2010 Q9.

(a) when a body is wholly or partly immersed in a liquid, it suffers an upthrust, or buoyancy, which is equal in magnitude to the weight of the liquid displaced.

$$B = V\rho g$$
$$= 0.61\left(\frac{4}{3}\pi(1)^3\right).1000.g$$
$$= 610.\frac{4}{3}\pi g$$

$$W = V\rho g$$
$$= \left(\frac{4}{3}\pi(1)^3 - \frac{4}{3}\pi(0.8)^3\right)\rho.g$$

$$W = B$$

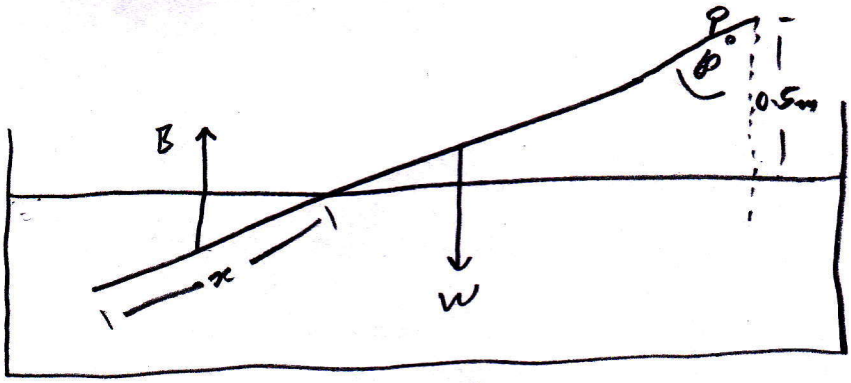
$$\left(\frac{4}{3}\pi - \frac{4}{3}\pi(0.8)^3\right)\rho g = 610\,\frac{4}{3}\pi g$$

$$\Rightarrow \rho - (0.8)^3\rho = 610$$

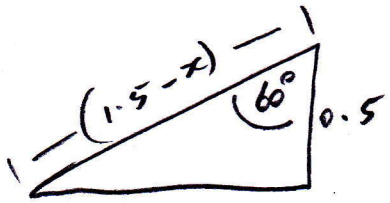
$$\Rightarrow 0.488\rho = 610$$

$$\Rightarrow \rho = 1250 \text{ km m}^{-3}$$

(b) (i)



Let the length of the immersed part = x



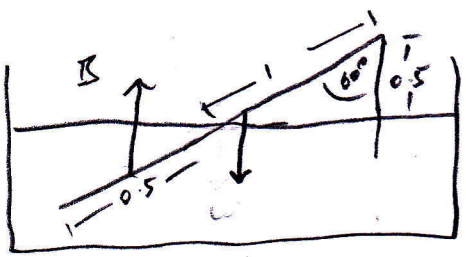
$\Rightarrow (1.5-x)\cos 60 = 0.5$

$\Rightarrow (1.5-x)\frac{1}{2} = 0.5$

$\Rightarrow 1.5 - x = 1$

$\Rightarrow x = 0.5$

Take the moments about P:



$B.1.25\sin 60^\circ = W(0.75)\sin 60^\circ$

$\Rightarrow 1.25B = 0.75W$

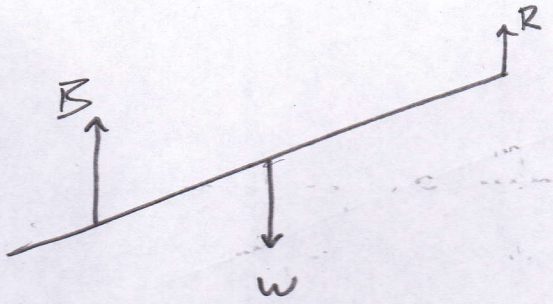
Also: $R = \frac{\frac{1}{3}W(1)}{S_{Rod}} = \frac{W}{3S_{Rod}}$

Substituting: $1.25\left(\frac{W}{3S_{Rod}}\right) = 0.75W$

$\Rightarrow \frac{1.25}{3S_R} = 0.75$

$\Rightarrow S_R = \frac{5}{9}$

(ii)



$B + R = W$ but $B = \frac{W}{3S_R} = \frac{W}{3.\frac{5}{9}}$

$\Rightarrow \frac{3W}{5} + R = W$ $= \frac{9W}{3.5} = \frac{3W}{5}$

$\Rightarrow R = W - \frac{3}{5}W$

$\Rightarrow R = \frac{2}{5}W$