MCQ 9

Solutions

Question 1

Use flowrate: $A_1 v_1 = A_2 v_2 \Rightarrow v_2 = \frac{A_1}{A_2} v_1$

(A) Thus $v_2 = \frac{\pi (2.5)^2}{\pi (1.5)^2} (0.54) = \boxed{1.5\ m/s}$

Question 2

Use Bernoulli's equation with $y_1 - y_2 = 4.5\ m$

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

but $P_1 = P_2$ and $v_1 = 0$ (See example 9.10)

$\Rightarrow \rho g y_1 = \frac{1}{2}\rho v_2^2 + \rho g y_2 \Rightarrow \boxed{v_2 = 9.4\ m/s}$

(A)

b) Use flow rate $= A v$

volume ← $\frac{\Delta V}{\Delta t}$ → time; $\frac{\Delta V}{\Delta t} = A v \Rightarrow \Delta V = \Delta t \times A \times v$

$\Delta t = (60\ s)$, $A = (0.25 \times 10^{-4})$, $v = (9.4)$

$\boxed{\Delta V = 0.014\ m^3}$

Question 3

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

but $y_1 - y_2 = 4$ m , $\rho = 1000$ kg/m^3, we need v_1 and v_2

Since flow rate is given $= 0.08$ m^3/s we can solve for v_1 and v_2:

flow rate $= Av \Rightarrow 0.08 = A_1 v_1 \rightarrow v_1 = \frac{0.08}{\pi(0.1)^2}$

$v_1 = 2.55$ m/s

Also: $0.08 = A_2 v_2 \rightarrow v_2 = \frac{0.08}{\pi(0.15)^2} = 1.13$ m/s

Thus: $130 \times 10^3 + \frac{1}{2}(1000)(2.55)^2 + 1000 \times 9.8 \times y_1 =$

(A) $P_2 + \frac{1}{2}(1000)(1.13)^2 + 1000 \times 9.8 \times y_2$

using $y_2 - y_1 = 4$ m $\Rightarrow$ Solve for P_2

$$\boxed{P_2 = 93 \times 10^3 \text{ Pa}}$$

Question 4:

(D)

$$P = 4 \times 10^5 \text{ Pa}$$

$$P = \frac{F}{A} \Rightarrow F = PA = \dots = 4000 \text{ N}$$

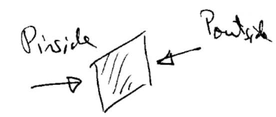
Question 5

(B)

$$P_{liquid} = \rho g d$$

$$= 1000 \times 9.8 \times 26 = \boxed{255 \text{ kPa}}$$

Question 6



$$\Delta P = 760 - 210 = 550 \text{ mm Hg}$$

in pascal $\Delta P = \frac{550}{760} \times 1.013 \times 10^5 = 73.3 \text{ kPa}$

This is one atm (1.013×10^5)

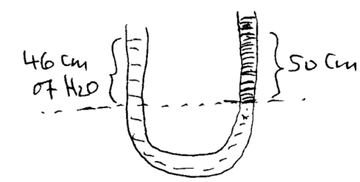
(D)

$$F = (\Delta P) A = (73.3 \times 10^3 \text{ Pa})(600 \times 10^{-4} \text{ m}^2)$$

$$= \boxed{4400 \text{ N}}$$

Question 7

At the dashed line:



$$P_{left} = P_{right}$$

(A)

$$\rho_{H_2O}\, g\, d_{H_2O} = \rho_{oil}\, g\, d_{oil}$$

$$(1000)(0.46) = (\rho_{oil})(0.5) \Rightarrow \boxed{\rho_{oil} = 920 \text{ kg/m}^3}$$

Question 8

$P_{atm} = 1.0 \times 10^5$ Pa

$P_{oil} = \rho_{oil}\, g\, d_{oil} = (0.78 \times 10^3 \text{ kg/m}^3)(9.8)(0.27)$

(A) $P_{oil} = 2064$ Pa

$P_{chamber} = 1.0 \times 10^5 - 2064 \approx 98 \times 10^3$ Pa

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Question 9

$W_{apparent} = W_{cube} - F_B$

$(\rho_{cube} \times V_{cube} \times g) - (\rho_{H_2O} \times V_{cube} \times g)$

(D) Where $V_{cube} = (0.02)^3$

$W_{apparent} = \ldots = 0.43N$

$m_{apparent} = \frac{0.43}{9.8} = 0.0448 kg = 44.8 g$

Question 10

Tension = $W_{apparent}$ (apparent weight in oil)

$\Rightarrow W_{apparent} = W_{Al} - F_B = (\frac{8.35}{1000} kg)(9.8) - \rho_{oil} V_{Al}\, g$

$\rho_{oil} \rightarrow (0.75 \times 10^3 \text{ kg/m}^3)$

(A) We need $V_{Al} = \frac{0.00835 \text{ kg}}{2700 \text{ kg/m}^3} = 3 \times 10^{-6} m^3$

Thus $W_{apparent}$ = Tension = 0.059 N