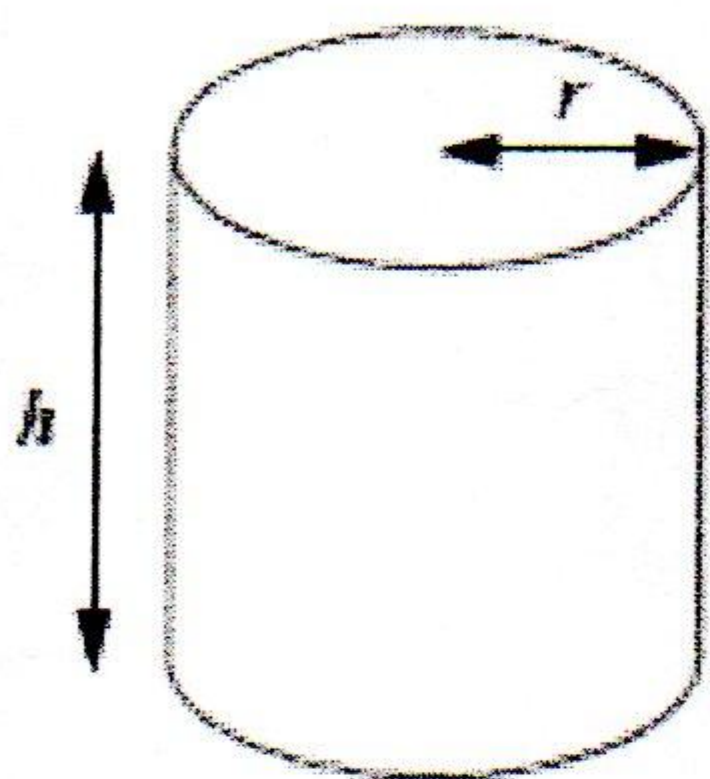# *3D shapes*

Cylinder
volume = area of circle × height *or* $V = \pi r^2 h$
where *r* is the **radius** of the cylinder and *h* is its height or **length**.

Example 1
Calculate the volume of a cylinder with a radius of 5 cm and a height of 12 cm.
Volume = $\pi r^2 h = \pi \times 5^2 \times 12 = 942.5 \text{ cm}^3$ (to 1 decimal place)
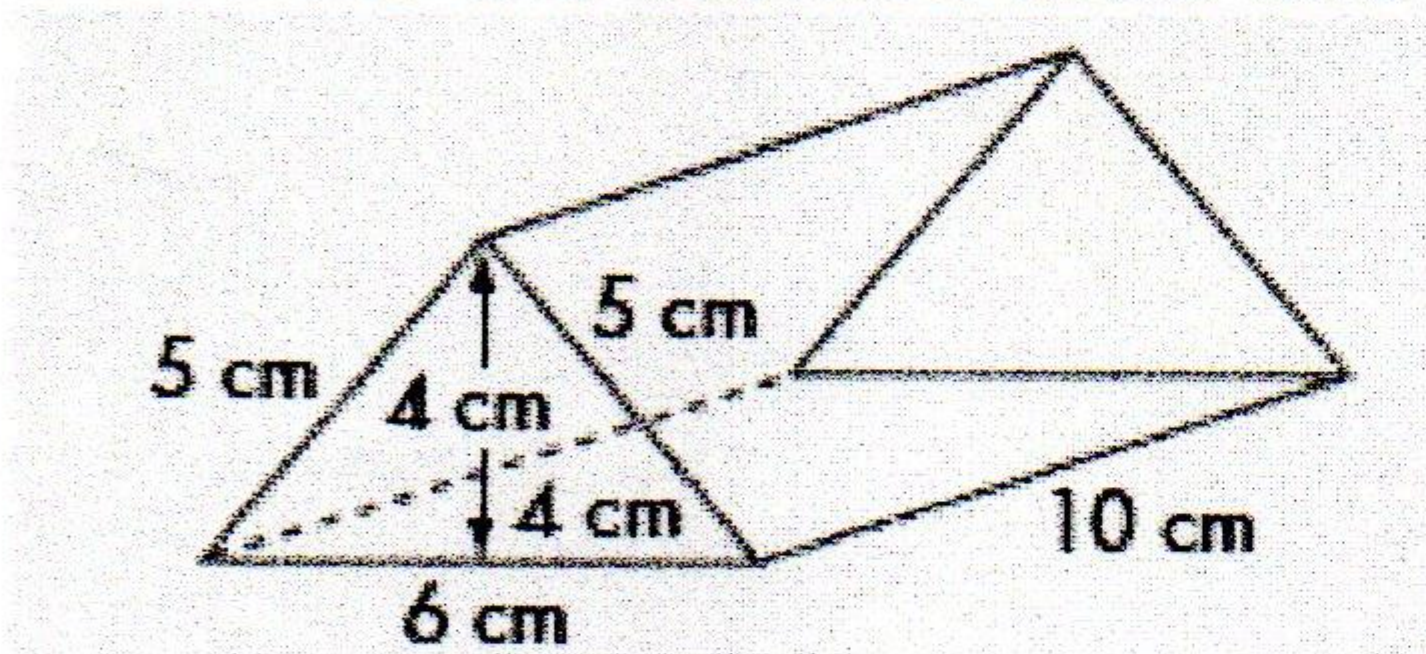
Triangular Prism

