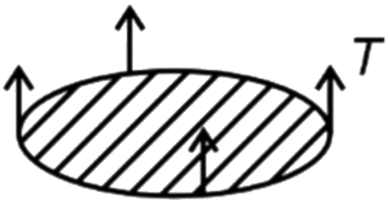
Solutions

S1. Ans. (d)



Excess force $= T \times 2\pi R$

$= \frac{7}{100} \times 2 \times 3.14 \times \frac{4.5}{100}$

$= 197.82 \times 10^{-4}$

$= 19.8 \times 10^{-3} N$

$= 19.8\, mN.$

S2. Ans. (d)

Surface energy of bubble

= 2 × charge in surface area × surface tension

$= 8\pi R^2 \times T$

$= 8 \times 3.142 \times 4 \times 10^{-4} \times 3 \times 10^{-2} J$

$30.1 \times 10^{-5} J$

S3. Ans. (c)

Factual (theory based)

S4. Ans. (a)

Initially speed is zero, then increases & after some time it becomes constant.

Acceleration (slope of v/t curve) of ball first decreases and after some time it becomes zero.

S5. Ans. (d)

$P = P_0 + \frac{4T}{R}$

⇒ R increases and P decreases

S6. Ans. (b)

Hint: In a capillary tube force of surface tension balances the weight of water in capillary tube

F_s = 2πrTcosθ = mg

Here, T and θ are constant

So, m ∝ r

Hence, $\frac{m_2}{5.0} = \frac{2r}{r}$

⇒ m_2 = 10.0g

S7. Ans. (b)

Hint: When angle of contact ≥ 90° then liquid doesn't wet solid.

S8. Ans. (a)

Hint: According to the question

76 cm × ρ_{Hg} × g = h × ρ_L × g

$h = 76\, cm \times \frac{\rho_{Hg}}{\rho_L} = 76\, cm \times \frac{13600}{760} = 13.6$ m

S9. Ans. (c)

Hint: Excess pressure $= \frac{4T}{R}$,

Gauge pressure $= \rho g Z_0$

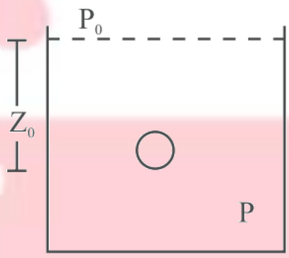
Pressure at equation

$P_0 + \frac{4T}{R} = P_0 + \rho g Z_0$

$Z_0 = \frac{4T}{R \times \rho g}$

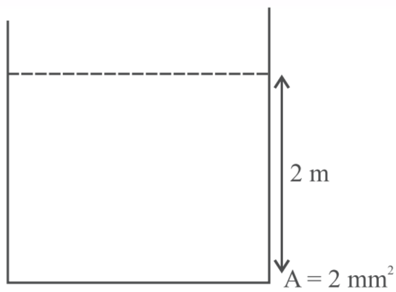
$Z_0 = \frac{4 \times 2.5 \times 10^{-2}}{10^{-3} \times 1000 \times 10} m$

$Z_0 = 1\, cm$



S10. Ans. (a)

Hint:



Rate of flow liquid

$Q = Au = A\sqrt{2gh}$

$= 2 \times 10^{-6} m^2 \times \sqrt{2 \times 10 \times 2} m/s$

$= 2 \times 2 \times 3.16 \times 10^{-6}\ m^3/s$

$= 12.64 \times 10^{-6}\ m^3/s$

$= 12.6 \times 10^{-6}\ m^3/s$

S11. Ans. (a)

Hint: Rate of heat produced = $F_v \cdot v_{terminal}$

$\frac{dQ}{dT} = F_v . v_T$

$= 6\pi\eta r v_T . v_T$

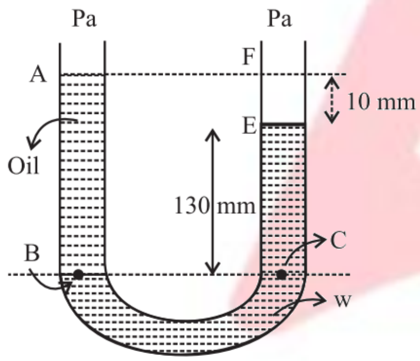
$\propto r . v_T^2$

$\propto r . r^4 \qquad [\therefore v_T \propto r^2]$

$\propto r^5$

S12. Ans. (c)

