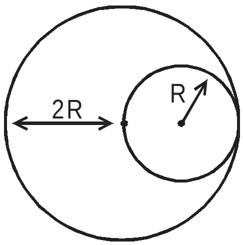
# Physics

**41.** A circular disc of radius R is removed from a bigger circular disc of radius 2R such that the circumferences of the discs coincide. The centre of mass of the the new disc is $\frac{\alpha}{R}$ from the center of the bigger disc. The value of $\alpha$ is

(1) $\frac{1}{4}$ (2) $\frac{1}{3}$ (3) $\frac{1}{2}$ (4) $\frac{1}{6}$

**Sol. (2)**




Let the mass of the larger disc be M. Then mass of the smaller disc $= \frac{M}{4R^2} \times R^2 = \frac{M}{4}$

Mass of remaining part $= \frac{3M}{4}$

If the position of the centre of mass of the remaining disc be (x, 0) with respect to the centre of the larger disc, then

$$\frac{3M}{4}(x) + \frac{M}{4}(R) = M(0)$$

$$\therefore\ x = \frac{-R}{3}$$

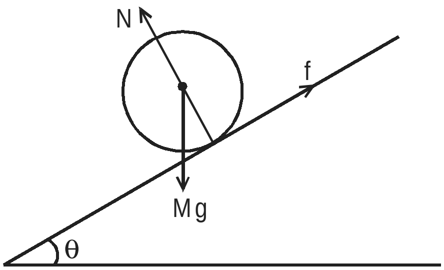
"<u>If the centre of mass of the new disc is</u> $\alpha R$ <u>from the centre of the bigger disc, then</u> $\alpha = \frac{1}{3}$"

**42.** A round uniform body of radius R, mass M and moment of inertia 'I', rolls down (without slipping) an inclined plane making an angle $\theta$ with the horizontal. Then its acceleration is

(1) $\frac{g \sin\theta}{1 - MR^2/I}$ (2) $\frac{g \sin\theta}{1 + I/MR^2}$

(3) $\frac{g \sin\theta}{1 + MR^2/I}$ (4) $\frac{g \sin\theta}{1 - I/MR^2}$

Sol. (2)




$Mg\sin\theta - f = Ma$

and $fR = I\alpha = \frac{Ia}{R}$

$\therefore f = \frac{Ia}{R^2}$

$\therefore Mg\sin\theta = Ma + \frac{Ia}{R^2}$

$\therefore a = \frac{g\sin\theta}{1+\frac{I}{MR^2}}$

**43.** Angular momentum of the particle rotating with a central force is constant due to
(1) Constant Torque (2) Constant Force
(3) Constant linear momentum (4) Zero Torque

**Sol. (4)**
If the force is central, then

$\vec{\tau} = \vec{r}\times\vec{F} = 0$

$\therefore$ Angular momentum is constant.

**44.** A 2 kg block slides on a horizontal floor with a speed of 4 m/s. It strikes a uncompressed spring, and compresses it till the block is motionless. The kinetic friction force is 15 N and spring constant 10,000 N/m. The spring compresses by
(1) 8.5 cm (2) 5.5 cm (3) 2.5 cm (4) 11.0 cm

**Sol. (2)**

$\frac{1}{2}mv^2 = fx + \frac{1}{2}kx^2$

$\therefore 16 = 15x + 5000x^2$

$\therefore 5000x^2 + 15x - 16 = 0$

$\Rightarrow x = \frac{-15 \pm \sqrt{225+320000}}{10000} = \frac{-15 \pm 565}{10000} = 55\times10^{-3}m = 5.5cm$

**45.** A particle is projected at 60° to the horizontal with a kinetic energy K. The kinetic energy at highest point is

(1) K / 2 (2) K (3) Zero (4) K / 4

**Sol. (4)**

If $v_0$ is the velocity of projection, then the velocity at the highest point is $v_0 \cos 60° = \frac{v_0}{2}$

