JEE MAIN-2017-PAPER 1

PART B – PHYSICS

31. **Sol. (3)**

$$\frac{N_0 - N}{N} = 0.3$$

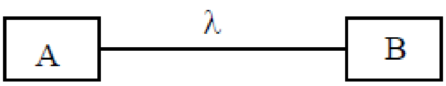
$$\Rightarrow N = \frac{N_0}{1.3}$$

$$N = N_0 e^{-\lambda t}$$

$$\Rightarrow \frac{1}{1.3} = e^{-\lambda t}$$

$$\Rightarrow t = \frac{\ell n(1.3)}{\lambda} = T\frac{\ell n(1.3)}{\ell n(2)}$$

$$\because \lambda = \frac{\ell n2}{T}.$$



	A	B
$t = 0$	N_0	0
$t = t$	N	$N_0 - N$

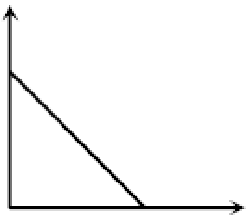
32. **Sol. (3)**

$$T = \frac{rhg}{2} \times 10^3 \text{ N/m}$$

$$\frac{\Delta T}{T} = \left|\frac{\Delta r}{r}\right| + \left|\frac{\Delta h}{h}\right| = \frac{0.01}{1.25} + \frac{0.01}{1.45}$$

$$\%\,\text{error} = \frac{\Delta T}{T} \times 100 = \frac{1}{1.25} + \frac{1}{1.45} = 0.8 + 0.69 \simeq 1.5\%$$

33. **Sol. (2)**



$$\frac{hc}{\lambda_{\min}} = eV$$

$$\log\frac{hc}{e} - \log\lambda_{\min} = \log V$$

$$\Rightarrow \log\lambda_{\min} = k - \log V$$

*34. **Sol. (2)**

$$I = \frac{m}{12}\left[3R^2 + \ell^2\right] \quad \left(R^2 = \frac{m}{\pi\ell\rho}\right)$$

$$= \frac{m}{12}\left[\frac{3m}{\pi\rho}\ell^{-1} + \ell^2\right]$$

$$\frac{dI}{d\ell} = \frac{m}{12}\left[-\frac{3m}{\pi\rho\ell^2} + 2\ell\right]$$

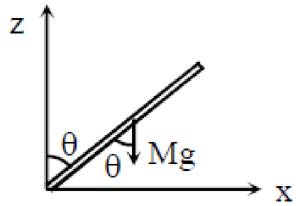
For minima

$$0 = \frac{-3m}{\pi\rho\ell^2} + 2\ell$$

$$\Rightarrow \frac{3\pi R^2\ell\rho}{\pi\rho\ell^2} = 2\ell$$

$$\Rightarrow \frac{\ell}{R} = \sqrt{\frac{3}{2}}$$

*35. **Sol. (2)**



$\tau = I\alpha$

$\Rightarrow Mg\frac{\ell}{2}\sin\theta = \frac{M\ell^2}{3}\alpha$

$\Rightarrow \alpha = \frac{3}{2}\frac{g}{\ell}\sin\theta$

*36. **Sol. (4)**

For ideal gas

$C_p - C_v = R/M$

If C_p and C_v are specific heats $\left(\text{J/kg}-{}^0C\right)$

M = molar mass of gas

$\Rightarrow a = R/2 \text{ and } b = R/28$

$\Rightarrow a = 14b$

*37. **Sol. (3)**

Final temperature of calorimeter and its contents is given, $T_0 = 75°\text{C}$

$\Rightarrow 100\times0.1\times(75-T)+100\times0.1(75-30)+170\times1\times(75-30)=0$

$\Rightarrow 75-T+45+765=0$

$\Rightarrow T = 885°\text{C}$

38. **Sol. (2)**

Modulated signal can be written as

$C_m(t) = (A_c + A_m\sin\omega_m t)\sin\omega_c t$

$\Rightarrow C_m(t) = A_c\sin\omega_c t + \frac{\mu A_c}{2}\cos(\omega_c - \omega_m)t - \frac{\mu A_c}{2}\cos(\omega_c + \omega_m)t$

where $\mu = \frac{A_m}{A_c}$

*39. **Sol. (1)**

Using, $n=\left(\frac{PV}{RT}\right)$

$$n_f-n_i=\frac{PV}{R}\left(\frac{1}{T_f}-\frac{1}{T_i}\right)\text{moles}$$
$$=\frac{1\times10^5\times30}{8.32}\left(\frac{1}{300}-\frac{1}{290}\right)\times6.023\times10^{23}\text{molecules}$$
$$=-2.5\times10^{25}\text{molecules}$$

