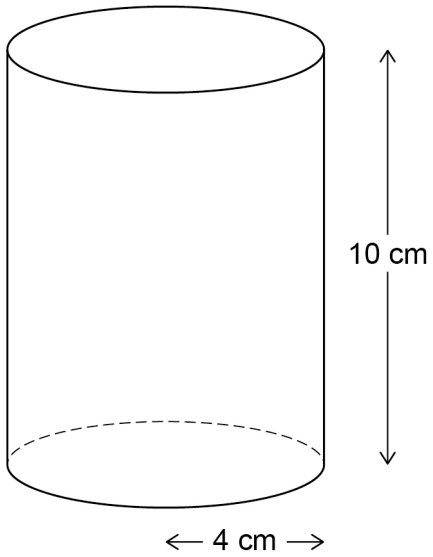
1 Here are two solids.

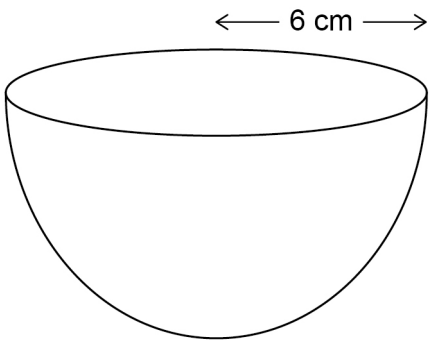
Cylinder

radius 4 cm height 10 cm



Hemisphere

radius 6 cm



volume of a hemisphere $= \frac{2}{3}\pi r^3$ where r is the radius

Which solid has the greater volume?

You **must** show your working.

[4 marks]

Volume of cylinder : $\pi \times 4^2 \times 10$

$= 160\pi$ (1)

Volume of a hemisphere : $\frac{2}{3} \times \pi \times 6^3$ (1)

$= \frac{2}{3}(216) \times \pi$

$= 144\pi$ (1)

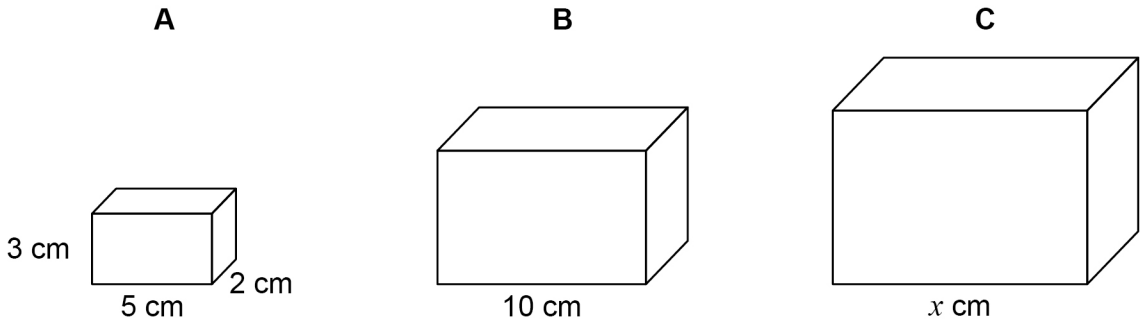
Answer cylinder (1)

2 Here are three similar cuboids, A, B and C.

A has length 5 cm, width 2 cm and height 3 cm

B has length 10 cm

C has length x cm



2 (a) The total surface area of A is 62 cm^2

Tim wants to work out the total surface area of B.

Here is his working.

$10 \div 5 =$	2
$62 \times 2 =$	124
Total surface area of B =	124 cm^2

Make **one** criticism of Tim's method.

[1 mark]

The scale factor should be 4. Hence, 62 x 4 = 248 (1)

2 (b) Volume of A $\times \frac{125}{8}$ = Volume of C

Work out the value of x.

[3 marks]

$\sqrt[3]{\frac{125}{8}} = \frac{5}{2}$ (1)

length of A $\times \frac{5}{2}$ = length of C

$5 \times \frac{5}{2} = x$ (1)

$12.5 = x$

Answer 12.5 (1)

3 A ball contains 5000 cm^3 of air.

More air is pumped into the ball at a rate of 160 cm^3 per second.

