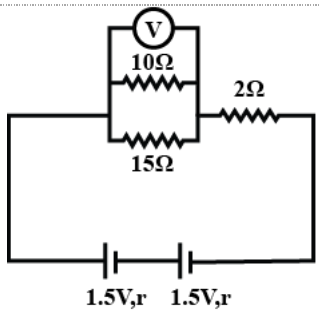
#1612238

Topic: Circuit Instruments



If the reading of the ideal voltmeter shown in the circuit is $2V$ the internal resistance of the two identical cells is

A 1Ω

B 0.5Ω

C 1.5Ω

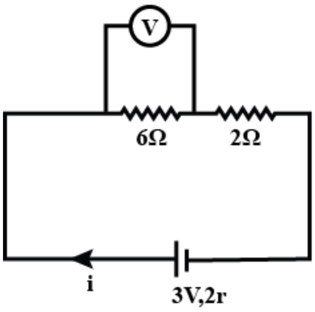
D 2Ω

Solution

$i = \frac{3}{8 + 2r}$

$\therefore$ Reading of voltmeter $= i \times 6 = \frac{3}{8 + 2r} \times 6 = 2$

$\Rightarrow 2r + 8 = 9 \Rightarrow r = \frac{1}{2}\Omega$



#1612240

Topic: Speed of Sound

A stationary source of sound is emitting sound of frequency $500Hz$. Two observers A and B lying on the same line as the source, observe frequencies $480Hz$ and $530Hz$ respectively. The velocity of A and B respectively are (in m/s), speed of sound = $300m/s$.

A 12, 18

B 8, 18

C 18, 8

D 18, 12

Solution

$f_A = \left(\frac{300 - V_A}{300}\right) \times 500 = 480$

$\Rightarrow 15000 - 50V_A = 14400$

$\Rightarrow \frac{600}{50} = V_A \Rightarrow V_A = 12\ m/s$

$f_B = \left(\frac{300 + V_B}{300}\right) \times 500 = 530$

$\Rightarrow V_B + 300 = 318$

$V_B = 18\ m/s$

#1612245
Topic: Acceleration due to Gravity

The height above the surface of earth at which acceleration due to gravity is half the acceleration due to gravity at surface of earth is ($R = 6.4 \times 10^6 m$)

A $6.4 \times 10^6 m$

B $2.6 \times 10^6 m$

C $12.8 \times 10^6 m$

D $19.2 \times 10^6 m$

Solution

$\frac{g}{2} = \frac{Gm}{(R+h)^2}$

$g = \frac{Gm}{R^2}$

$\frac{1}{2} = \frac{R^2}{(R+h)^2}$

$R + h = \sqrt{2}R$

$R = 0.41R$

$= 0.41 \times 6.4 \times 10^6 m = 2.6 \times 10^6 m$

#1612250
Topic: Free, Forced and Damped Oscillations

Equation of motion for a particle performing damped harmonic oscillation is given as $x = e^{-1t} cos(10\pi t + \phi)$. The times when amplitude will half of the initial is :

A 27

B 4

C 1

D 7

Solution

$\frac{A_0}{2} = A_0 e^{-0.1t} \Rightarrow e^{-0.1t} = 2 \Rightarrow 0.1t = \ell n2$

$t = \frac{\ell n2}{0.1} = 10\ \ell n2 \approx 6.93 \approx 7s$

#1612253
Topic: Change in Nucleus due to Radioactive decay

A sample containing same number of two nuclei A and B start decaying. The decay constant of A and B are 10λ and λ. The time after which $\frac{N_A}{N_B}$ becomes $\frac{1}{e}$ is

A $\frac{1}{9\lambda}$

B $\frac{1}{18\lambda}$

C $\frac{2}{9\lambda}$

D $\frac{3}{19\lambda}$

Solution

$\frac{N_A}{N_B} = \frac{N_0 e^{-10\lambda t}}{N_0 e^{-\lambda t}} = \frac{1}{e}$

$\Rightarrow e^{-9\lambda t} = e^{-1}$

$\Rightarrow 9\lambda t = 1$

$\Rightarrow t = \frac{1}{9\lambda}$

#1612262
Topic: Drift of electrons

In conducting wire of radius $5\ mm$, resistivity $\rho = 1.1 \times 10^{-8} \Omega / m$ and current of $5A$ is flowing. Drift velocity of free electron is $1.1 \times 10^{-3}\ m/s$ find out mobility of free electron.

