

SAMPLE PAPER 5: PAPER 2

QUESTION 9 (40 MARKS)

Question 9 (a)

$$\frac{|BC|}{|AB|} = \frac{|DE|}{|AD|} \Rightarrow \frac{1.5}{1.5+h} = \frac{2.75}{5.75+h}$$

$$1.5(5.75+h) = 2.75(1.5+h)$$

$$8.625 + 1.5h = 4.125 + 2.75h$$

$$4.5 = 1.25h$$

$$\therefore h = \frac{4.5}{1.25} = 3.6 \text{ cm}$$

$$\sin \theta = \frac{1.5}{1.5+3.6} = \frac{1.5}{5.1} \Rightarrow \theta = \sin^{-1}\left(\frac{1.5}{5.1}\right) = 17.1^\circ$$

Question 9 (b)

$$\text{Height } H = 3.6 + 2(1.5) + 2(2.75) = 12.1 \text{ cm}$$

$$\text{Radius } R : \tan \theta = \frac{R}{H} \Rightarrow R = 12.1 \tan 17.1^\circ = 3.72 \text{ cm}$$

Question 9 (c)

$$V = \frac{1}{3} \pi R^2 H = \frac{1}{3} \pi (3.72)^2 (12.1) = 175 \text{ cm}^3$$

Question 9 (d)

$$\sin 17.1^\circ = \frac{r}{3.6-r}$$

$$(3.6-r) \sin 17.1^\circ = r$$

$$3.6 \sin 17.1^\circ - r \sin 17.1^\circ = r$$

$$3.6 \sin 17.1^\circ = r + r \sin 17.1^\circ$$

$$3.6 \sin 17.1^\circ = r(1 + \sin 17.1^\circ)$$

$$\therefore r = \frac{3.6 \sin 17.1^\circ}{(1 + \sin 17.1^\circ)} = 0.82 \text{ cm}$$

Volume of empty space with two spheres:

$$V_1 = 175 - \frac{4}{3} \pi (2.75)^3 - \frac{4}{3} \pi (1.5)^3 = 73.75 \text{ cm}^3$$

Volume of empty space with three spheres:

$$V_2 = 73.75 - \frac{4}{3} \pi (0.82)^3 = 71.44 \text{ cm}^3$$

$$\% \text{ decrease in empty space} = \frac{73.75 - 71.44}{73.75} \times 100\% = 3.13\%$$