$\therefore k = \frac{1}{2} m v_0^2$

At the highest point

$$K.E. = \frac{1}{2} m \left(\frac{v_0}{2}\right)^2 = \frac{K}{4}$$

**46.** In the Young's double slit experiment the intensity at a point where the path-difference is $\frac{\lambda}{6}$ ($\lambda$ being the wavelength of the light used) is I. If $I_0$ denotes the maximum intensity, $\frac{I}{I_0}$ is equal to

(1) $\frac{3}{4}$ (2) $\frac{1}{\sqrt{2}}$ (3) $\frac{\sqrt{3}}{2}$ (4) $\frac{1}{2}$

**Sol. (1)**

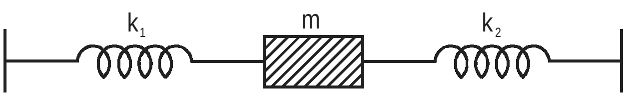
Phase difference, $\phi = \left(\frac{\Delta x}{\lambda}\right) \cdot 2\pi = \frac{\pi}{3}$

$$I = I' + I' + 2\sqrt{I' . I'} \cos \frac{\pi}{3} = 3I'$$

But $I_o = 4I' \ (\phi = 0)$

$$\therefore \quad \frac{I}{I_o} = \frac{3}{4}$$

**47.** Two springs, of force constant $k_1$ and $k_2$, are connected to a mass m as shown. The frequency of oscillation of the mass is f. If both $k_1$ and $k_2$ are made four times their original values, the frequency of oscillation becomes



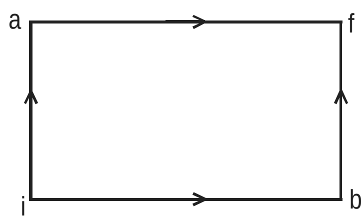

(1) 2f (2) f / 2 (3) f / 4 (4) 4f

**Sol. (1)**

$$f = \sqrt{\frac{k_{eff}}{m}} = \sqrt{\frac{k_1 + k_2}{m}}$$

$$f' = \sqrt{\frac{4k_1 + 4k_2}{m}} = 2\sqrt{\frac{k_1 + k_2}{m}} = 2f$$

**48.** When a system is taken from state i to state f along the path iaf, it is found that Q = 50 cal and W = 20 cal. Along the path ibf Q = 36 cal. W along the path ibf is




(1) 14 cal. (2) 6 cal. (3) 16 cal. (4) 66 cal.

**Sol. (2)**

$\Delta U$ for both the paths will be the same.

$\therefore \Delta U_{iaf} = \Delta U_{ibf}$

$\therefore Q_{iaf} - W_{iaf} = Q_{ibf} - W_{ibf}$

or 50 – 20 = 36 – $W_{ibf}$

$\therefore w_{ibf} = 6$ cal

**49.** A particle of mass m executes simple harmonic motion with amplitude 'a' and frequency '$\nu$'. The average kinetic energy during its motion from the position of equilibrium to the end is

(1) $2\pi^2 \, m \, a^2 \, \nu^2$ (2) $\pi^2 \, m \, a^2 \, \nu^2$

(3) $\frac{1}{4} m \, a^2 \, \nu^2$ (4) $4\pi^2 \, m \, a^2 \, \nu^2$

**Sol. (2)**

Let $y = a \sin \omega t$

$$\therefore v = \frac{dy}{dt} = a\omega \cos \omega t$$

$$\therefore k = \frac{1}{2} m v^2 = \frac{1}{2} m a^2 \omega^2 \cos^2 \omega t$$

$\therefore$ Average KE:

$$K_{avg} = \frac{\int_0^{T/4} k\,dt}{\int_0^{T/4} dt} = \frac{\frac{1}{2} ma^2\omega^2 \int_0^{T/4} \cos^2 \omega t\,dt}{T/4}$$

$$= \frac{ma^2\omega^2}{T}\frac{1}{2}\int_0^{T/4}(1+\cos 2\omega t)dt = \frac{ma^2\omega^2}{2T}\left[t + \frac{\sin 2\omega t}{2\omega}\right]_0^{T/4}$$

$$= \frac{ma^2\omega^2}{2T}\left[\frac{T}{4} + \frac{\sin \omega T/2}{2\omega}\right] = \frac{1}{4}ma^2\omega^2 \; (\because \omega T = 2\pi)$$

$$= \frac{1}{4}ma^2\left(4\pi^2\nu^2\right) = \pi^2 ma^2\nu^2$$

**50.** The displacement of an object attached to a spring and executing simple harmonic motion is given by $x = 2 \times 10^{-2} \cos \pi t$ metres. The time at which the maximum speed first occurs is