The **volume** of a prism is found by multiplying the area of its cross-section by the length of the prism
(or height if the prism is stood on end), that is:
Volume of prism = area of cross-section × length *or* $V = Al$

Example 2
Calculate the **surface area** and the volume of the triangular prism below.

The surface area is made up of three rectangles and two isosceles triangles.

Area of the three rectangles = 10x5 + 10x5 + 10x6 = 50 + 50 + 60 = 160 cm^2

Area of one triangle = (6x4)/2= 12, so area of two triangles = 24 cm^2
Therefore, the total surface area = 184 cm^2

Volume of the prism = *Al*

Area of the cross-section = area of the triangle = 12 cm^2

So, *V* = 12x10 = 120 cm^3

Find the Surface area and the volume of the following cylinders where radius or diameter known.

Volume $\qquad$ = area of circle × height
$\qquad\qquad$ = $\pi r^2 h$
Total surface area $\quad$ = Flat surface area + Curved surface area
$\qquad\qquad$ = $2\pi r^2 + 2\pi rh$
$\qquad\qquad$ = $2\pi r(r + h)$

Q1	Radius/ Diameter	Height (H)	Surface Area	Volume
a)	R= 5 cm	3cm		
b)	D= 7 cm	5cm		
c)	R= 12 cm	7cm		
d)	D= 15 cm	4cm		
e)	R =9 m	30 cm		

Q2. Work out the volume and surface area of the triangular prism.

