

Qu. 4

Beam strength $\propto \frac{I}{d^2}$ (Z)

$$\therefore \frac{\frac{1}{12} 2.5 \times 5^3}{\frac{5}{2}} = \frac{\frac{1}{12} (2.5 D^3 - 2.0 (D-0.5)^3)}{D/2}$$

$$\text{or } 2.5 \times 5^2 = 2.5 D^2 - \frac{2 (D-0.5)^3}{D}$$

rearranging gives:

$$\frac{2 (D-0.5)^3}{D} - 2.5 D^2 + 2.5 \times 5^2 = 0$$

this equation is best solved using a spreadsheet (use 'Solver') or by using Derive.

When solved $D = 8.7 \text{ cm}$

$$\text{Weight solid} = b d l \rho = 2.5 \times 5 \times 100 \times 9.8 = \underline{12.25 \text{ kg}}$$

$$\text{" hollow} = (BD - bd) l \rho$$

$$= (2.5 \times 8.7 - 2 \times 8.2) \times 100 \times 9.8 = \underline{5.21 \text{ kg}}$$

(e. Some strength beam has less than half the weight of the solid beam.