CH#15

Q.1 $P = P_0 + \rho g h$

$= 1.01 \times 10^5 + (1680 \times 9.8 \times 0.5)$

$P = 2.57 \times 10^5$ Pa

Q.2 $R_m = \rho A v = 10^3 \times (\pi (4.2 \times 10^{-2})^2) \times 4.5$

$= 24.92$ kg/s

Q.3 $A_1 v_1 = A_2 v_2 \Rightarrow v_1 = \frac{A_2 v_2}{A_1} = \frac{4.1 \times 10^{-4} \times 8.4}{9.3 \times 10^{-4}} = 3.7$ m

$P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$

$y_1 = 0$ (ground). $y_2 = 13$ m.

$P_1 + \frac{1}{2}(10^3)(3.7)^2 + 0 = 1.66 \times 10^5 + \frac{1}{2}(10^3) \times (8.4)^2 + 10^3 \times 9.8 \times 13$

$\Rightarrow P_1 = 3.218 \times 10^5$ Pa

Q.4 $r_B = 0.5 r_A$, $v_A = 4$ m/s

$\Rightarrow A_A v_A = A_B v_B$

$(\pi r_A^2)(4) = (\pi r_B^2) v_B$

$v_B = \frac{4 r_A^2}{(0.5)^2 r_A^2} = 16$ m/s.

Q.5 (Special case of open tank):

$v_{\text{at the hole}} = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 1}$

$v = 4.42$ m/s

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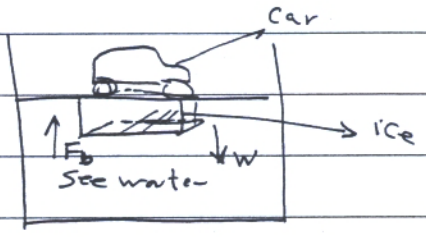
Q. 6



Ice slab is completely submerged inside the water.

$$\Rightarrow \underset{\text{(buoyant force)}}{F_b} = W_{ice} + W_{car}$$

$$\rho_{see} V_{ice} g = \rho_{ice} V_{ice} g + m_{car} g$$

$$1020 \times V_{ice} \cancel{g} = 920 \times V_{ice} \times \cancel{g} + 2000 \times \cancel{g}$$

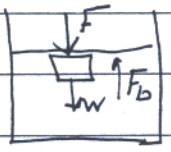
$$(1020 - 920) V_{ice} = 2000$$

$$V_{ice} = \frac{2000}{100} = 20\ m^3$$

$$V_{ice} = A \times (\text{thickness})$$

$$\Rightarrow A = V_{ice} / \text{thick} = \frac{20}{1} = 20\ m^2$$

Q. 7



$$F_b = W_{ice} + F_{orce}$$

$$\rho_{\underset{water}{see}} \times V_{ice} \times g = \rho_{ice} \times V_{ice} \times g + F_{ext}$$

$$F_{ext} = V_{ice}\, g\, (\rho_{water} - \rho_{ice}) \qquad V_{ice} = 10^3\ cm^3 = 10^{-3}\ m^3$$

$$F = 10^{-3} \times 9.8 \times (10^3 - 917) = 0.813\ N$$

Cont, 15 →

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Q. 8

$$P = P_o + \rho g h$$

$$= 1.01 \times 10^5 + (1003 \times 9.8 \times 2)$$

$$= 1.206 \times 10^5 \text{ Pa}$$

$$F = PA = 1.206 \times 10^5 \times (30 \times 10) = 36.9 \times 10^6 \text{ N}$$

Q.9 $V_{f\text{displaced fluid}} = 0.67\ V_{block}$ (inside water)

In water $F_b = W_{ice}$

$$\rho_{water} \times V_f = \rho_{ice} \times V_{block}$$

$$10^3 \times 0.67\ V_{block} = \rho_{ice} \times V_{block}$$

$$\rho_{ice} = 670 \text{ kg/m}^3$$

In oil $\rho_{oil} \times V_{oil\ displaced} = \rho_{ice} \times V_{ice}$, $V_{oil\ displaced} = 0.9\ V_{ice}$

$$\rho_{oil} \times 0.9\ V_{ice} = 670 \times V_{ice}$$

$$\rho_{oil} = \frac{670}{0.9} = 744.4 \text{ kg/m}^3$$

Q.10 $A_1 V_1 = A_2 V_2 \Rightarrow V_2 = \frac{A_1 V_1}{A_2}$

$$V_2 = \frac{\pi (1 \times 10^{-2})^2}{\pi (0.5 \times 10^{-2})^2} \times 4 = 16 \text{ m/s}$$

$$P_2 = P_1 + \frac{1}{2}\rho(V_1^2 - V_2^2) + \rho g (Y_1 - Y_2)$$

$$P_2 = 4 \times 10^5 + \frac{1}{2}(10^3)(4^2 - 16^2) + 10^3 \times 9.8 (0 - 5)$$

$$(P_2 = 2.31 \times 10^5 \text{ Pa})$$

Cont. 15

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Q. 11 $W - W' = F_b$

$10 - 6 = \rho_{mat} \times V_f \times g$

When $V_f = V_{sphere}$

$4 = 10^3 \times V_{sphere} \times g$

$V_{sph} = 4.08 \times 10^{-4}\ m^3 = \frac{4}{3}\pi r^3$

$\Rightarrow$

$r^3 = \frac{3 \times 4.08 \times 10^{-4}}{4 \times \pi}$

$r = 0.046\ m = 4.6\ cm$

Q. 12 $v = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 0.9}$

$v = 4.2\ m/s$

$R_v = 8\ l/min = \frac{8 \times 10^{-3}}{60} * \frac{m^3}{s}$

$A\,v = 8 \times 10^{-3}/60$

& $A = \frac{8 \times 10^{-3}}{60 \times 4.2} = 3.17 \times 10^{-5}\ m^2$

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