A $1.57\ m^2$ volt/sec

B $1.25\ m^2$ volt/sec

C $1.2\ m^2$ volt/sec

D $2\ m^2$ volt/sec

Solution

$V_d = \mu E = \mu \frac{V}{\ell}$

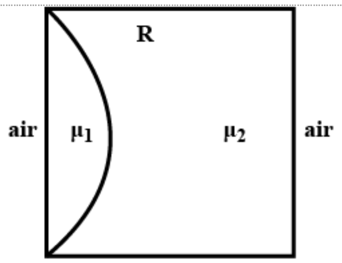
$V_d = \frac{\mu.IR}{\ell} \frac{\mu.I_\rho \ell}{A\ell} = \frac{\mu.I_\rho}{A}$

$\mu = \frac{V_d.A}{I_\rho} = \frac{1.1 \times 10^{-3} \times \lambda \times 25 \times 10^{-6}}{5 \times 1.1 \times 10^{-8}}$

$\mu = 1.57\ m^2$ volt/sec.

#1612277

Topic: Combination of Lenses and Mirrors



Find out equivalent focal length of given lens combination

A $\left(\frac{R}{\mu_1 - \mu_2}\right)$

B $\left(\frac{2R}{\mu_1 - \mu_2}\right)$

C $\left(\frac{4R}{\mu_1 - \mu_2}\right)$

D $\left(\frac{R}{\mu_1 + \mu_2}\right)$

Solution

$\frac{1}{f_1} = (\mu_1 - 1)\left(\frac{1}{\infty} - \frac{1}{-R}\right) = \frac{\mu_1 - 1}{R}$

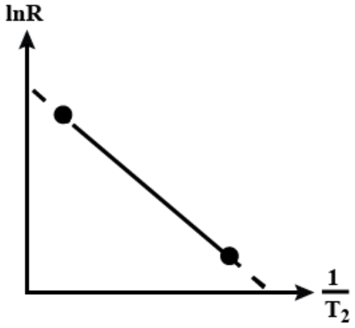
$\frac{1}{f_2} = (\mu_2 - 1)\left(\frac{1}{-R} - \frac{1}{\infty}\right) = \frac{\mu_2 - 1}{-R}$

$\frac{1}{f_{eq}} = \left(\frac{\mu_1 - 1}{R}\right) - \left(\frac{\mu_1 - 1}{R}\right)$

$f_{eq} = \left(\frac{R}{\mu_1 - \mu_2}\right)$

#1612288

Topic: Graphs in Kinematics



The graph shows the variation of ℓnR v/s $\frac{1}{T^2}$, where R is resistance and T is temperature. Then find R as function of T.

A $R = R_0 e^{-T_0^2/T^2}$

B $R = R_0 e^{-T^2/T_0^2}$

C $R = R_0 e^{T^3/T^0}$

D $R = R_0 e^{-T^3/T_0^3}$

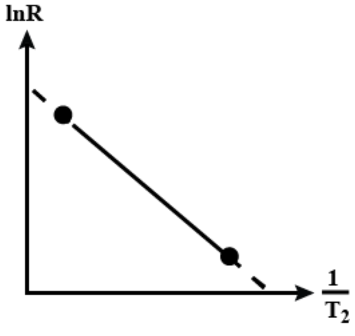
Solution

$y = mx + c$

$lnR = -m\frac{1}{T^2} + c$

$R = e^{-\frac{m}{T^2}} \times e^c$

$R = R_0 e^{-\frac{T_0^2}{T^2}}$



#1612308

Topic: Basics of Moment of Inertia

Two uniform circular rough disc of moment of inertia I_1 and $\frac{I_1}{2}$ are rotating with angular velocity ω_1 and $\frac{\omega_1}{2}$ respectively in same direction. Now one disc is placed the other disc co-axially. The change in kinetic energy of the system is :

A $-\frac{1}{24}I_1\omega_1^2$

B $\frac{1}{24}I_1\omega_1^2$

C $\frac{1}{12}I_1\omega_1^2$

D $-\frac{1}{12}I_1\omega_1^2$

Solution

$\vec{L}_i = \vec{L}_f$

$I_1\omega_1 + \frac{I_1}{2}\frac{\omega_1}{2} = I_1\omega_f + \frac{I_1}{2}\omega_t$

$\frac{5I_1\omega_1}{4} = \frac{3}{2}I_1\omega_f\ \omega f = \frac{5}{6}\omega_1$

$\Delta K.E. = \left(\frac{1}{2}I_1\omega_f^2 + \frac{1}{2}\frac{I_1}{2}\omega_f^2\right) - \left(\frac{1}{2}I_1\omega_1^2 + \frac{1}{2}\frac{I_1}{2}\left(\frac{\omega_1}{2}\right)^2\right)$