The ball is full of air when it becomes a sphere with radius 15 cm

Volume of a sphere $= \frac{4}{3}\pi r^3$ where r is the radius

Does it take **less than** 1 minute to fill the ball?

You **must** show your working.

[4 marks]

Volume of ball $= \frac{4}{3} \times \pi \times 15^3$ (1)

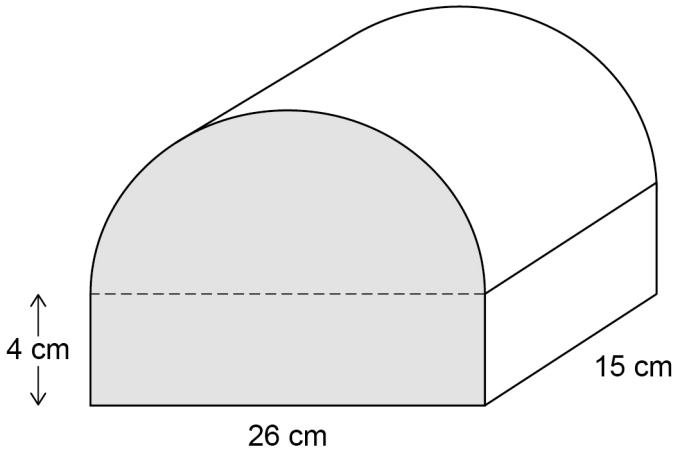
$= 14\,137 \ldots$

Air needed : $14\,137 - 5000 = 9137\ cm^3$ (1)

time taken $= \frac{9137\ cm^3}{160\ cm^3 s^{-1}} = 57.1\ s$ (1)

Yes. It takes only 57.1 seconds to fill the ball. (1)

4 A box is the shape of half a cylinder on top of a cuboid.



Work out the volume of the box.

[4 marks]

Volume of rectangle = $4 \times 26 \times 15 = 1560$ (1)

Volume of half cylinder = $\frac{1}{2} \times \pi \times 13^2 \times 15$ (1)

$= 1267.5\pi$

$= 3979.95..$ (1)

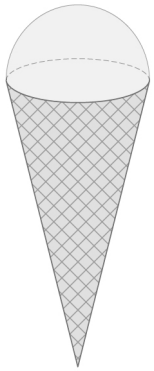
Total volume = $1560 + 3979.95..$

$= 5539..$ (1)

Answer 5539 cm^3

5 Outside a cafe there is a large plastic ice cream cornet.

The cornet is a hemisphere on top of a cone.



The cone and the hemisphere each have radius 24 cm

The cone has perpendicular height 117 cm

Volume of a cone $= \frac{1}{3}\pi r^2 h$ r is the radius h is the perpendicular height	Volume of a hemisphere $= \frac{2}{3}\pi r^3$ r is the radius

5 (a) Work out the total volume of the cornet.

[4 marks]

Volume of a cone $= \frac{1}{3} \times \pi \times 24^2 \times 117 = 22\,464\,\pi$ (1)

Volume of a hemisphere $= \frac{2}{3} \times \pi \times 24^3 = 9216\,\pi$ (1)

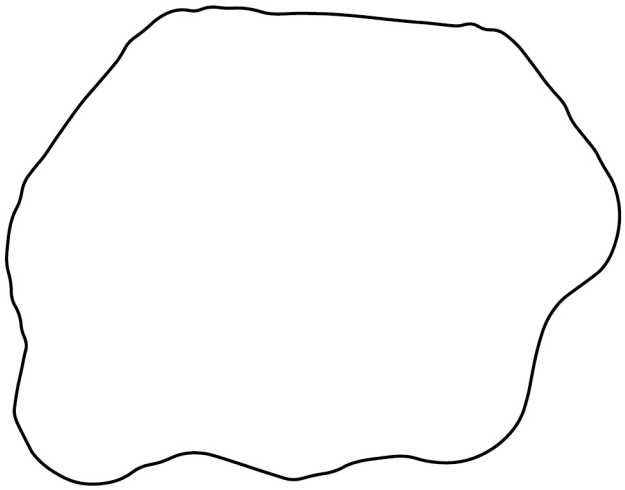
Total volume : $22\,464\,\pi + 9216\,\pi = 31680\,\pi$ (1)

