JEE MAIN - 2009

PHYSICS

39. Sol. (A)

$V_B = (1/e)\left[(hc/\lambda) - \phi\right]$

$V_P = (1/e)\left[(1240/550) - 2\right]eV = 0.2545V$

$V_q = (1/e)\left[(1240/450) - 2.5\right]eV = 0.255V$

$V_r = (1/e)\left[(1240/350) - 3\right]eV = 0.5428V$

If n is the number of photons in unit time then $nhc/\lambda = I$

$\Rightarrow i_p : i_q : i_r = n_p : n_q : n_r = \lambda_p : \lambda_q : \lambda_r$

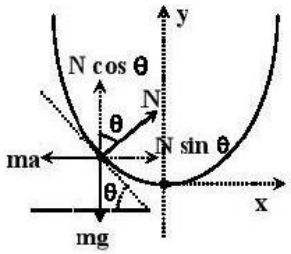
40. Sol. (C)

Restoring torque $= -2 \times k\left(\frac{\ell}{2}\theta\right)\frac{\ell}{2} = \frac{Id^2\theta}{dt^2}$

$$\frac{d^2\theta}{dt^2} = \frac{\frac{k\ell^2}{2}(-\theta)}{\frac{M\ell^2}{12}}$$

$$\Rightarrow \omega = \sqrt{\frac{6k}{M}}$$

41. Sol. (B)



$$\tan\theta = \frac{a}{g}$$

$$\tan\theta = \frac{dy}{dx} = 2kx$$

$$\Rightarrow x = \frac{a}{2gk}$$

42. Sol. (D)

$$x_1 + x_2 = A$$

$$k_1 x_1 = k_2 x_2$$

Hence $x_1 = \dfrac{k_2 A}{k_1 + k_2}$

43. Sol. (A)

44. Sol. (B) & (D)

$$\Delta Q = \Delta U + W$$

For process $B \to C \to D$

ΔU is negative as well as W is also negative

45. Sol. (B) & (C)

46. Sol. (A) & (D)

Larger the length of air column, feebler is the intensity

47. Sol. (B) & (D)

As $-\frac{d\phi}{dt} = emf$ is same, the current induced in the ring will depend upon resistance of the ring. Larger the resistivity smaller the current.

48. Sol.

$$A \to (p,s); B \to (q); C \to (t); D \to (r,s,t)$$

49. Sol.

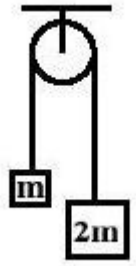
$$A \to (p,q,t); B \to (q); C \to (s); D \to (s)$$

50. Sol. 7

$$B = \frac{\mu_0 I}{4\pi \frac{12x}{5}}[\cos 53° + \cos 37°] = 7\left(\frac{\mu_0 I}{48\pi x}\right)$$

$k = 7$

51. Sol. 8



$2\text{mg} - T = 2\text{ma}$

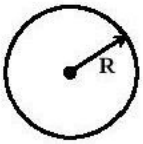
$T - \text{mg} = \text{ma}$

$\Rightarrow \text{a} = g/3$

$T = 4\,\text{mg}/3$

$W = T.s = T.\frac{1}{2}\text{at}^2 = 8\,\text{Joules}$

52. Sol. 2



$\rho = kr^a$

$E\left(r = \frac{R}{2}\right) = \frac{1}{8}E\left(r = R\right)$

$\frac{q_{\text{enclosed}}}{4\pi\varepsilon_0\left(R/2\right)^2} = \frac{1}{8}\frac{Q}{4\pi\varepsilon_0 R^2}$

$32q_{\text{enclosed}} = Q$

$$q_{\text{enclosed}} = \int_0^{R/2} kr^a 4\pi r^2 dr = \frac{4\pi k}{(a+3)}\left(\frac{R}{2}\right)^{(a+3)}$$

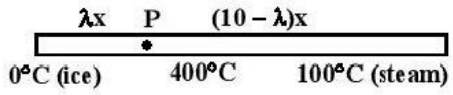
$$Q = \frac{4\pi k}{(a+3)} R^{(a+3)}$$

$$\frac{Q}{q_{\text{enclosed}}} = 2^{a+3}$$

$$2^{a+3} = 32$$

$$a = 2$$

53. Sol. 9

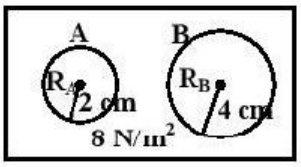


$$\frac{dm_{\text{ice}}}{dt} = \frac{dm_{\text{vap our}}}{dt}$$

$$\frac{400kS}{\lambda x L_{\text{ice}}} = \frac{300kS}{(100-\lambda)\,xL_{\text{vap our}}}$$

$$\lambda = 9$$

54. Sol. 6

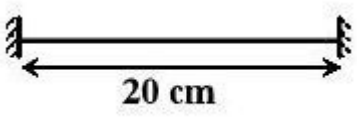


$$P_A = P_O + \frac{4T}{R_A} = 14 = 16\,\text{N/m}^2$$

$$P_B = P_O + \frac{4T}{R_B} = 14 = 12\,\text{N/m}^2$$

$$\frac{n_b}{n_A} = \frac{P_B}{P_A}\left(\frac{R_B}{R_A}\right)^3 = 6$$

55. Sol. 5

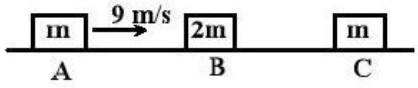


$$v = \sqrt{\frac{T}{\mu}} = 10\,\text{m/s}$$

$$\lambda = \frac{v}{f} = \frac{10}{100} = 10\text{cm}$$

Distance between the successive nodes $= \lambda/2 = 5\text{cm}$

56. Sol. 4



After 1^{st} collision

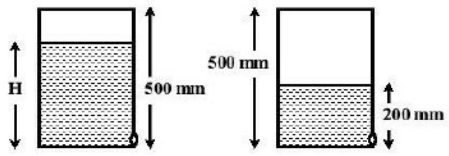
$$mv_A = mv'_A + 2mv'_B$$

$$-1 = \frac{v'_B - v'_A}{0 - v_A} \Rightarrow v'_B = 6\,\text{m/s}$$

After 2^{nd} collision

$$2mv'_A = (2m + m)v_C \Rightarrow \quad v_C = \frac{2}{3}v'_B \Rightarrow v_C = 4\,\text{m/s}$$

57. Sol. 6



$$P = P_0 - \rho gh = 98\times10^3\ \text{N/m}^2$$

$$P_0V_0 = PV$$

$$10^5\left[A(500 - H)\right] = 98\times10^3\left[A(500 - 200)\right]$$

$$H = 206\text{mm}$$

$$\text{Level fall} = 206 - 200 = 6\text{mm}$$