40. **Sol. (3)**

$$y=\frac{m\times650\times10^{-9}\times D}{d}=\frac{n\times20\times10^{-9}\times D}{d}$$

$\Rightarrow\frac{m}{n}=\frac{4}{5}\Rightarrow$ minimum values of m and n will be 4 and 5 respectively.

$$y=\frac{4\times650\times10^{-9}\times1.5}{5\times10^{-4}}\text{meter}$$
$$=7.8\,\text{mm}$$

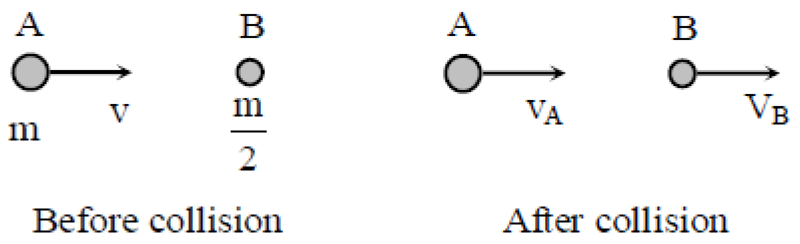
41. **Sol. (3)**

$mv=mv_A+\frac{m}{2}v_B$ (conservation of linear momentum)

$\therefore v=v_A+\frac{v_B}{2}=v_B-v_A$(elastic collision)

$\therefore\frac{v_B}{v_A}=4$

$\therefore\frac{\lambda_A}{\lambda_B}=\frac{m_Bv_B}{m_Av_A}=2$



42. **Sol. (2)**

$$T = 2\pi\sqrt{\frac{I}{MB}}$$

$$= 2\pi\sqrt{\frac{7.5\times10^{-6}}{6.7\times10^{-2}\times0.01}} = 0.665\,\text{sec}$$

So, time of 10 oscillations $= 6.65\,\text{sec}$

43. **Sol. (4)**

From the given information

$$\therefore PE_1 \sin\theta = \sqrt{3}PE_1 \sin\left(\frac{\pi}{2}+\theta\right)$$

$$\therefore \theta = 60^\circ$$

44. **Sol. (4)**

Change in flux $= R\int idt = 250\,\text{Wb}$

*45. **Sol. (2)**

From impulse momentum theorem

$$\int_0^1 6tdt = mv$$

$$\therefore v = 3\,\text{m/s}$$

So, work done by the force $= \Delta K.E. = \frac{1}{2}(1)(3)^2 = 4.5J$

46. **Sol. (1)**

$$\Delta E \propto \frac{1}{\lambda}$$

$$\Rightarrow \frac{\lambda_1}{\lambda_2} = \frac{\Delta E_2}{\Delta E_1} = \frac{1}{3}$$

47. **Sol. (1)**

Potential difference across each resistor is zero.

*48. **Sol. (4)**

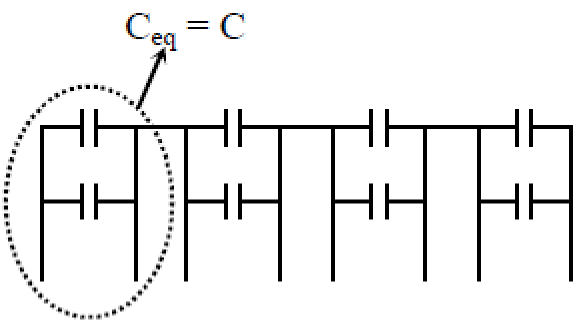
$$v = u - gt$$

49. **Sol. (1)**

$$\frac{C}{4} = 2 \Rightarrow C = 8\mu F$$

Which requires eight $1\mu F$ capacitors in parallel.

$\Rightarrow$ Minimum number of capacitors required is 32.



50. **Sol. (4)**

$$q = CV$$

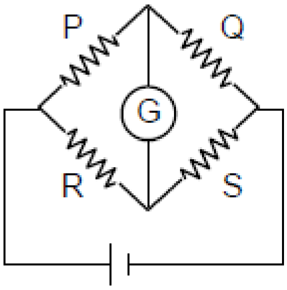
$$= \frac{CEr_2}{r + r_2}$$

51. **Sol. (1)**

In common emitter amplifier circuit the output voltage is out of phase w.r.t. input voltage.