3 cm

5 cm

20 cm

4 cm
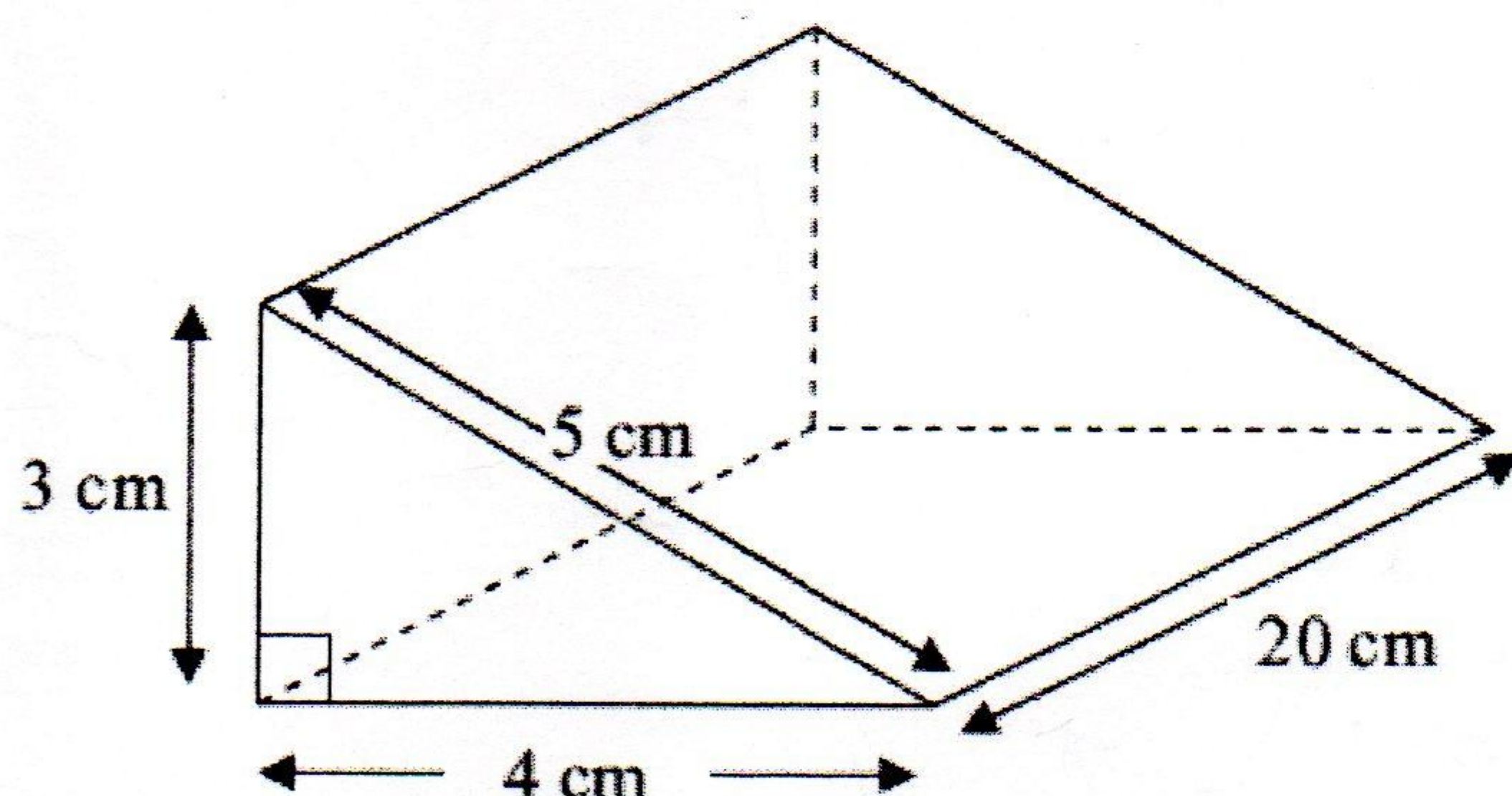
Volume=_____ , Surface Area=_____

Q3. The radius of the base of the cylinder is $2x$ cm and the height of the cylinder is h cm. The radius of the sphere is $3x$ cm.
The volume of the cylinder is equal to the volume of the sphere.
Express h in terms of x. Give your answer in its simplest form.
A sphere has radius r.

Q4. A cone has base radius r and perpendicular height x.
The volume of the sphere is double the volume of the cone.
(a) Show that $x = 2r$
(b) Calculate the ratio of the surface area of the sphere to the curved surface area of the cone. Give your answer in surd form.

Q6. A hemispherical bowl of radius 6 cm has the same volume as a cone of perpendicular height 27 cm. Calculate the base radius, r, of the cone.

