JEE Advanced 2014 Paper- 2

PHYSICS

Sol. **1**. $I_1/I_2 = R/a\, a = 90\Omega$

$\Rightarrow R = a\, I_1/I_2$

$\Delta R/R = \Delta I_1/I_2 + \Delta I_1/I_2$

$\Delta R = R[\Delta I_1/I_1 + \Delta I_2/I_2]$

$\Rightarrow \Delta R = 6[0.1/60 + 0.1/40 * 3/2]$

$\Delta R = 2.5 * 0.1 = 0.25$
$R = 60 \pm 0.25$

Sol: **2.** $\Rightarrow \text{mgh} = \frac{1}{2} mv^2$

$\text{mg}\cos\theta - N = mv^2/R$

$\text{mg}\cos\theta - N = 2\text{mg}\, h/R$

After $h = R/2,$

$\Rightarrow N$ should be in words an lead

$\Rightarrow N$ should be out words and wire

($\because$ Action – Reaction pair)

Force applied an the wire (normal) changes from radially in words initially to radially out words alter.

Sol: **3.** $V = gt$ (dropped from $\propto$ height $u = o$

$K.E >= 1/2\, mv^2$

$\Rightarrow K.e. = 1/2\, M\, GT^2$

$\Rightarrow K.e. \propto \mathrm{T}^2$

Sol: **4.** For the lower meniscus fending the contact angle, with the contacting layer From the geometry,

Angle formed with the radon will be $(\theta + \propto/2)$

So, height, $h = 25/\mathrm{rpgcos}\,(\theta + \propto/2)$

Also, calculating for ensure below to the liquid surface will be

$P_{\mathrm{Lawer}}\,(P_0 - 2T/R + Pgh)$

Sol: **5.** $E_1 = kQ/R^2 \quad E_2 = k2Q/R^2$

Q inside sphere of radius R

$q = 4Q/4/3\pi * 5R^3\, 4/3\pi\, R^3 = Q/2$

$E_3 = kQ/2KR^2$

Clearly, $E_1 > E_2 > \underline{F}_3$

Sol: **6.** Energy absorbed

Per unit time $= IA/4$

Energy radiated $= 6A(T^4 - T_0{}^4)$

Per unit time

$T \rightarrow$ final temp.

$T_0 \rightarrow$ surrounding temp

$IA/-4 = 6A(T^4 - T_0 4) \Rightarrow T_0{}^4 = T_0{}^4 + I/46 \Rightarrow T = 330K$

Sol: **7.** $\sin\theta_c = n_1/n_b$

$n_1 = n_b \sin\theta_c$

$n_1 = 2.72 * 5.27/10 = 1.36$

Sol: **8.** $E = \lambda C/\lambda$

$K.E. = E - \phi$

$K.E._1/K.E._2 = E_1 - \phi/E_2 - \phi$

$1/2\,\text{mu}_1\,2/1/2\,\text{mu}_2\,2 = 1240/\lambda_1 - \phi/1240/\lambda_2 - \phi$

$4/1 = 1240/248 - \phi/1240/310 - \phi$

$\Rightarrow = 3.7eV$

Sol: **9.** $\lambda = hC/E_K - E_L$ for K_x

For $K_x, DE = hv = Rhc\left(Z^2\right)\left(1/1^2 - 1/2^2\right)$

$= ¾\,RhcZ^2$

$\lambda_{cu}/\lambda_{mo} = Z_{mo}\,2/Z_{cu}\,2 = 2.14$

Sol: **10.** $R_p = R_e/10\ f_p = f_e$

(B) $M_e/4/3\pi\,R_e 3 = M_p/4/3\pi\,R_e 3 * 1000$

$M_p = M_e/1000$

$dF = GM_p / R_p^3 \, x\lambda dxiF = GM_e\lambda / R_p^3 \int_{\frac{4}{5}Rp}^{Rp} xdx$

$\Rightarrow F = GM_p / R_p^3 x^2$

$\Rightarrow F = 108N$

Sol: **11.** (c) Electric field due to wire $= \mu_0 I / 2\lambda \sqrt{d^2 + h^2}$

Electric field due to circular $100/p = \mu_0 I / 2(q^2 + h^2)^{3/2}$

To cancel out the electric field due to circular loop, equivalent electric field due to wires should be opposite.

Current in wires are in PQ & SR direction

Sol: **12.** (B) $\vec{\tau} = \overrightarrow{M} * \vec{B}$

Sol: **13.** $(D) n_{\text{dia}} Cp_{\text{dia}} (T_g - T_{\text{dia}}) = n_{\text{mono}} (v_{\text{non}} (T_{\text{mono}} - T_t)$

$\therefore V_{\text{dia}} = n_{\text{mono}}$

$7/7(T - 400) = 3/2(700 - T_t)$

$7T - 2800 = 2100 - 3T$

$10T = 4900$

$T = 490V$

Sol: **14.** Ans. (D).

$\Delta W_1 + \Delta U_1 = \Delta Q_1$

$\Delta W_2 + \Delta U_2 = \Delta Q_2$

$\Delta Q_2 + \Delta Q_2 = 0$

$7/2\,R(T-400)=5/2\,R(700-\mathrm{T})$

$\Rightarrow T=6300/12=525k$

So $\Delta W_1+\Delta U_1=2.R_1(525-400)+2R(525-700)$

$=+250R-350R$

$=-100R$

Sol: **15.** (c)

$A_1V_1=A_2V_2$

$\pi d_1{}^2 v_1=\pi d_2{}^2 v_2$

$V_2=d_1{}^2/d_2{}^2\,v_1=2\text{m}5-1$

Sol: **16.** Ans. (A)

$\rho_0-1/2\,\rho_a v_a{}^2$

$=\rho-1/2\,p\ell v\ell^2\text{-}\rho\ell gh$

$v\ell=\sqrt{\rho_a/p\ell v_a}-2gh$

Sol: **17.** Ans. (B). Velocity form orifice $=\sqrt{2gh}$

n height of water in vessel V increases, horizontal range increases.

$V\uparrow R\uparrow$

Lift going up; geff $=g+a$

Lift going down; geff $=g-a$

Free fall $=$ geff $=0$

Uniform velocity; geff $=0$

Sol: **18.** (A). $\vec{F} = \pm KQq/r^2\hat{r}$

Sol: **19.** $1/f = 1/f_1 + 1/f_2$

$1/f = (n = 1)[1R_1 + 1/R_2]$

For' $Q\ldots, f = r/2$

For' $Q, f = r$

$R, f = -r$

$S, f = 2r$

Sol: **20**. (D)

$(m_1 + m_2) g \sin\theta = f_s = \mu m_2 g \omega s\theta$

$[N = m_2 g \cos\theta]$

$Tan\theta = \mu m_2/(m_1 + m_2) = 0.2$

$\Rightarrow \theta = 11.5°$

$it\,\theta > 11.5°\, slipping;\ ts = \mu N$

$\theta < 11.5°, rest; ts = (m_1 + m_2) g \sin\theta$