(1) 0.25 s (2) 0.5 s (3) 0.75 s (4) 0.125 s

**Sol. (2)**

$x = 2 \times 10^{-2} \cos(\pi t)$ ; SHM with particle at extreme position at t = 0.

$\Rightarrow$ Velocity is maximum for the 1st time when it crosses the origin i.e. $t = \frac{T}{4}$

$\omega = \pi$

or $\frac{2\pi}{T} = \pi$ $\Rightarrow t = \frac{T}{4} = 0.5\,s$

**51.** In an a.c. circuit the voltage applied is $E = E_0 \sin \omega t$. The resulting current in the circuit is $I = I_0 \sin(\omega - \frac{\pi}{2}).$ The power consumption in the circuit is given by

(1) $P = \sqrt{2}\, E_0\, I_0$ (2) $P = \frac{E_0\, I_0}{\sqrt{2}}$ (3) P = zero (4) $P = \frac{E_0\, I_0}{2}$

**Sol. (3)**

$$P = \frac{E_0 I_0}{2}\cos\varphi$$

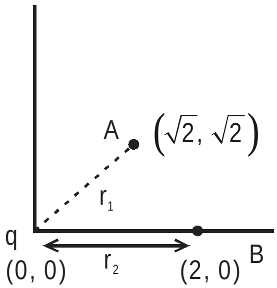
$$\varphi = \pi/2$$

$$\therefore p = \frac{E_0 I_0}{2}\cos \pi/2 = 0$$

**52.** An electric charge $10^{-3}$ $\mu C$ is placed at the origin (0, 0) of X – Y co-ordinate system. Two points A and B are situated at $(\sqrt{2}, \sqrt{2})$ and (2, 0) respectively. The potential difference between the points A and B will be

(1) 4.5 volt (2) 9 volt (3) zero (4) 2 volt

**Sol. (3)**




$$V_A = \frac{k \cdot q}{r_1}$$

$$V_B = \frac{k \cdot q}{r_2}$$

$$V_A - V_B = \frac{kq}{r_1} - \frac{kq}{r_2} = 9 \times 10^9 \times 10^{-9} \left\{\frac{1}{2} - \frac{1}{2}\right\} = 0$$

**53.** A battery is used to charge a parallel plate capacitor till the potential difference between the plates becomes equal to the electromotive force of the battery. The ratio of the energy stored in the capacitor and the work done by the battery will be

(1) $\frac{1}{2}$ (2) 1 (3) 2 (4) $\frac{1}{4}$

**Sol. (1)**

Energy shared in the battery $= \frac{1}{2}QV$

Work done by the battery = QV

$$\text{ratio} = \frac{\frac{1}{2}QV}{QV} = \frac{1}{2}$$

**54.** An ideal coil of 10 H is connected in series with a resistance of 5 $\Omega$ and a battery of 5 V. 2 seconds after the connection is made, the current flowing in amperes in the circuit is

(1) $(1-e^{-1})$ (2) $(1-e)$ (3) $e$ (4) $e^{-1}$

**Sol. (1)**

$$i=\frac{E_0}{R}\left(1-e^{\frac{-t\times R}{L}}\right)=\frac{5}{5}\left(1-e^{-\frac{2x5}{10}}\right)=\left(1-e^{-1}\right)$$

**55.** A long straight wire of radius 'a' carries a steady current i. The current is uniformly distributed across its cross section. The ratio of the magnetic field at $\frac{a}{2}$ and 2a is