Q7. The diagram shows a solid made from a cone and a hemisphere.
The radius of both shapes is r. The slant height of the cone is l.
The perpendicular height of the cone is h.
The curved surface area of the cone and the curved surface area of the hemisphere are equal.
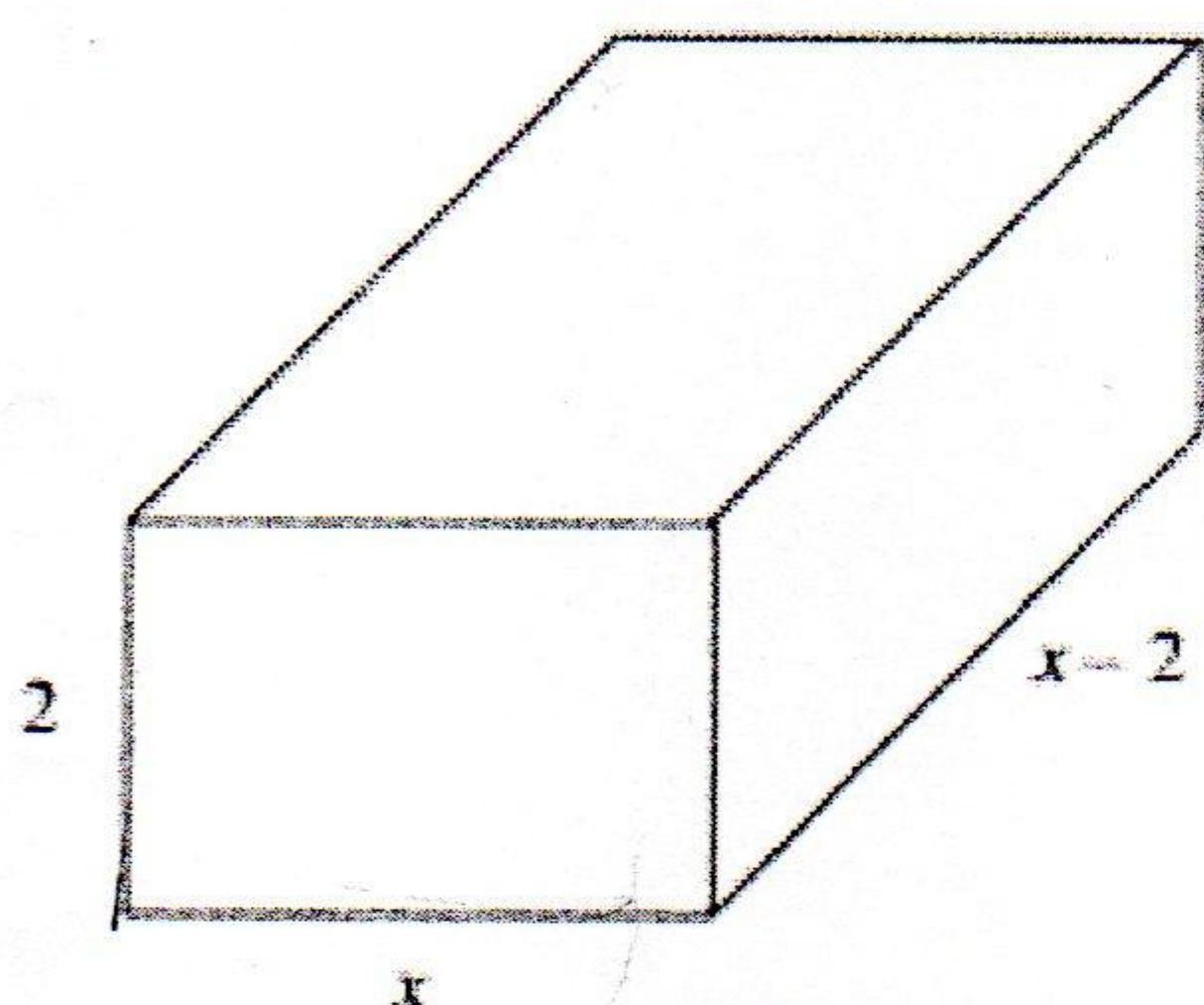(a) Show that $l = 2r$
(b) Find the perpendicular height, h, of the cone in terms of r.

Q8. The diagram shows a cuboid.
All the measurements are in cm.
The volume of the cuboid is 51 cm^3.