$= \frac{1}{2}.\frac{3}{2}I_1\frac{25}{36}\omega_1^2 - \frac{1}{2}.\frac{9}{8}I_1\omega_1^2$

$= \frac{75I_1\omega_1^2}{144} - \frac{9}{8}I_1\omega_1^2$

$= \frac{75-81}{144}I_1\omega_1^2$

$\Delta K.E = -\frac{1}{24}I_1\omega_1^2$

#1612332

Topic: Lorentz Force

An electron, a proton and a He^+ ion projected into a magnetic field with same kinetic energy, with velocities being perpendicular to the magnetic field. The order of the radii of cirlces traced by them is:

A $r_p > r_{He^+} > r_e$

[B] $r_{He^+} > r_p > r_e$

C $r_p = r_{He^+} > r_e$

D None of these

Solution

radius of circle is given by

$r = \frac{mv}{qB} = \frac{p}{qB} = \frac{\sqrt{2mk}}{qB} = \frac{\sqrt{2m}}{qB}\sqrt{k}$

where K is kinetic energy

For poor

$r_p = \frac{\sqrt{2m_p}}{eB}\sqrt{k}$

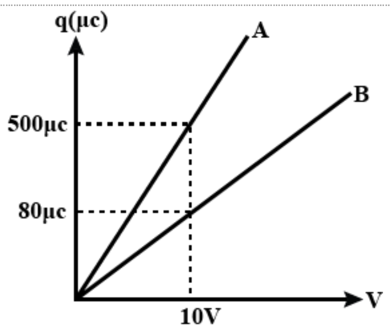
for electron $r_e = \frac{\sqrt{2m_e}}{eB}\sqrt{K}$

for He^+ $r_{He^+} = \frac{\sqrt{2\times4m_p}}{eB}\sqrt{K} = \frac{2\sqrt{2m_p}}{eB}\sqrt{K}$

Clearly $r_{He^+} > r_p > r_e$

#1612334

Topic: Equivalent Capacitance in series-parallel



Plot $A\&B$ represent variation of charge with potential difference across the combination (series and parallel) of two capacitors. Then find the value of capacitance of capacitors.

A $20\mu F, 30\mu F$

[B] $10\mu F, 40\mu F$

C $10\mu F, 15\mu F$

D $25\mu F, 25\mu F$

Solution

For parallel combination -

$q = 10(C_1 + C_2)$

$q_1 = 500\mu C$

$500 = 10(C_1 + C_2)$

$C_1 + C_2 = 50\mu F....(i)$

For series combination

$q_2 = 10\dfrac{C_1C_2}{(C-2+C_2)}$

$80 = 10\dfrac{C_1C_2}{50}$ From equation ... (i)

$C_1C_2 = 400...(ii)$

From equation (i) and (ii)

$C_1 = 10\mu F \quad C_2 = 40\mu F$

#1612335

Topic: Transistor

Power gain for $N-P-N$ transistor is 10^6, input resistance 100Ω and output resistance $1000\,\Omega$. find out current gain.

A 100

B 150

C 200

D 50

Solution

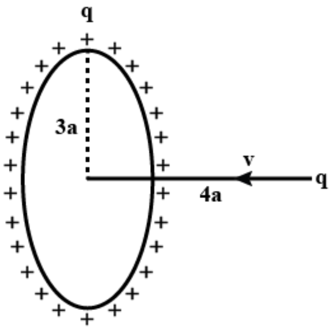
Power gain = $(Current\,gain)^2\left(\dfrac{R_{out}}{R_{in}}\right)$

$10^6 = \beta^2 \times \dfrac{10^4}{100}$

$\beta = 100$

#1612336

Topic: Basics of Projectile Motion



A Circular ring of radius $3a$ is uniformly charged with charge q is kept in $x-y$ plane with center at origin. A particle of charge q and mass m is projected from $x = 4a$ towards origin. Find the minimum speed of projection such that it reaches origin.

