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1) $V_1 = 5ms^{-1}$ $\quad V_2 = 2ms^{-1}$

$P_1 = 2.5m$

$P_2 = ?$ $\quad P_{T_1} - P_{T_2} = \frac{0.35(V_1 - V_2)^2}{2g}$

$= \frac{0.35 \times 3^2}{2 \times 9.81} = 0.161$

$P_{T_1} - P_{T_2} = 0.161$

$2.5 - P_{T_2} = 0.161$

$P_{T_2} = 2.5 + 0.161$

$P_{T_2} = 2.72m$

$\therefore$ pressure head at lower end = 2.7m

2) $D = 200mm$

$= 0.20m$

$A_1 = \frac{\pi d^2}{4} = \frac{\pi (0.20)^2}{4} = 0.0314m^2$

$$= \frac{0.98 \times 0.0314 \times 7.85 \times 10^{-3} \sqrt{2 \times 9.81 \times 4 \ldots}}{\sqrt{(0.0314)^2 - (7.85 \times 10^{-3})^2}}$$

$$= 0.0210869166 \text{ s}$$

3) $d_1 = 150mm = 0.15m$

Pipe diameter $d_2 = 300mm = 0.30m$

$$A_2 = \frac{\pi d^2}{4} = \frac{3.142 \times 0.15}{4} = 0.0177m^2$$

$$A_1 = \frac{\pi d^2}{4} = \frac{3.142 \times 0.30^2}{4} = 0.0707m^2$$

$y = 500mm\ Hg = 0.50m\ Hg$

$C_d = 0.64$

$$h = \frac{S.G \text{ of Hg} - S.G \text{ of oil}}{S.G \text{ of oil}} \times y$$

$$= \frac{13.6 - 0.9}{0.9} \times 0.5$$

$$= 7.06m$$

$$Q_{actual} = \frac{0.6 \times 0.0707 \times 0.0177 \sqrt{2 \times 9.81 \times 7.06}}{\sqrt{(0.020)^2 - (0.0177)^2}}$$

$$= 0.1327$$

4 $V = \sqrt{2gh}$

$$H = J\left(\frac{\text{S.G of mercury} - \text{S.G of water}}{\text{S.G of water}}\right)$$

$$H = 0.17\left(\frac{13.0 - 1.026}{1.026}\right)$$

$$= 0.17 \times 12.26$$

$$= 2.0842\,m$$

$$V = \sqrt{2 \times 9.81 \times 2.0842}$$

$$= 6.39\,ms^{-1}$$

∴ Speed of Submarine $= 6.39\,ms^{-1}$

8) D. Charge $Q = 0.05\,m^3/s$

$P = 16\,a$

$p_2 = 17.658\ N/cm^2 = \frac{17.658}{10^{-6}} = 17.658 \times 10^6$

Specific gravity of mercury = 13.6

$\frac{\rho_1}{\omega} = \frac{\rho_1}{\rho g} = \frac{17.658 \times 10^6}{1000 \times 9.81} = 1.8 \times 10^3$

C_r Vacuum pressure

$= \frac{p_2}{\omega} = 300\ mm\ Hg$

$d_2 = 100\ mm = 0.1\ m$

$= 0.3 \times 13.6$ $A_2 = \frac{\pi d^2}{4} = \pi \frac{(0.1)^2}{4} = 7.854 \times 10^{-3}$

$p_2 = -4.08$

$h = 1.8 \times 10^3 + 4.08$

$= 4.08800002\ m$

$h = \frac{p_1}{\omega} - \frac{p_2}{\omega}$

$Q_{actual} = \frac{C_d A_1 A_2 \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}}$