(1) $\frac{1}{2}$ (2) $\frac{1}{4}$ (3) 4 (4) 1

**Sol. (4)**

Let field at a/2 be $B_1$ and at 2a be $B_2$. Then

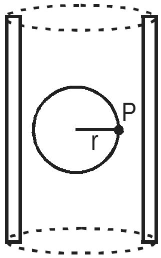
$$B_1=\frac{\mu_0 ia}{2\pi a^2 2}=\frac{\mu_0 i}{4\pi a}$$

$$B_2=\frac{\mu_0 i}{2\pi\times 2a}\quad\therefore\frac{B_1}{B_2}=\frac{1}{1}$$

**56.** A current I flows along the length of an infinitely long, thin walled pipe. Then

(1) the magnetic field at all points inside the pipe is the same, but not zero
(2) the magnetic field is zero only on the axis of the pipe
(3) the magnetic field is different at different points inside the pipe
(4) the magnetic field at any point inside the pipe is zero

**Sol. (4)**




$\vec{B}\cdot\vec{dl}=\mu_o\ i_{enclosed}$

For any loop inside the hollow tube $i_{enclosed}$ is zero hence B = 0

**57.** If $M_0$ is the mass of an oxygen isotope ${}_8O^{17}$, $M_P$ and $M_N$ are the masses of a proton and a neutron respectively, the nuclear binding energy of the isotope is

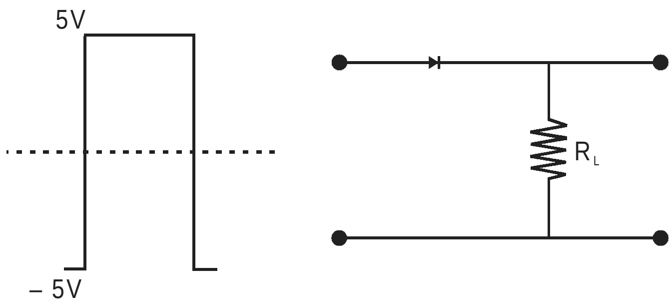
(1) $(M_O - 17\,M_N)C^2$ (2) $(M_O - 8\,M_P)C^2$ (3) $(M_O - 8\,M_P - 9M_N)C^2$ (4) $M_O C^2$

**Sol. (3)**
By definition

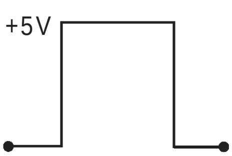
**58.** In gamma ray emission from a nucleus
(1) only the proton number changes
(2) both the neutron number and the proton number change
(3) there is no change in the proton number and the neutron number
(4) only the neutron number changes

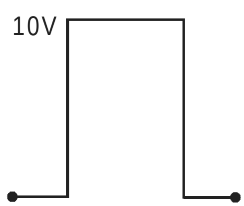
**Sol. (3)**
Gamma ray are EM waves produced, when daughter nuclei make a transition from higher energy state to lower energy state. There is a no change in mass number or atomic number.

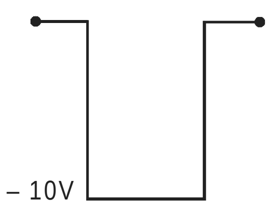
**59.** If in a p-n junction diode, a square input signal of 10 V is applied as shown

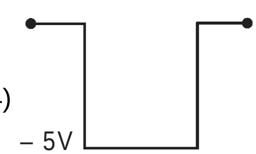



Then the output signal across $R_L$ will be

(1) 


(2) 


(3) 


(4) 

**Sol. (1)**

Half wave rectification

**60.** Photon of frequency $\nu$ has a momentum associated with it. If c is the velocity of light, the momentum is

(1) $h\nu/c$ (2) $\nu/c$ (3) $h\nu c$ (4) $h\nu/c^2$

**Sol. (1)**

$$P = \frac{h}{\lambda} = \frac{h\cdot\nu}{c}$$

**61.** The velocity of a particle is $v = v_0 + gt + ft^2$. If its position is x = 0 at t = 0, then its displacement after unit time (t = 1) is