Hint:



$P_B = P_C$ (pressure at same level is same) [Pascal law]

$H_{\rho_{oil}} g = h\rho w_g$

$(65 + 65 + 10) \times 10^{-3} \times \rho_0 = (65 + 65) \times 10^{-3} \times 10^3$

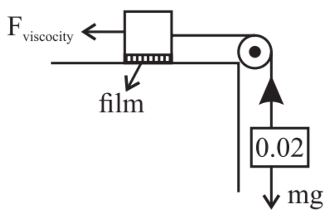
$140\ \rho_0 = 130 \times 10^3$.

$\rho_0 = \frac{130}{140} \times 10^3$

$\rho_0 = 928\ kgm^{-3}\ (approx)$

S13. Ans. (c)

Hint:



$F_v = \eta A \frac{dv}{dx}$

$mg - F_V = ma$

$\therefore a = 0$

$mg = F_v$

$mg = \eta A \frac{dv}{dx}$

$\eta = \frac{0.02 \times 10 \times 0.6 \times 10^{-3}}{0.2 \times 0.17}$

$\eta = 3.45 \times 10^{-3}$ Pa-s

S14. Ans. (d)

Hint: $h = \frac{2T\cos\theta}{\rho g r}$

As r, h, T are same, $\frac{\cos\theta}{\rho} = constant$

$\Rightarrow \frac{\cos\theta_1}{\rho_1} = \frac{\cos\theta_2}{\rho_2} = \frac{\cos\theta_3}{\rho_3}$

As $\rho_1 > \rho_2 > \rho_3$

$\Rightarrow \cos\theta_1 > \cos\theta_2 > \cos\theta_3 \Rightarrow \theta_1 < \theta_2 < \theta_3$

As water rises so θ must be acute

So, $0 \le \theta_1 < \theta_2 < \theta_3 < \frac{\pi}{2}$

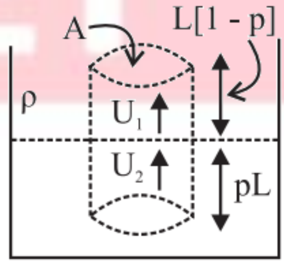
S15. Ans. (d)

Hint: $W = T(2\Delta A) \qquad \{\Delta A = (20 - 8)cm^2\}$

$$\Rightarrow T = \frac{W}{2\Delta A} = \frac{3 \times 10^{-4}}{2 \times 12 \times 10^{-4}} = 0.0125\ Nm^{-1}$$

S16. Ans. (d)

Hint:



For equilibrium.

$U_1 + U_2 = mg$

AL[1 – p]g × ρ + ApL nρg = ρ_b ALg

ALgρ [1 – p + np] = ρ_b ALg

d = ρ_b = ρ[1 + (n – 1)p]

S17. Ans. (b)

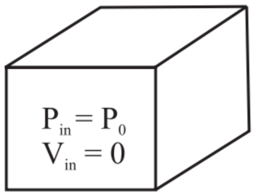
Hint: By Bernoulli's equation

$P + \frac{\rho v^2}{2} = P_0$

$P_0 - P = \frac{\rho v^2}{2}$

$F = (P_0 - P)A$

$F = \frac{\rho v^2 A}{2}$



F = 2.4 × 10^5 upward

S18. Ans. (c)

Hint: The liquid meniscus adjusts its radius of curvature so that hR = constant.

S19. Ans. (c)

Hint: As surface area decreases so energy is released. Released energy

$= 4\pi R^2 T[n^{1/3} - 1]$ where $R = n^{1/3} r$

$= 4\pi R^3 T\left[\frac{1}{r} - \frac{1}{R}\right]$

$= 3VT\left[\frac{1}{r} - \frac{1}{R}\right]$

S20. Ans. (a)

Hint: The wettability of a surface by a liquid depends primarily on angle of contact between the surface and the liquid