diagram NOT accurately drawn

(4 marks)

$$\text{Slant height of the large cone} = \sqrt{(12^2 + 9^2)} = \sqrt{225} = 15 \text{ cm}$$

$$\text{Slant height of the small cone} = \sqrt{(4^2 + 3^2)} = \sqrt{25} = 5 \text{ cm}$$

$$\text{Curved surface area of a cone} = \pi r l$$

$$\text{Curved surface area of the frustum} = \pi \times 9 \times 15 - \pi \times 3 \times 5 = 135\pi - 15\pi = 120\pi$$

$$120\pi = 376.99... = 377 \text{ cm}^2 \text{ (3 s.f.)}$$

$$\boxed{377 \text{ cm}^2}$$

12

A solid cone has base radius 5 cm.

The curved surface area of the cone is $65\pi \text{ cm}^2$.

Work out the volume of the cone.

Give your answer correct to 3 significant figures.

(5 marks)

$$\text{Curved surface area} = \pi r l, \text{ so } \pi \times 5 \times l = 65\pi \text{ and } l = 13$$

$$\text{By Pythagoras, height} = \sqrt{(13^2 - 5^2)} = \sqrt{144} = 12 \text{ cm}$$

$$\text{Volume} = \frac{1}{3} \times \pi \times r^2 \times h = \frac{1}{3} \times \pi \times 25 \times 12 =$$

$$100\pi$$

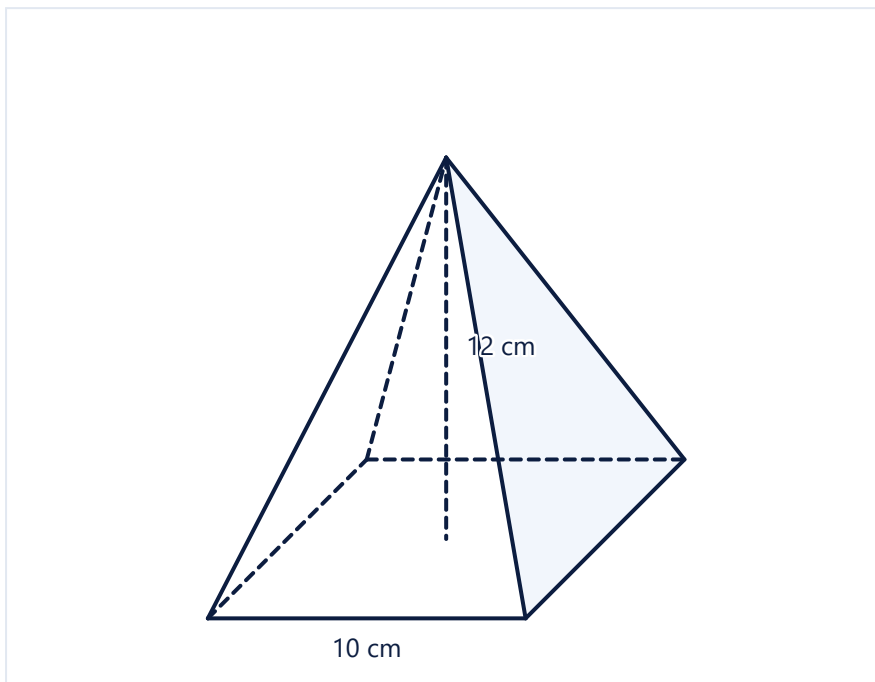
$$100\pi = 314.15... = 314 \text{ cm}^3 \text{ (3 sf)}$$

$$314 \text{ cm}^3$$

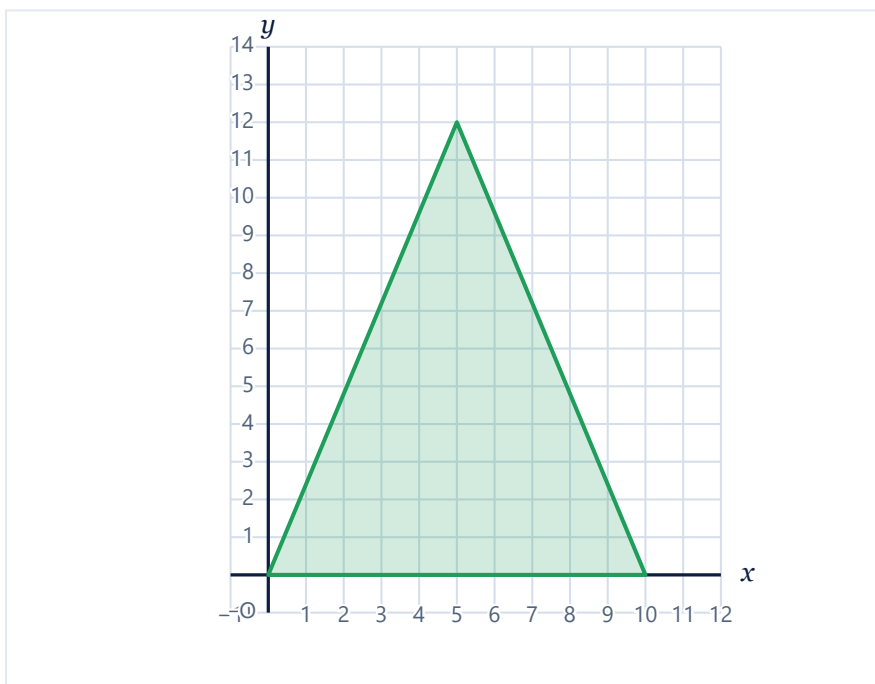
13

A solid square-based pyramid has base edges of 10 cm and vertical height 12 cm. The apex is directly above the centre of the base.

- Draw an accurate front elevation of the pyramid.
- Work out the total surface area of the pyramid.



Given solid



Front elevation

(6 marks)

- From the front the pyramid looks like an isosceles triangle with base 10 cm and vertical height 12 cm
- The slant height of each triangular face runs from the apex to the midpoint of a base edge. The horizontal distance from the centre of the base to the midpoint of an edge is 5 cm

$$\text{Slant height} = \sqrt{12^2 + 5^2} = \sqrt{169} = 13 \text{ cm}$$

Each triangular face has area $\frac{1}{2} \times 10 \times 13 = 65 \text{ cm}^2$, so the four faces have area $4 \times 65 = 260 \text{ cm}^2$

The base has area $10 \times 10 = 100 \text{ cm}^2$, so the total surface area
 $= 260 + 100 = 360 \text{ cm}^2$