(a) Show that $2x^2 - 4x - 51 = 0$ for $x > 2$

(b) Solve the quadratic equation $2x^2 - 4x - 51 = 0$
Give your solutions correct to 3 significant figures.
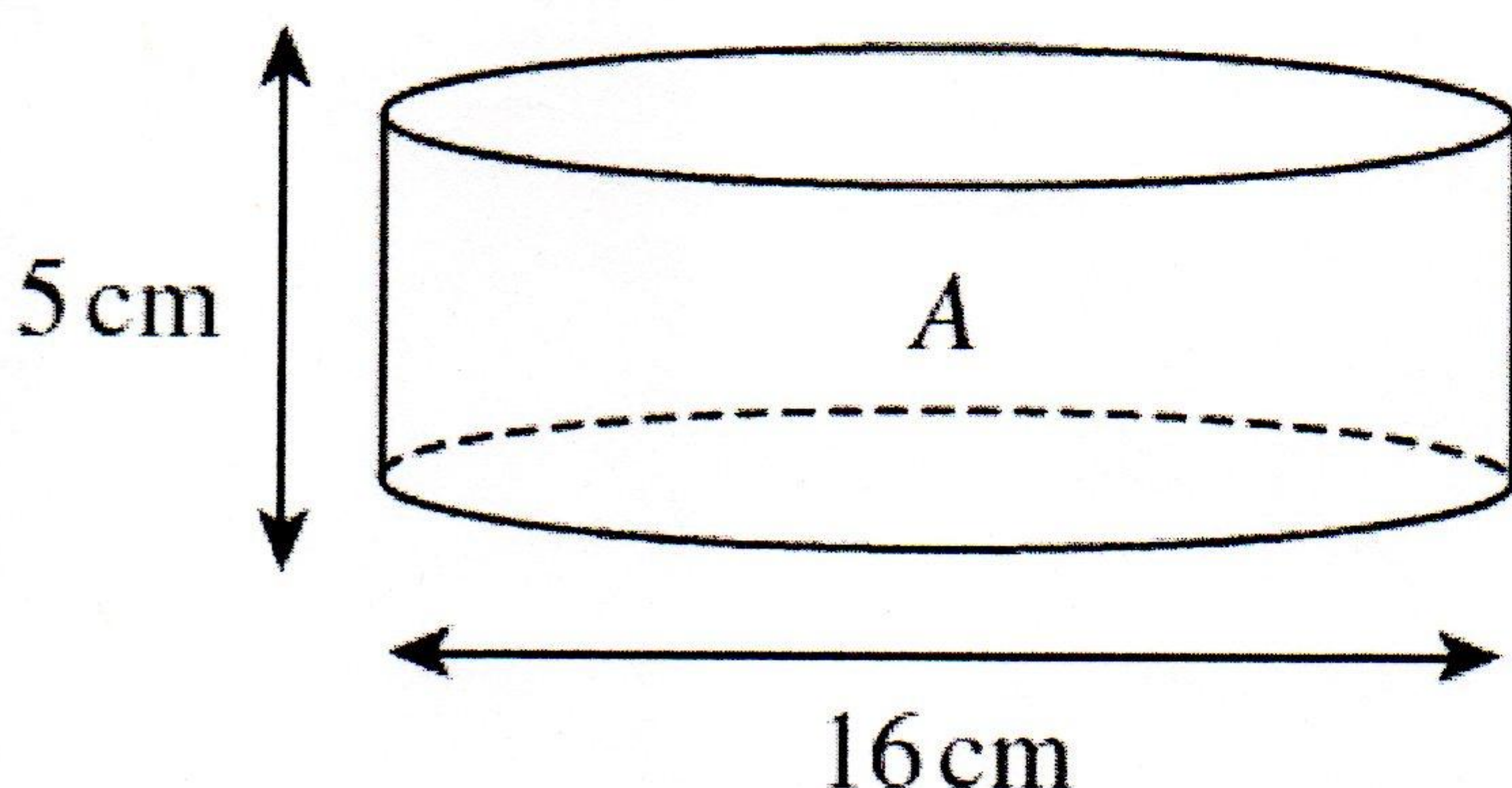You must show your working.
....