$31680 \times 3.142\ldots = 99538\ldots$

Answer 99 538 (1) cm^3

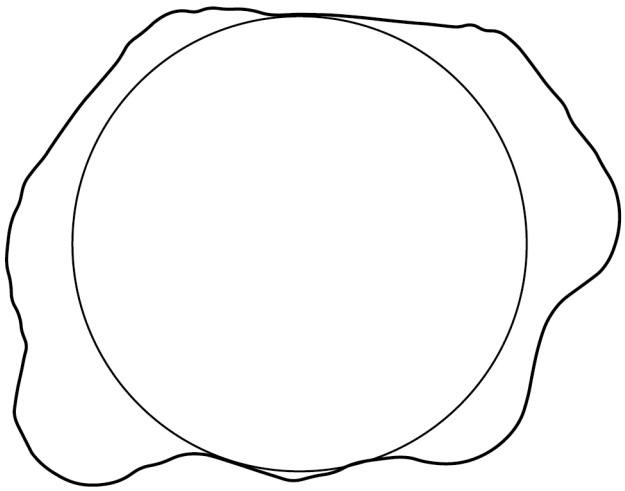
6 Here is a scale drawing of a reservoir.

Scale: 1 cm represents 500 m



Virat wants to estimate the volume of water in the reservoir.

He draws on the scale drawing a circle with radius 3 cm



6 (a) Virat estimates the volume of the reservoir by assuming that

- the reservoir is a cylinder whose cross section is the circle
- the depth of the reservoir is 17 metres.

Work out Virat's estimate in cubic metres.

[3 marks]

Actual radius = $3 \times 500 = 1500$ m (1)

Volume = $\pi \times 1500^2 \times 17$ (1)

$= 38\,250\,000\,\pi$ m^3

$= 120\,181\,500$ m^3

$= 1.2 \times 10^8$ m^3 (1)

Answer 1.2×10^8 m^3

6 (b) In fact,

- the depth of the reservoir is 13.8 metres
- the reservoir is **not** a cylinder (see diagram).

Which statement about the actual volume of the reservoir is correct?

Tick **one** box.

☐ It is less than Virat's estimate

☐ It is greater than Virat's estimate

☑ (1) It could be less than or greater than Virat's estimate

Give a reason for your answer.

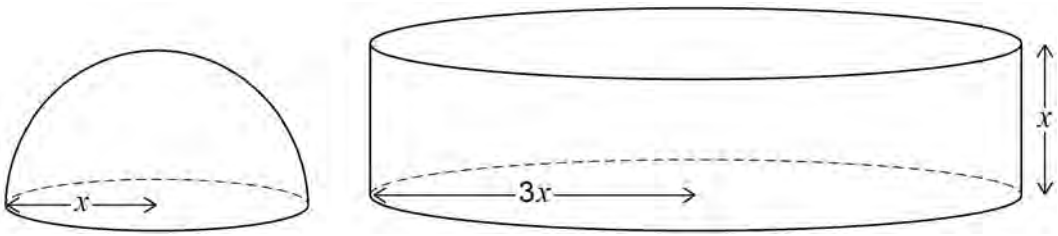
[2 marks]

The area is larger but the depth is smaller

(1)

7 A solid hemisphere has radius x.

A solid cylinder has radius $3x$ and height x.



Surface area of a sphere = $4\pi r^2$
where r is the radius

Work out the ratio

total surface area of the hemisphere : total surface area of the cylinder

Give your answer in its simplest form.

You **must** show your working.

[3 marks]

surface area of hemisphere : $\frac{4\pi x^2}{2} + \pi x^2 = 3\pi x^2$ (1)

Surface area of cylinder : $2 \times \pi (3x)^2 +$

$: 18\pi x^2 + 2\pi (3x) x$

$: 18\pi x^2 + 6\pi x^2 = 24\pi x^2$ (1)

s.a. of hemisphere : s.a of cylinder $= 3\pi x^2 : 24\pi x^2$

$= 3 : 24$

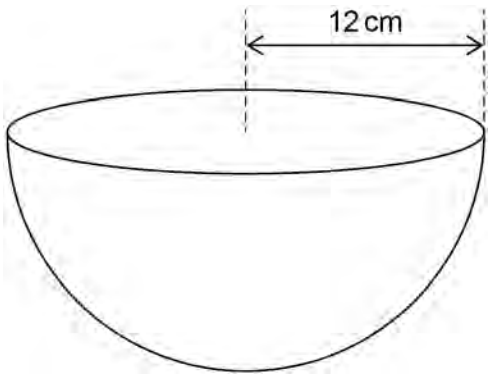
$= 1 : 8$ (1)

Answer 1 : 8

8

Volume of a sphere = $\frac{4}{3}\pi r^3$

A bowl is a hemisphere with radius 12 cm



Water is poured into the bowl

at a rate of 325 cm^3 per second

for 8 seconds.

Does the water fill **more than** 70% of the bowl?

You **must** show your working.

[4 marks]

Volume of water = $325 \times 8 = 2600$ (1)

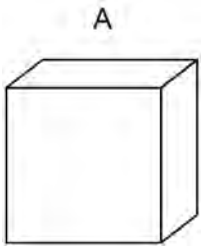
Volume of hemisphere = $\frac{1}{2} \times \frac{4}{3} \times \pi \times 12^3$

$= 3620$ (1)

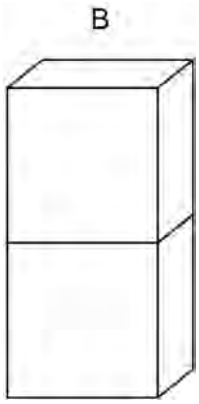
$\frac{2600}{3620} \times 100\% = 71.8\%$ (1)

Yes. The water fills 71.8% of the bowl. (1)

9 Here is cuboid A.



Cuboid B is made from **two** of cuboid A.



volume of A : volume of B = 1 : 2

Matthew says,

"surface area of A : surface area of B must be 1 : 2 because B is made of 2 of A."

Is Matthew correct?

Tick **one** box.

☐ Yes ☑ No ☐ Cannot tell

(1)

Give a reason for your answer.

[2 marks]

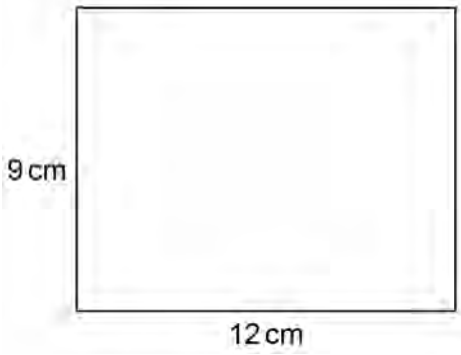
2 faces are hidden. (1)

10 A solid shape is made from centimetre cubes.

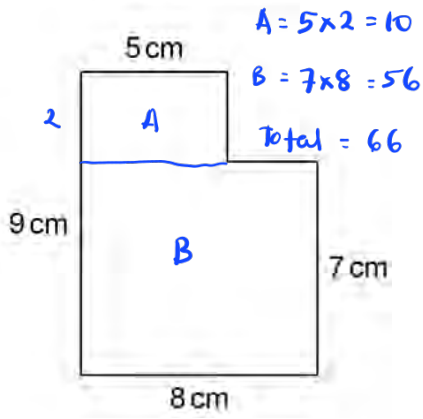
The front elevation and side elevation of the shape are shown.

Not drawn accurately

Front elevation



Side elevation



A = 5×2 = 10
B = 7×8 = 56
Total = 66

Work out

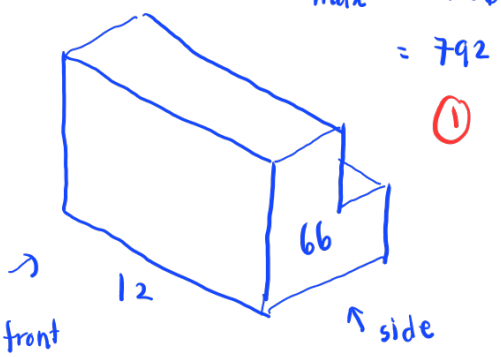
the **maximum** possible number of cubes in the shape

and

the **minimum** possible number of cubes in the shape.

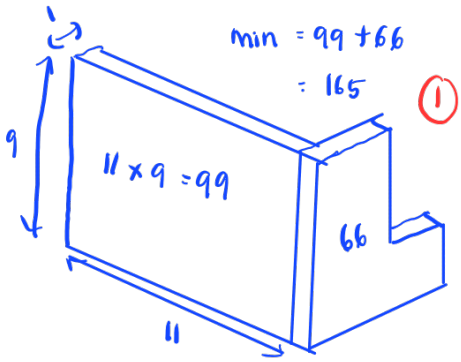
[3 marks]

Maximum :



Max = 12×66
= 792 (1)

Minimum :



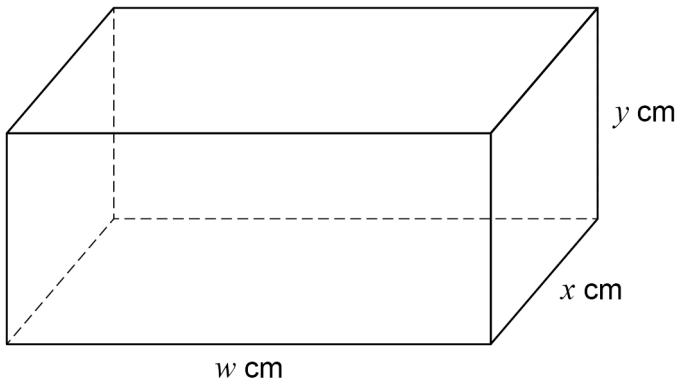
min = 99 + 66
= 165 (1)

Maximum 792 (1)

Minimum 165

11 (a) Here is a cuboid.

w, x and y are **different** whole numbers.



The total length of **all** the edges of the cuboid is 80 cm

The volume is **greater** than 200 cm^3

Work out one possible set of values for w, x and y.

[2 marks]

$4w + 4y + 4x = 80$

$4(w + x + y) = 80$

$w + x + y = 20$

$w \times y > 200$

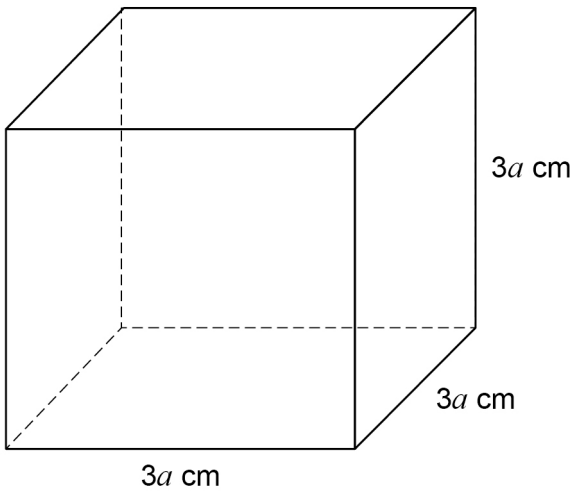
let $w = 8$, $x = 7$, $y = 5$

$8 + 7 + 5 = 20$, $8 \times 7 \times 5 = 280$

(2)

$w =$ 8 $x =$ 7 $y =$ 5

11 (b) Here is a solid cube.



6 (3a × 3a)

Circle the expression for the **total** surface area in cm^2 6 ($9a^2$)

54a^2

[1 mark]

36a 54a 36a^2 54a^2

1

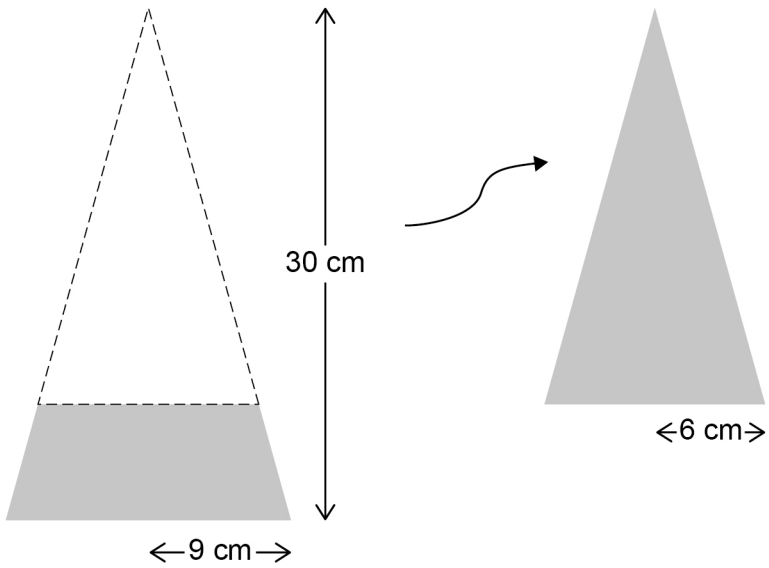
12 Alec makes a bowl for dog food from a solid wooden cone.

The sketches show how the bowl is made.

The cone has radius 9 cm and perpendicular height 30 cm

A smaller cone, with radius 6 cm, is removed.

Not drawn accurately

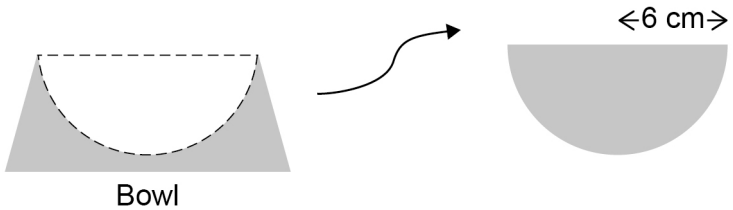


Volume of a cone $= \frac{1}{3}\pi r^2 h$

where r is the radius and h is the perpendicular height

A hemisphere with radius 6 cm is then removed.

Not drawn accurately



Volume of a hemisphere $= \frac{2}{3}\pi r^3$ where r is the radius

Work out the volume of the remaining wood that forms the bowl.

[5 marks]

Volume of large cone : $\frac{1}{3} \times \pi \times 9^2 \times 30 = 810\pi$ (1)

Volume of small cone : $\frac{1}{3} \times \pi \times 6^2 \times \left(\frac{30}{9} \times 6\right)$ (1)

$\frac{1}{3} \times \pi \times 36 \times 20 = 240\pi$

Volume of remaining cone : $810\pi - 240\pi = 570\pi$ (1)

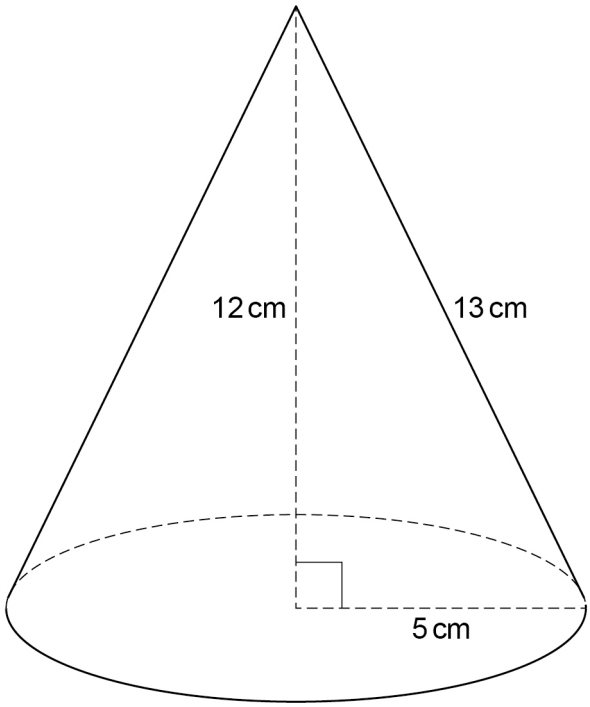
Volume of hemisphere = $\frac{2}{3} \times \pi \times 6^3 = 144\pi$ (1)

Volume of bowl : $570\pi - 144\pi$

$= 426\pi$ (1)

Answer 426π cm^3

13 Here is a cone.



13 (a)

Curved surface area of a cone $= \pi rl$ where r is the radius and l is the slant height

Beth tries to work out the curved surface area in terms of π

Curved surface area of the cone $= \pi \times 5 \times 12$ $= 60\pi \text{ cm}^2$

What mistake has she made?

[1 mark]

The value of l should be 13 instead of 12 ✓0

13 (b) Adam uses $\pi = 3$ to estimate the area of the **base** of the cone.

Work out his estimate.

[2 marks]

Area of the base of the cone = $\pi \times r^2$

$= 3 \times 5^2$

$= 3 \times 25$ ✓1

$= 75\ cm^2$ ✓1

Answer 75 cm^2

13 (c) Beth uses $\pi = 3.14$ to estimate the area of the **base** of the cone.

Is Beth's estimate more than or less than Adam's estimate?

Tick a box.

More than [✓] Less than [ ]

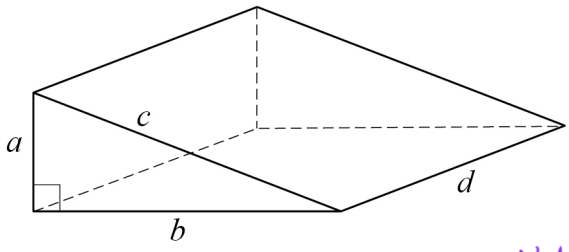
Give a reason for your answer.

[1 mark]

3.14 is larger than 3. ✓1

Turn over for the next question

14 Here is a right-angled triangular prism.



Volume of prism = $\frac{1}{2} \times (a \times b) \times d$

The ratio of the edges is $a : b : c : d = 3 : 4 : 5 : 12$

The **volume** of the prism is $1125\,cm^3$

Work out the total length of **all** of the edges of the prism.

[5 marks]

let length of edges is variable of x.

Volume of prism $= \frac{1}{2} \times 3x \times 4x \times 12x = 1125$ ✓1

$144x^3 = 2250$

$x^3 = 15.625$ ✓0

$x = \sqrt[3]{15.625}$

$= 2.5$ ✓1

$a = 3 \times 2.5 = 7.5$ cm

$b = 4 \times 2.5 = 10$ cm

$c = 5 \times 2.5 = 12.5$ cm

$d = 12 \times 2.5 = 30$ cm

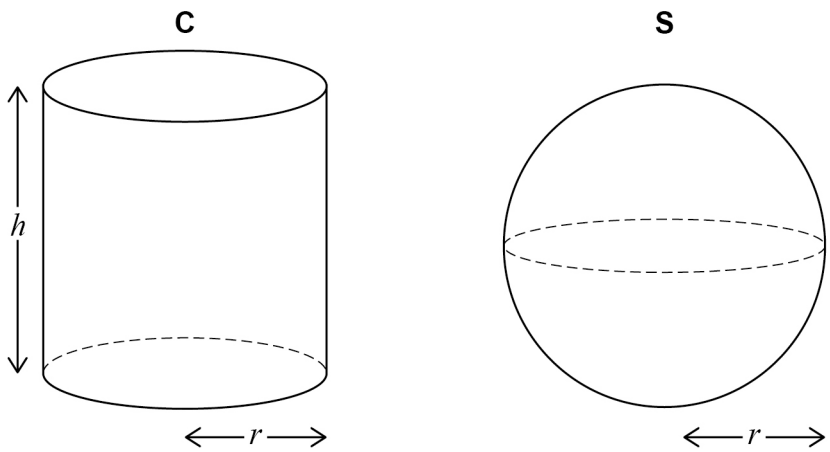
Total length of edges $= 2(7.5) + 2(10) +$ ✓0 $2(12.5) + 3(30)$

$= 150$ cm ✓0

Answer 150 cm

15 A cylinder, C, and a sphere, S, each have radius r

C has height h



Volume of a sphere $= \frac{4}{3}\pi r^3$

where r is the radius

15 (a) volume of C = volume of S

Work out the ratio $r : h$

You **must** show your working.

[3 marks]

Volume of C $= \pi r^2 h$ (1)

Volume of S $= \frac{4}{3}\pi r^3$

$\pi r^2 h = \frac{4}{3}\pi r^3$

$h = \frac{4}{3}r$ (1)

$\frac{r}{h} = \frac{3}{4}$

Answer 3 : 4 (1)

15 (b) A **different cylinder** has radius $3r$ and height $2h$.

How many times bigger is the volume of this cylinder than the volume of C?

[2 marks]

$V = \pi(3r)^2(2h)$ ✓ (1)

$= \pi(9r^2)(2h)$

$= 18(\pi r^2 h)$

Answer 18 ✓ (1)