(1) $v_0 + g/2 + f$ (2) $v_0 + 2g + 3f$

(3) $v_0 + g/2 + f/3$ (4) $v_0 + g + f$

**Sol. (3)**

$v = v_0 + gt + ft^2$

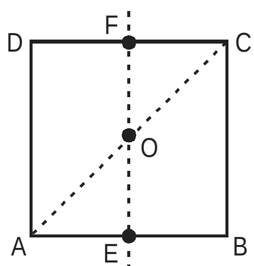
$$x = x_0 + v_0 t + \frac{1}{2}gt^2 + \frac{ft^3}{3}$$

$$x\big|_{t=0} = 0$$

$$\Rightarrow\ x_0 = 0$$

$$x\big|_{t=1} = v_0 + \frac{g}{2} + \frac{f}{3}$$

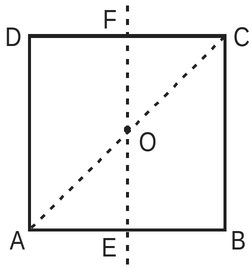
**62.** For the given uniform square lamina ABCD, whose centre is O,




(1) $I_{AC} = \sqrt{2}\, I_{EF}$ (2) $\sqrt{2}I_{AC} = I_{EF}$

(3) $I_{AD} = 3I_{EF}$ (4) $I_{AC} = I_{EF}$

**Sol. (4)**




$$I_{AC} = \frac{I_{0\perp}}{2} \qquad (\perp \text{ axis theorem})$$

$$I_{EF} = \frac{I_{0\perp}}{2} \Rightarrow I_{AC} = I_{EF}$$

**63.** A point mass oscillates along the x-axis according to the law $x = x_0 \cos(\omega t - \pi/4)$. If the acceleration of the particle is written as $a = A\cos(\omega t + \delta)$, then

(1) $A = x_0 \omega^2, \quad \delta = \frac{3\pi}{4}$

(2) $A = x_0, \ \delta = -\frac{\pi}{4}$

(3) $A = x_0 \omega^2, \quad \delta = \frac{\pi}{4}$

(4) $A = x_0 \omega^2, \quad \delta = -\frac{\pi}{4}$

**Sol. (4)**

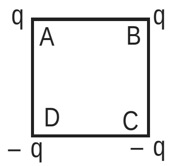
$$x = x_0 \cos\left(\text{cot} - \frac{\pi}{4}\right)$$

$$\frac{dx}{dt} = -x_0\omega^2 \sin\left(\omega t - \frac{\pi}{4}\right)$$

$$\frac{d^2x}{dt^2} = -x_0\omega^2 \cos\left(\omega t - \frac{\pi}{4}\right)$$

$$\Rightarrow A = x_0\omega^2; \ \delta = -\frac{\pi}{4}$$

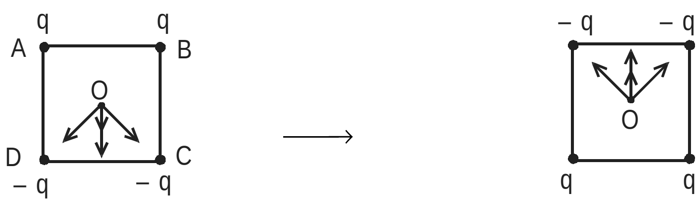
**64.** Charges are placed on the vertices of a square as shown. Let $\vec{E}$ be the electric field and V the potential at the centre. If the charges on A and B are interchanged with those on D and C respectively, then




(1) $\vec{E}$ changes, V remains unchanged (2) $\vec{E}$ remains unchanged, V changes

(3) Both $\vec{E}$ and V change (4) $\vec{E}$ and V remain unchanged

**Sol. (1)**




(I) (II)

V = 0 V = 0

Direction of $\vec{E}$ is as indicated Direction of $\vec{E}$ is as indicated

**65.** The half-life period of a radio-active element X is same as the mean life time of another radio-active element Y. Initially they have the same number of atoms. Then

(1) X and Y decay at same rate always (2) X will decay faster than Y

(3) Y will decay faster than X (4) X and Y have same decay rate initially

**Sol. (3)**

$$t_{1/2}^{(1)} = \frac{0.693}{\lambda_1}$$

$$\tau^{(2)} = \frac{1}{\lambda_2}$$

$t_{1/2}^{(1)} = \tau^{(2)} \Rightarrow \lambda_1 = 0.693\ \lambda_2$

or $\lambda_1 < \lambda_2$ (same initial amount).