Q9. Cylinder A has a height of 5 cm and a diameter of 16 cm.
Calculate the volume of the cylinder A.
Give your answer in terms of π.
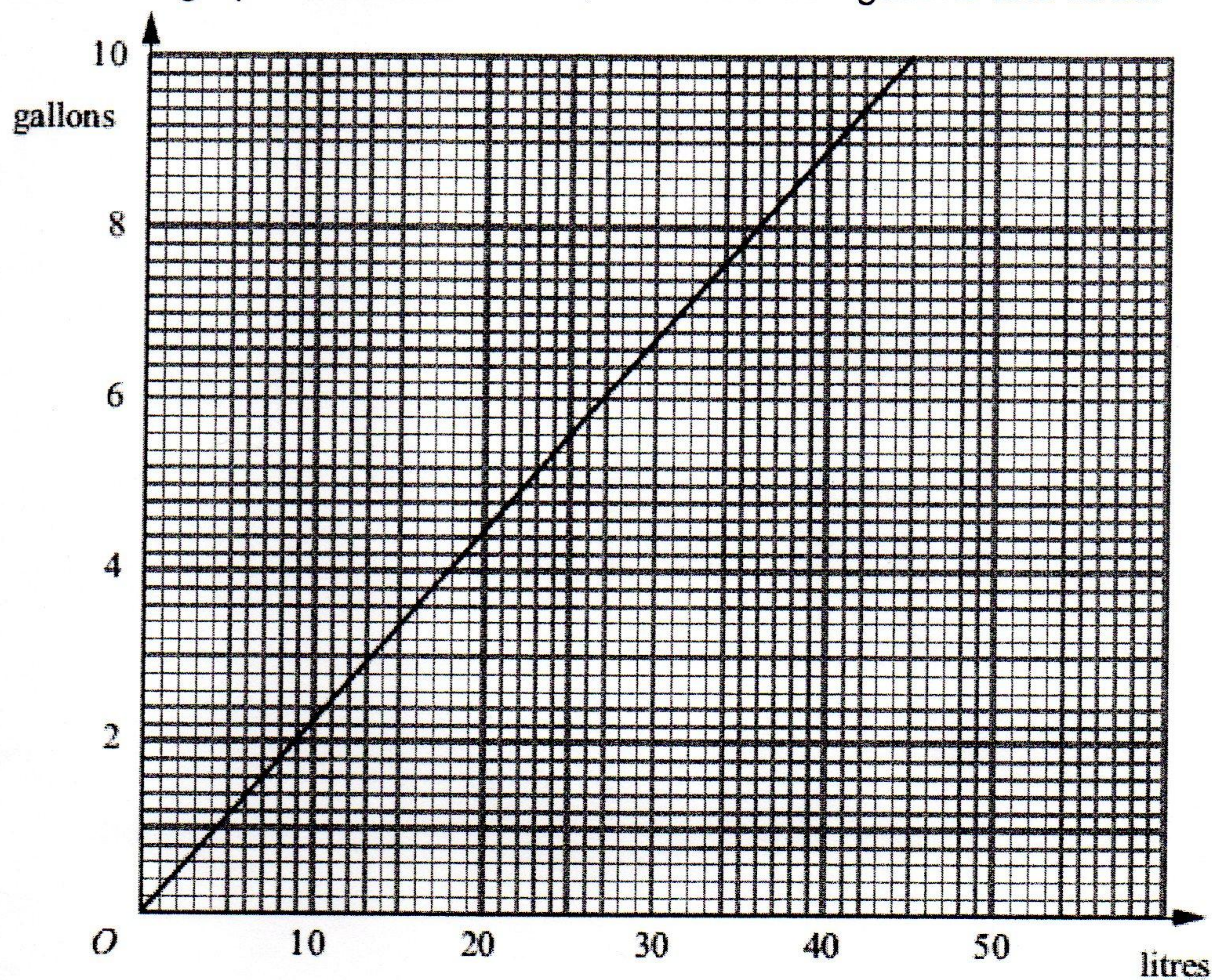State the units of your answer.

