8. A rectangular boat with horizontal dimensions of 2.0 m by 2.5 m carries a cargo with a mass of 5000 kg. When floating in water with the cargo, the boat's bottom is at a depth of 1.8 m. What is the mass of the boat without the cargo?

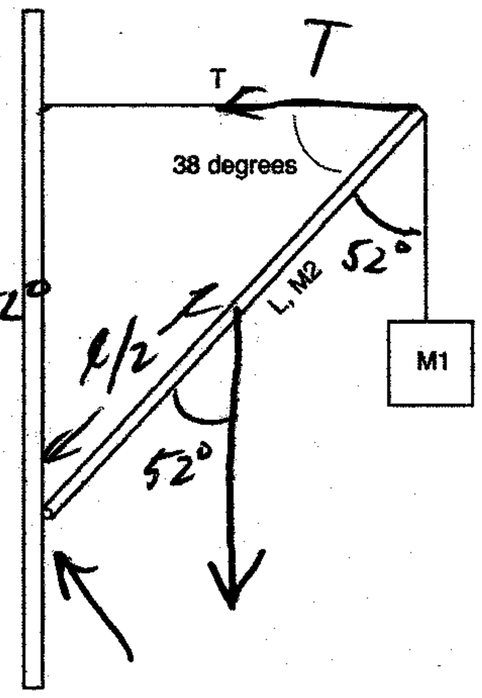
$B = \rho_w g V_{submerged} = (1000\ kg/m^3)(9.8\ m/s^2)(2.0\ m)(2.5\ m)(1.8\ m)$

$B = 89.2\ kN \qquad W_{cargo} = (5000\ kg)g = 49.0\ kN$

$W_{boat} + W_{cargo} = B \quad$ so $\quad W_{boat} = 89.2\ kN - 49.0\ kN = 39.2\ kN$

$m_{boat} = \frac{W_{boat}}{g} = 4000\ kg$

9. A pole with L=4.5 m and mass M2=55 kg has its left hand end pivoted to a wall as shown. It is supported by a horizontal cable, and a mass M1=35 kg hangs vertically from its end. Find the tension in the horizontal cable.



Torques about P add to 0.

$T\ell \sin 38° - (M_1)g\ell \sin 52° - (M_2)g\frac{\ell}{2}\sin 52° = 0$

ℓ's cancel

$T = \frac{g}{\sin 38°}\left[M_1 + \frac{M_2}{2}\right]\sin 52° = 784\ N$

10. Find the horizontal and vertical components of the reaction force at the pivot in problem 10.

$\Sigma F_x = 0 \qquad R_x - T = 0 \qquad R_x = T = 784\ N$

$\Sigma F_y = 0 \qquad R_y - m_1 g - m_2 g = 0 \qquad R_y = (m_1 + m_2)g = 882\ N$

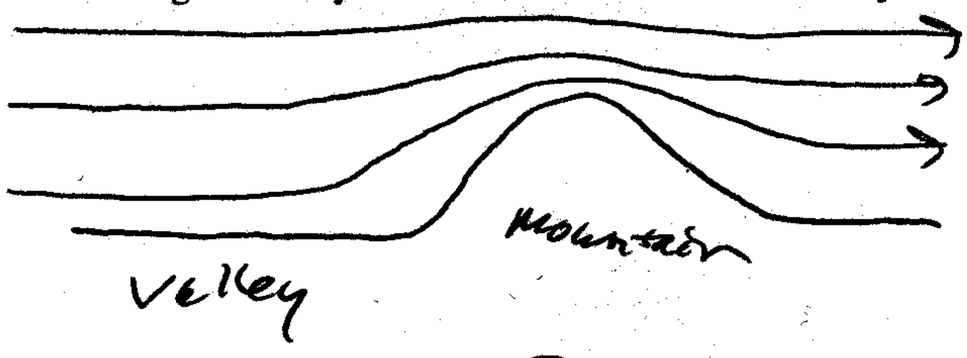
11. An airplane has wings with an area of 45 m^2. Its mass is 2400 kg. It flys level at an airspeed of 120 m/s, which can be taken to be the speed of the air on the bottom surface of the wings. Neglect the thickness of the wings. What must the speed of the air moving over the top of the wings be for level flight (lift=weight)?

$P_b + \frac{1}{2}\rho_{air} V_b^2 = P_t + \frac{1}{2}\rho_{air} V_t^2$ or $P_b - P_{top} = \frac{1}{2}\rho_{air}(V_t^2 - V_b^2)$

$P_b - P_t = \frac{mg}{A} = 523\ Pa \qquad V_t^2 = V_B^2 + \frac{2}{\rho_{air}}(P_b - P_t) = (120\ m/s)^2 + \frac{2}{1.29\ kg/m^3}(523\ Pa)$

$V_t = 123\ m/s$

12. A wind blows through a valley. The wind speed is much higher when it goes over the mountains surrounding the valley than it is on the floor of the valley? Why?



Air flow is constricted over mountain.

By equation of continuity, V increases.