$\Rightarrow$ Y decays faster.

**66.** A Carnot engine, having an efficiency of $\eta = \frac{1}{10}$ as heat engine, is used as a refrigerator. If the work done on the system is 10 J, the amount of energy absorbed from the reservoir at lower temperature is

(1) 100 J (2) 99 J (3) 90 J (4) 1 J

**Sol. (3)**

For a heat engine

$$\eta = \frac{W}{Q_H}$$

$$\Rightarrow Q_H = \frac{W}{\eta} = 100 \text{ J}$$

$$Q_H = Q_L + W$$

$$Q_L = 90 \text{ J}$$

When the same engine is used as a refrigerator, heat will be absorbed from the system at lower temperature. Hence heat absorbed at lower temperature = $Q_L$ = 90 J

**67.** Carbon, silicon and germanium have four valence electrons each. At room temperature which one of the following statements is most appropriate?

(1) The number of free electrons for conduction is significant only in Si and Ge but small in C.
(2) The number of free conduction electrons is significant in C but small in Si and Ge.
(3) The number of free conduction electrons is negligibly small in all the three.
(4) The number of free electrons for conduction is significant in all the three.

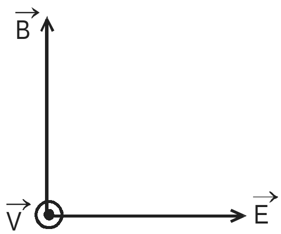
**Sol. (1)**

The 4 bonding electrons of C, Si or Ge lie, respectively, in the second, third and fourth orbit. Hence, energy required to take out an electron from these atoms (i.e. ionisation energy $E_g$) will be least for Ge, followed by Si and highest for C. Hence, number of free electrons for conduction in Ge and Si are significant but negligibly small for C. **(NCERT Book – XII, Page – 415)**

**68.** A charge particle with charge q enters a region of constant, uniform and mutually orthogonal fields $\vec{E}$ and $\vec{B}$ with a velocity $\vec{v}$ perpendicular to both $\vec{E}$ and $\vec{B}$, and comes out without any change in magnitude or direction of $\vec{v}$. Then

(1) $\vec{v} = \vec{B} \times \vec{E} / E^2$
(2) $\vec{v} = \vec{E} \times \vec{B} / B^2$
(3) $\vec{v} = \vec{B} \times \vec{E} / B^2$
(4) $\vec{v} = \vec{E} \times \vec{B} / E^2$

**Sol. (2)**




$$\vec{F}_e = q\vec{E}$$

$$\vec{F}_B = q\vec{v}\times\vec{B}$$

$$q\vec{E} + q\vec{v}\times\vec{B} = 0 \quad \Rightarrow \vec{E}\times\vec{B} + \vec{v}\times\vec{B}\times\vec{B} = 0$$

$$\vec{E}\times\vec{B} + \left(\vec{B}\cdot\vec{v}\right)\vec{B} - \left(\vec{B}\cdot\vec{B}\right)\vec{v} = 0$$

or $\vec{v} = \dfrac{\vec{E}\times\vec{B}}{B^2}$

**69**. The potential at a point x (measure in $\mu m$) due to some charges situated on the x-axis is given by V(x) = 20 / ($x^2$ – 4) Volts