5 cm   A

16 cm

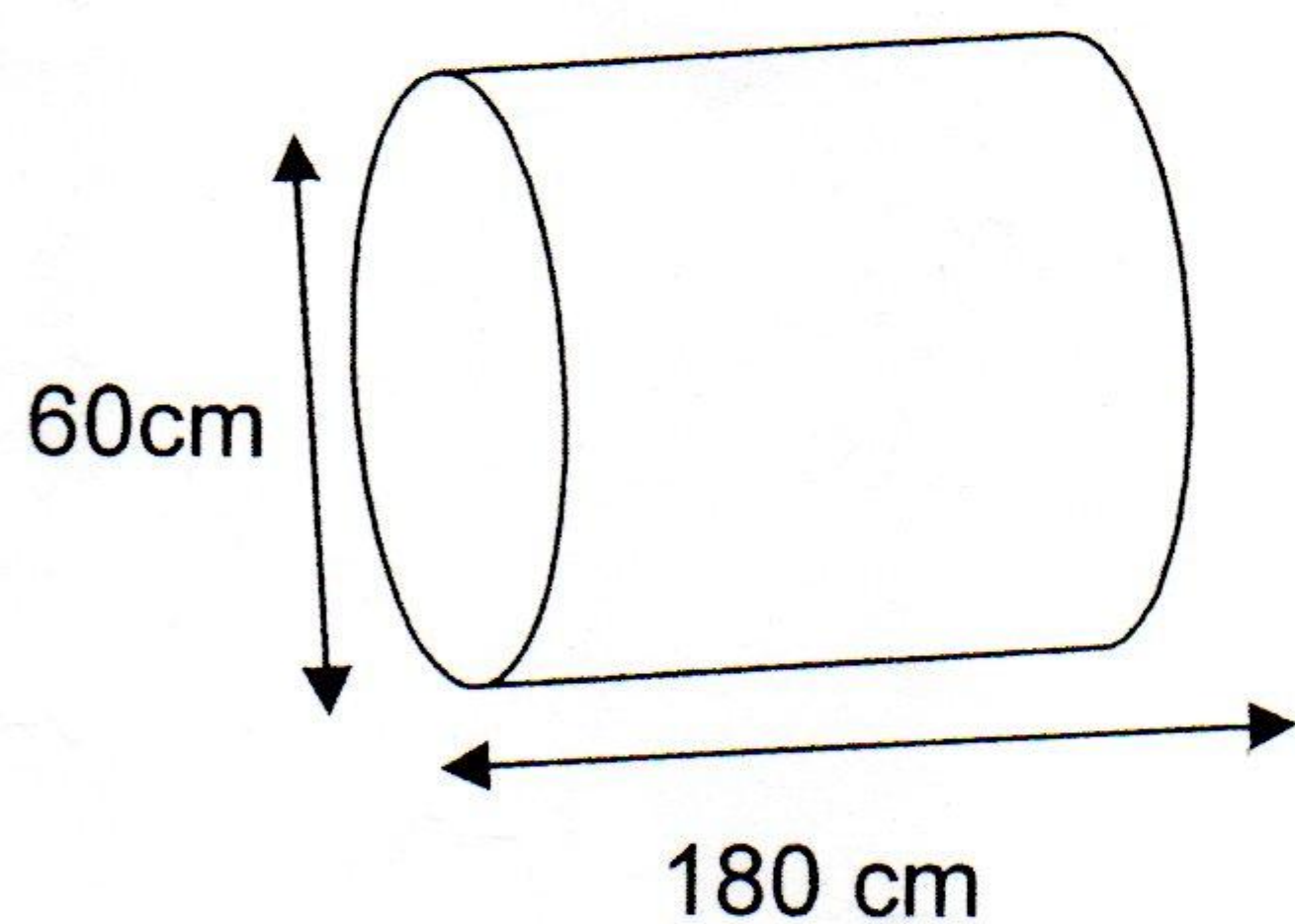Cylinder B has a height of 20 cm and a radius of r cm.
Cylinder B has the same volume as cylinder A.
Calculate the value of r.

Q10. The graph can be used to convert between gallons and litres.

The diagram shows a central heating oil tank.

60cm

180 cm

The oil tank is in the shape of a cylinder of length 180 cm and radius 60 cm.

The oil tank contains 200 gallons of oil.

(a) Is the oil tank more or less than ½ full? Please show every steps of your working.

The oil has a density of 0.85 g/cm³.
(b) Work out, in kg, the mass of the oil in the tank.

The **volume** of a **cylinder** is found by multiplying the area of its circular cross-section by its **height**, that is: