I.G.C.S.E. Volume & Surface Area

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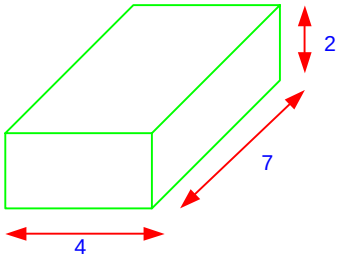
You can access the solutions from the end of each question

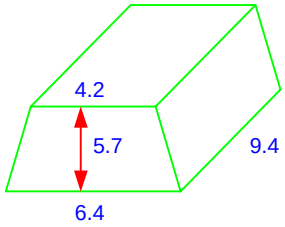
Question 1

Find the volume of the following prisms. All lengths are in cm.

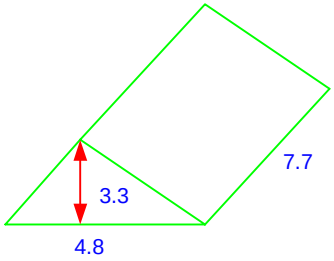
a.



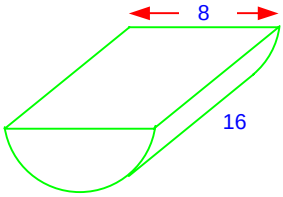
b.



c.



d.



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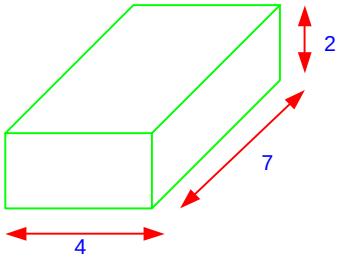
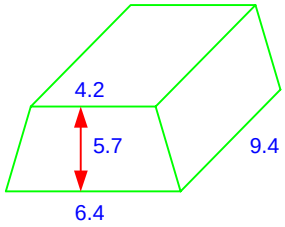
Solution to question 1

a.



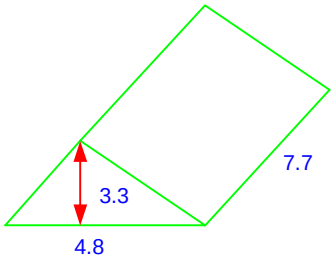
$$V = l \times w \times h$$
$$= 4 \times 7 \times 2$$
$$= 56\,\text{cm}^3$$

b.



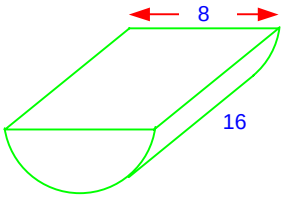
$$\text{V} = \text{area of cross section} \times \text{length}$$
$$= \text{area of trapezium} \times \text{length}$$
$$= \frac{1}{2}(6.4 + 4.2)5.7$$
$$= 30.21$$
$$= 30.2\,\text{cm}^3$$

c.



$$\text{V} = \text{area of cross section} \times \text{length}$$
$$= \text{area of triangle} \times \text{length}$$
$$= \frac{1}{2} \times \text{base} \times \text{height}$$
$$= \frac{1}{2} \times 4.8 \times 3.3 \times 7.7$$
$$= 60.984$$
$$= 61.0\,\text{cm}^3$$

d.



$$\text{V} = \text{area of cross section} \times \text{length}$$
$$= \text{area of semicircle} \times \text{length}$$
$$= \frac{1}{2}\pi r^2 \times \text{length}$$
$$= \frac{1}{2} \times \pi \times 4^2 \times 16$$
$$= 128\pi$$
$$= 402\,\text{cm}^3$$

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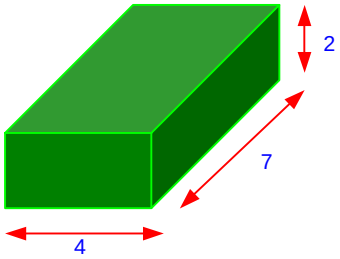
Question 2

2. Find the surface area of the following rectangular prism. All lengths are in cm.



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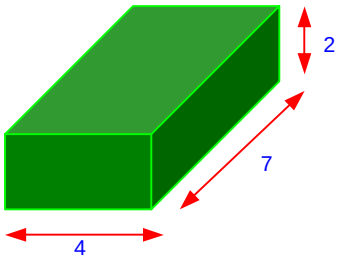
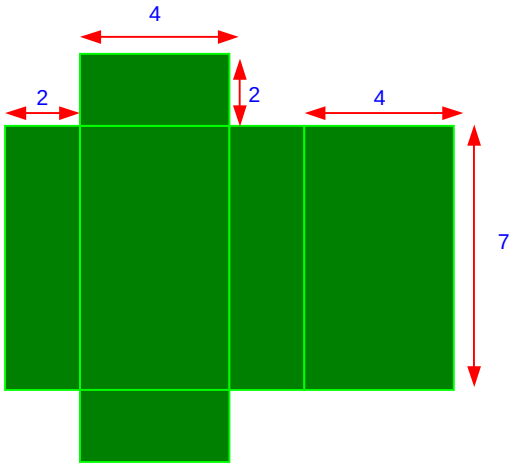
Solution to question 2



Drawing the net we can see



The surface area is the sum of the area of each of the six rectangles.

$$\text{Surface area} = 2\times(4\times 2+7\times 2+7\times 4)$$
$$= 100\,\text{cm}^2$$

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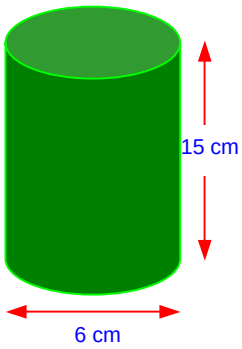
Question 3

a. Find the volume in litres of the following cylinder. ($1L = 1000\,cm^3$).



b. Calculate the surface area in cm^2.

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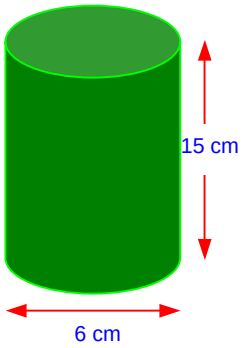
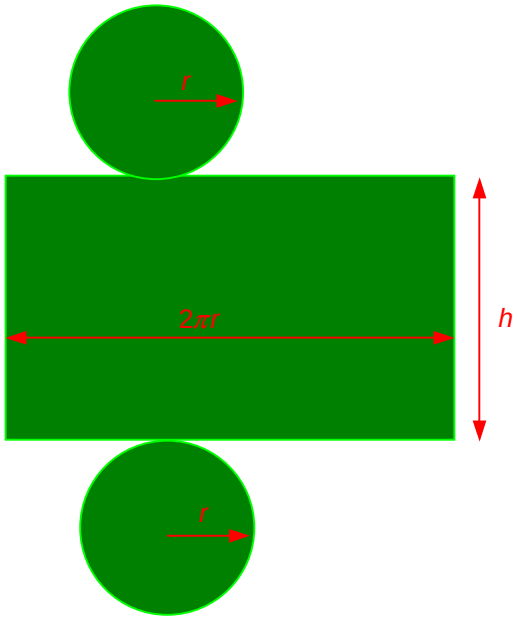
Solution to question 3

a. Note that $r = \frac{1}{2}d = \frac{1}{2} \times 6 = 3\,\text{cm}$



$$\begin{aligned} V &= \text{area of base} \times \text{height} \\ &= \pi r^2 h \\ &= \pi (3)^2 (15) \\ &= 135\pi \\ &= 424\,\text{cm}^3 \end{aligned}$$

b. Drawing the net



From the net we can see that the surface area is the sum of the area of the two circles and the rectangle.

$$\begin{aligned} SA &= 2\pi r^2 + 2\pi rh \\ &= 2\pi (3)^2 + 2\pi (3)(15) \\ &= 18\pi + 90\pi \\ &= 108\pi \\ &= 339\,\text{cm}^2 \end{aligned}$$

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Question 4

A solid cylinder of radius 5 cm and height 9 cm is melted down and recast into a solid cube. Find the side of the cube.

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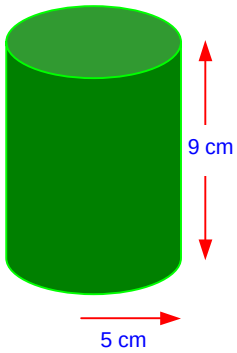
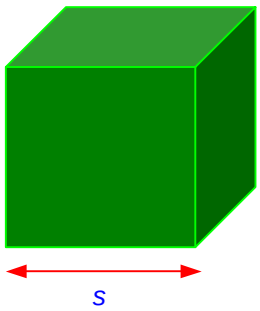
Solution to question 4





The cylinder and the cube have the same volume.

The volume of the cylinder is given $= \pi r^2 h$

$$= \pi (5)^2 (9)$$
$$= 225\pi \text{ cm}^3$$

Now the volume of the cylinder $=$ the volume of the cube

Let s be the length of the side of the cube

The volume of the cube $= s^3$

$$225\pi = s^3$$
$$s = \sqrt[3]{225\pi}$$
$$= 8.91\text{cm}$$

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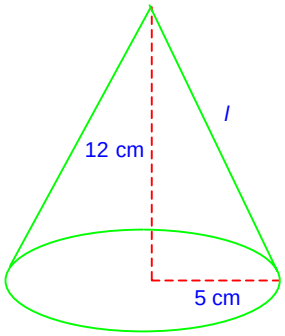
Question 5

a. Find the volume of the following cone, with radius 5 cm and vertical height 12 cm.



b. The cone has a slant height of l cm. Find the value of l.

c. Find the curved surface area of the cone.

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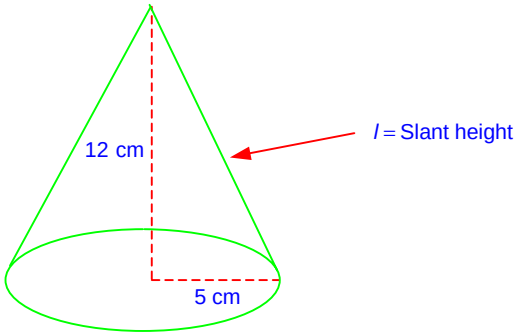
Solution to question 5



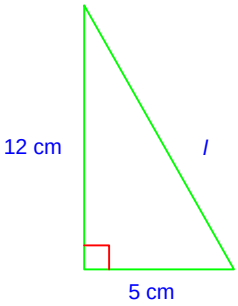
a. The volume of a cone $= \frac{1}{3}\pi r^2 h$

$= \frac{1}{3}\pi(5)^2(12)$

$= 100\pi$

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

b.



By Pythagoras'

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

$l = \sqrt{169}$

$= 13\,\text{cm}$

c. The curved surface area $= \pi r l$

$= \pi(5)(13)$

$= 65\pi$

$= 204\,\text{cm}^2$

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Question 6

Find the volume and curved surfaced area of a sphere radius 4 cm.

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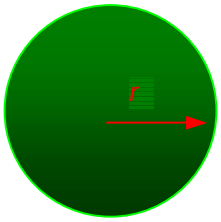
Solution to question 6



$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$
$$= \frac{4}{3}\pi(4)^3$$
$$= \frac{256}{3}\pi$$
$$= 268\,\text{cm}^3$$

$$\text{Curved surface area} = 4\pi r^2$$
$$= 4\pi(4)^2$$
$$= 64\pi$$
$$= 201\text{cm}^2$$

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Question 7

Find the height of a squared based pyramid of volume 40 m^3 and base area 9 m^2

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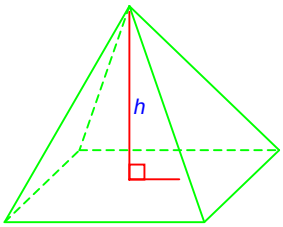
Solution to question 7



$$\text{The volume of a pyramid} = \frac{1}{3} \times \text{base area} \times \text{height}$$

$$\begin{aligned} \Rightarrow \text{height} &= \frac{3 \times \text{ volume}}{\text{base area}} \\ &= \frac{3 \times 40}{9} \\ &= 13.3\,\text{cm} \end{aligned}$$

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Question 8

A small pencil consists of a cylinder of radius 6 mm, which is ‘sandwiched’ between a hemisphere and cone of the same radius. The height of the 50 mm. Find the total volume of the pencil.

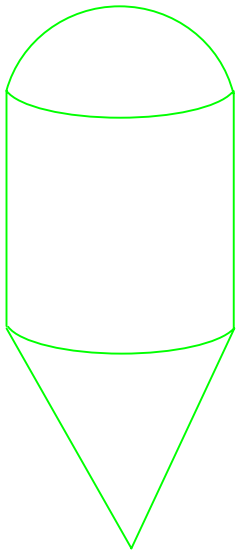

Diagram not to scale

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Solution to question 8

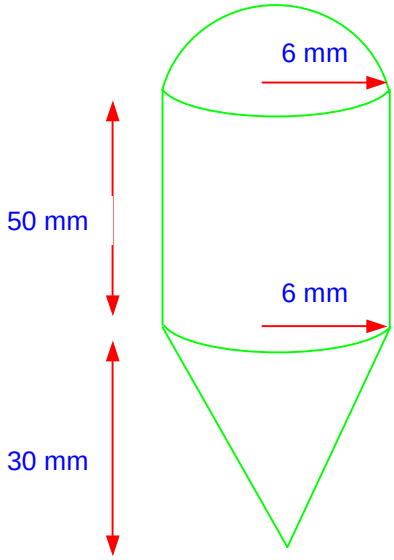

Diagram not to scale

Considering each shape separately, leaving our answers in terms of π, we have

$$\text{Volume of hemisphere} = \frac{1}{2}\left(\frac{4}{3}\pi r^3\right)$$
$$= \frac{1}{2}\left(\frac{4}{3}\pi 6^3\right)$$
$$= 144\pi$$

$$\text{Volume of cylinder} = \pi r^2 h$$
$$= \pi(6)^2(50)$$
$$= 1800\pi$$

$$\text{Volume of cone} = \frac{1}{3}\pi r^2 h$$
$$= \frac{1}{3}\pi(6)^2(30)$$
$$= 360\pi$$

$$\text{Total volume of pencil} = 144\pi + 1800\pi + 360\pi = 2304\pi = 7238 = 7240\,\text{mm}^3$$

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