52. **Sol. (3)**

The balanced condition is given by $\frac{P}{Q}=\frac{R}{S}$;When battery and Galvanometer are exchanged, it become $\frac{P}{R}=\frac{Q}{S}$; which is same as previous



*53. **Sol. (1)**

For given $SHM\ x=A\sin\omega t$

$$v=\frac{dx}{dt}=A\omega\cos\omega t$$

$$KE=\frac{1}{2}mv^2=\frac{1}{2}mA^2\omega^2\cos^2\omega t=KE_{\max}\left(\frac{1+\cos 2\omega t}{2}\right)$$

54. **Sol. (4)**

$$f'=\left(\sqrt{\frac{1+\beta}{1-\beta}}\right)f\text{, where }\beta=\frac{v}{c}$$

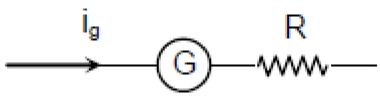
So, $f'=17.3\text{GHz}$

*55. **Sol. (2)**

$$\text{Stress}=\frac{F}{A}=\frac{mg}{A}=\frac{\rho\ell Ag}{A}=\rho\ell g$$

So, $\frac{\text{Stress}_f}{\text{Stress}_i}=9$

56. **Sol. (2)**



$$i_g = \left(R + R_g\right) = V$$

$$R = \frac{V}{i_g} - R_g$$

$$R = \frac{10}{5\times10^{-3}} - 15 = 1.985\times10^{3}\Omega$$

*57. **Sol. (1)**

The variation of magnitude of acceleration due to gravity is given by

$$g \;= \left(\frac{GM}{R^3}\right)d, \text{where } 0 \le \text{d} \le R$$

$$= \frac{GM}{d^3}, \text{where } d > R$$

*58. **Sol. (2)**

By applying pressure, $\Delta P = -\frac{B\Delta V}{V}$

$$\Rightarrow -\frac{\Delta V}{V} = \frac{\Delta P}{B} = \frac{P}{K}\left(\text{given } B = K\right)$$

By increasing temperature, fractional increase in volume

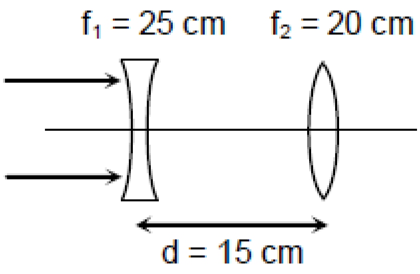
$$-\frac{\Delta V}{V} = 3\alpha\Delta\theta$$

$$\frac{P}{K} = 3\alpha\Delta\theta$$

$$\Delta\theta = \frac{P}{3\alpha K}$$

59. **Sol. (2)**

For diverging lens,



$$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}\Rightarrow\frac{1}{v}-\frac{1}{\infty}=\frac{1}{-25}$$
$$\Rightarrow v=-25\,\text{cm}$$

First image is formed at a distance $25\,\text{cm}$ left to the diverging lens. For the converging lens.

$$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$$
$$\frac{1}{v}-\frac{1}{-40}=\frac{1}{20}\Rightarrow\frac{1}{v}=\frac{1}{20}-\frac{1}{40}$$
$$\Rightarrow v=+40\,\text{cm}$$

*60. **Sol. (4)**

$$\frac{1}{2}mv_f^2=\frac{1}{8}mv_0^2\Rightarrow v_f=\frac{v_0}{2}$$

Now, $\frac{mdv}{dt}=-kv^2$

$$\Rightarrow m\int_{v_0}^{\frac{v_0}{2}}\frac{dv}{v^2}=-k\int_0^{10}dt$$

$$\Rightarrow m\left[-\frac{1}{v}\right]_{v_0}^{\frac{v_0}{2}}=-k\left[t\right]_0^{10}$$

$$\Rightarrow m\left(\frac{1}{v_0}-\frac{1}{v_0}\right)=10k$$

$$\Rightarrow\frac{m}{v_0}=10k$$

$$\Rightarrow k=\frac{m}{10v_0}=\frac{10^{-2}}{10\times10}=10^{-4}\,\text{kg}\,\text{m}^{-1}$$