The electric field E at x = 4 $\mu m$ is given by

(1) 10/9 Volt/$\mu m$ in the +ve x direction

(2) 5/3 Volt/$\mu m$ and in the –ve x direction

(3) 5/3 Volt/$\mu m$ and in the +ve x direction

(4) 10/9 Volt/$\mu m$ and in the – ve x direction

**Sol. (1)**

$$V(x) = \frac{20}{x^2-4} = \frac{20}{4}\left\{\frac{1}{x-2} - \frac{1}{x+2}\right\}$$

$$= 5\left\{\frac{1}{x-2} - \frac{1}{x+2}\right\}$$

$$E(x) = -\frac{dV}{dx} = \frac{5}{(x-2)^2} - \frac{5}{(x+2)^2}$$

$$E\ (x = 4) = \left(\frac{5}{4} - \frac{5}{36}\right)\frac{V}{\mu m} = \frac{8\times5}{36}\frac{V}{\mu m}$$

$$= \frac{10}{9}\frac{V}{\mu m}$$

**70.** Which of the following transitions in hydrogen atoms emit photons of highest frequency?

(1) n = 1 to n = 2 (2) n = 2 to n = 6

(3) n = 6 to n = 2 (4) n = 2 to n = 1

**Sol. (4)**

$$\frac{1}{2^2}-\frac{1}{6^2}<\frac{1}{1^2}-\frac{1}{2^2}$$

**71.** A block of mass 'm' is connected to another block of mass 'M' by a spring (massless) of spring constant 'k'. The blocks are kept on a smooth horizontal plane. Initially the blocks are at rest and the spring is unstretched. Then a constant force 'F' starts acting on the block of mass 'M' to pull it. Find the force on the block of mass 'm'.

(1) $\frac{MF}{(m+M)}$ (2) $\frac{mF}{M}$ (3) $\frac{(M+m)F}{m}$ (4) $\frac{mF}{(m+M)}$

**Sol. (4)** Common acceleration of two blocks $a=\frac{F}{m+M}$

$\therefore$ Force on mass m, $F'=ma=\frac{mF}{M+m}$

**72.** Two lenses of power –15D and +5D are in contact with each other. The focal length of the combination is

(1) +10 cm (2) –20 cm ( 3) – 10 cm (4) + 20 cm

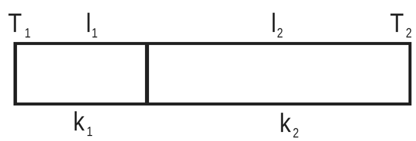
**Sol. (3)**

$p = p_1 + p_2 = -15 + 5 = -10D$

$$P=\frac{1}{F}=-10D$$

$$\Rightarrow F=-\frac{1}{10}m \qquad = -10 \text{ cm}$$

**73.** One end of a thermally insulated rod is kept at a temperature $T_1$ and the other at $T_2$. The rod is composed of two sections of lengths $l_1$ and $l_2$ and thermal conductivities $k_1$ and $k_2$ respectively. The temperature at the interface of the two sections is




(1) $(k_1 \ell_1 T_1 + k_2\ell_2T_2) / (k_1\ell_1 + k_2 \ell_2)$ (2) $(k_2\ell_2 T_1 + K_1\ell_1 T_2) / (k_1 \ell_1 + k_2 \ell_2)$

(3) $(k_2\ell_1T_1 + k_1 \ell_2T_2) / (k_2\ell_1 + k_1\ell_2)$ (4) $(k_1\ell_2 T_1 + k_2 \ell_1 T_2) / (k_1 \ell_2 + k_2\ell_1)$

**Sol. (4)**

Let the temperature at the interface is T

$$\therefore \frac{T_1 - T}{\frac{l_1}{k_1 A}} = \frac{T - T_2}{\frac{l_2}{k_2 A}}$$

$$\Rightarrow T\left[\frac{k_1}{l_1} + \frac{k_2}{l_2}\right] = \frac{T_1 k_1}{l_1} + \frac{T_2 k_2}{l_2}$$

$$\Rightarrow T = \frac{k_1 l_2 T_1 + k_2 l_1 T_2}{k_1 l_2 + k_2 l_1}$$

**74.** A sound absorber attenuates the sound level by 20 dB. The intensity decreases by a factor of

(1) 100 (2) 1000 (3) 10000 (4) 10

**Sol. (1)**

$$\beta = (10\text{dB})\log\left(\frac{I}{I_0}\right)$$

$$\beta_2 - \beta_1 = 10\log\left(\frac{I_2}{I_1}\right)$$

$$\Rightarrow 20 = 10\log\left(\frac{I_2}{I_1}\right)$$

$$\Rightarrow \log\left(\frac{I_2}{I_1}\right) = 2$$

$$\Rightarrow \frac{I_2}{I_1} = 10^2 = 100$$

**75.** If $C_p$ and $C_v$ denote the specific heats of nitrogen per unit mass at constant pressure and constant volume respectively, then

(1) $C_p - C_v = 28\,R$ (2) $C_p - C_v = R / 28$ (3) $C_p - C_v = R/14$ (4) $C_p - C_v = R$

**Sol. (2)**

$C_P'$ and $C_v'$ are specific heats per unit mole,

$C_P' - C_V' = R$

$$\Rightarrow M(C_P - C_V) = R$$

$$\Rightarrow C_P - C_V = \frac{R}{M} = \frac{R}{28}$$

**76.** A charge particle move through a magnetic field perpendicular to its direction. Then
(1) kinetic energy changes but the momentum is constant
(2) the momentum changes but he kinetic energy is constant
(3) both momentum and kinetic energy of the particle are not constant
(4) both, momentum and kinetic energy of the particle are constant

**Sol. (2)**
Magnitude of velocity remains same where as direction changes.

**77.** Two identical conducting wires AOB and COD are placed at right angles to each other. The wire AOB carries an electric current $I_1$ and COD carries a current $I_2$. The magnetic field on a point lying at a distance 'd' from O, in a direction perpendicular to the plane of the wires AOB and COD, will be given by

(1) $\frac{\mu_0}{2\pi d}\left(I_1^2 + I_2^2\right)$ (2) $\frac{\mu_0}{2\pi}\left(\frac{I_1 + I_2}{d}\right)^{1/2}$

(3) $\frac{\mu_0}{2\pi d}\left(I_1^2 + I_2^2\right)^{1/2}$ (4) $\frac{\mu_0}{2\pi d}\left(I_1 + I_2\right)$

**Sol. (3)**

$$B_1 = \frac{\mu_0 I_1}{2\pi d},\ B_2 = \frac{\mu_0 I_2}{2\pi d}$$

Angle between $B_1$ and $B_2$ is 90°

$$= \frac{\mu_0}{2\pi d}(I_1^2 + I_2^2)^{1/2}$$

**78.** The resistance of a wire is 5 ohm at 50 ° C and 6 ohm at 100 ° C . The resistance of the wire at 0 °C . The resistance of the wire at 0°C will be
(1) 3 ohm (2) 2 ohm (3) 1 ohm (4) 4 ohm

**Sol. (4)**

From , $R_t = R_0\left(1 + \alpha\Delta T\right)$

$$(50 - 0)\alpha = \frac{5 - R_0}{R_0} \qquad ...........(1)$$

$$(100 - 0)\alpha = \frac{6 - R_0}{R_0} \qquad ..........(2)$$

$$\Rightarrow\ 2 = \frac{6 - R_0}{5 - R_0}$$

$$\Rightarrow R_0 = 4 \text{ ohm}$$

**79.** A parallel plate condenser with a dielectric of dielectric constant K between the plates has a capacity C and is charged to a potential V volts. The dielectric slab is slowly removed from between the plates and then reinserted. The net work done by the system in this process is

(1) zero
(2) 1/2 (K – 1) $CV^2$
(3) $CV^2$ (K – 1) / K
(4) (K – 1) $CV^2$

**Sol. (1)**

work done (insert) = – work done (removed)

**80.** If $g_E$ and $g_m$ are the accelerations due to gravity on the surfaces of the earth and the moon respectively and if Millikan's oil drop experiment could be performed on the two surfaces, one will find the ratio $\frac{\text{electronic charge on the moon}}{\text{electronic charge on the earth}}$ to be

(1) $g_M / g_E$
(2) 1
(3) 0
(4) $g_E / g_M$

**Sol. (2)**

Charge is independent of gravity.