A $\sqrt{\dfrac{q^2}{15\pi\varepsilon_0\,ma}}$

B $\sqrt{\dfrac{q^2}{30\pi\varepsilon_0\,ma}}$

C $\sqrt{\dfrac{q^2}{10\pi\varepsilon_0\,ma}}$

D $\sqrt{\dfrac{q^2}{20\pi\varepsilon_0\, ma}}$

Solution

$W_{ext} + W_{i.n.c.} = \Delta KE + \Delta U$

$0 = \left(0 - \frac{1}{2}mv^2\right) + q\left(\frac{kq}{3a} - \frac{Kq}{5a}\right)$

$\frac{1}{2}mv^2 = \frac{2kq^2}{15a}$

$v = \sqrt{\frac{4Kq^2}{15\,ma}} = \sqrt{\frac{q^2}{15\,\pi\varepsilon_0 ma}}$

#1612337

Topic: Isobaric, Isochoric, Isothermal Processes

An Ideal gas undergoes an isobaric process. If its heat capacity is C_v at constant volume and number of mole n. then the ratio of work done by gas to heat given to gas when temperature of gas changes by ΔT is:

[A] $\left(\frac{nR}{c_v + R}\right)$

B $\left(\frac{R}{c_v + R}\right)$

C $\left(\frac{nR}{c_v - R}\right)$

D $\left(\frac{R}{c_v - R}\right)$

Solution

$\frac{f}{2}R = \frac{C_v}{n}$

$W = nR\Delta T$

$\Delta Q = \left(\frac{f}{2} + 1\right)nR\Delta T$

$\frac{W}{\Delta Q} = \left(\frac{2}{f+2}\right) = \frac{2}{\frac{2C_v}{nR} + 2} = \left(\frac{nR}{C_v + R}\right)$

#1612338

Topic: Basics of Moment of Inertia

Surface mass density of a disc of mass m and radius R is $\sigma = Kr^2$. then its moment of inertia w.r.t. axis of rotation passing through centre and perpendicular to the plane of disc

A $I = \frac{3}{2}mR^2$

B $I = \frac{4}{3}mR^2$

C $I = \frac{2}{5}mR^2$

[D] $I = \frac{2}{3}mR^2$

Solution

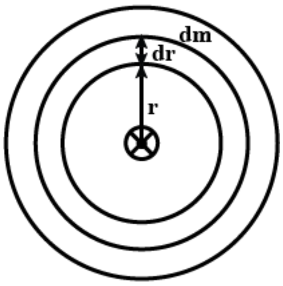
$dI = dm r^2$

$I = \int_0^R K r^2 2\pi r dr.\, r^2 = K2\pi \frac{R^6}{6} = \frac{K\pi R^6}{3}$

$\int_0^m dm = \int_0^R K r^2 2\pi r dr$

$m = 2\pi K \frac{R^4}{4} = \frac{\pi K R^4}{2}$

$I = \frac{2}{3} m R^2$



#1612340

Topic: Amplitude Modulation

A modulating wave of frequency $100\ MHz$ and amplitude $100\ V$ is superimposed on a carrier wave of frequency $300\ GHz$ and amplitude $400\ V$. the value of modulating index and difference between the maximum frequency and minimum frequency of modulated wave are respectively:

A $0.25, 1 \times 10^8\ Hz$

B $4, 2 \times 10^8\ Hz$

C $4, 1 \times 10^8\ Hz$

D $0.25, 2 \times 10^8\ Hz$

Solution

Modulating index $m = \frac{100}{400} = 0.25$

$f_{max.} - f_{min.} = (f_c + f_m) - (f_c - f_m)$

$= 2F_M = 2 \times 10^8 Hz$

#1612344

Topic: Maxwell's Equations

The maximum kinetic energy of electron if wavelength of incident electromagnetic wave is $260\ nm$ and cut-off wavelength is $380\ nm$ given $hc = 1237\ nm - eV$ is

A $1.5\ eV$

B $6.4\ eV$

C $10\ eV$

D None of these

Solution

We know

$KE_{max} = \frac{hc}{\lambda} - \frac{hc}{\lambda_0}$

$= \frac{1237\ nm.\ eV}{260\ nm} - \frac{1237\ nm.\ eV}{380\ nm}$

$= 1.5 eV$

#1612346

Topic: Maxwell's Equations

If $\vec{E} = E_0 \cos(kz)\cos(\omega t)\hat{i}$ then $\vec{B}$ for electromagnetic wave is:

A $\vec{B} = \frac{E_0}{C}\hat{k}$

B $\vec{B} = \frac{E_0}{C}\sin(kz)\sin(\omega t)\hat{i}$

C $\vec{B} = \frac{E_0}{C}\sin(kz)\cos(\omega t)\hat{j}$

D $\vec{B} = \frac{E_0}{C}\cos(kz)\sin(\omega t)\hat{j}$

Solution

$\frac{dE}{dz} = -\frac{dB}{dt}$

If $\vec{E} = E_0\cos(kz)\cos(\omega t)$ then

$\vec{B} = \frac{E_0}{C}\sin(kz)\sin(\omega t)$ will satisfy the equation

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#1612348

Topic: Basics of Projectile Motion

A particle is projected vertically upwards with speed v_0. The drag force acting on it given by $f_{drag} = m\gamma v^2$. the time when it is at maximum height is:

A $\frac{1}{\sqrt{g\gamma}}\tan^{-1}\left(\frac{\sqrt{\gamma}}{\sqrt{g}}v_0\right)$

B $\sqrt{g\gamma}\tan^{-1}\left(\frac{\sqrt{\gamma}}{\sqrt{g}}v_0\right)$

C $\frac{\tan^{-1}}{\sqrt{g\gamma}}\left(\frac{\sqrt{g}}{\sqrt{\gamma}}v_0\right)$

D $\frac{1}{\sqrt{g\gamma}}\tan^{-1}\left(\frac{\sqrt{\gamma}}{\sqrt{g}}\frac{1}{v_0}\right)$

Solution

$a = -(g + \gamma v^2)$

$\frac{dv}{dt} = -(g + \gamma v^2)$

$\int_{v_0}^{0}\frac{dv}{g + \gamma v^2} = -\int_0^t dt$

$\frac{1}{\gamma}\int_{v_0}^{0}\frac{dv}{\left(\frac{g}{\gamma} + v^2\right)} = -\int_0^t dt$

$\frac{1}{\gamma}\frac{1}{\sqrt{\frac{g}{\gamma}}}\left[\tan^{-1}\left(\frac{v}{\sqrt{\frac{g}{\gamma}}}\right)\right]_{v_0}^{0} = -t$

$\frac{1}{\sqrt{g\gamma}}\tan^{-1}\left(\frac{\sqrt{\gamma}}{\sqrt{g}}v_0\right) = t$

#1612349

Topic: Transformers

In a step-down transform the turn ratio is $1:2$ and output power is $2.2\ kW$. if output current is $10\ A$ then the value of input voltage and input current:

A $100\ V, 20\ A$

B $110\ V, 10\ A$

C $440\ V, 5\ A$

D $440\ V, 20\ A$

Solution

$P_{out} = V_0 I0$

$\Rightarrow 2200 = V_0 \times 10 \Rightarrow V_0 = 220$ volt

$\therefore V - i = 2 \times 220 = 440V(\because N_s/N_p = 1/2 = V_0/V_1)$

Also $2200 = 440 \times I_i$

$\Rightarrow I_i = 5A$

#1612350
Topic: Viscosity

The depression of mercury in a capillary tube of radius R_1 is observed to be equal to the rise of water in another capillary tube of radius R_2. if the ratio of surface tension of mercury and water is 7.5, ratio of their density $\frac{\rho_{Hg}}{\rho_{water}} = 13.6$ and their angle of contact are $\theta_{Hg} = 135^o$ and $\theta_{water} = 0^o$ in the respective tubes then R_1/R_2 is:

A 0.2

B 0.4

C 0.7

D 0.8

Solution

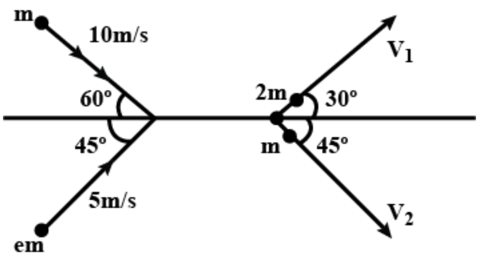
$|h_{Hg}| = |h_{water}|$

$\frac{2S_{Hg}]cos\theta_{Hg}}{\rho_{Hg}R_{Hg}g} = \frac{2S_w\cos\theta_w}{\rho_w R_w g}$

$\frac{R_{Hg}}{R_w} = \frac{\rho_w}{\rho_{Hg}}\frac{S_{hg}}{S_w}\frac{\cos\theta_{Hg}}{\cos\theta_w} = \frac{1}{13.6} \times 7.5 \times \frac{1}{\sqrt{2}}$

$\frac{R_{Hg}}{R_w} = 0.4$

#1612351
Topic: Elastic Collisions in One-Dimension



Two particle of masses m and $2m$ are colliding elastically as given in figure. If V_1 and V_2 speed of particle just after collision then

A $V_1 = 11.16\ m/s$, $V_2 = 6.31\ m/s$

B $V_1 = 10.16\ m/s$, $V_2 = 5.31\ m/s$

C $V_1 = 9.16\ m/s$, $V_2 = 6.31\ m/s$

D $V_1 = 6.31\ m/s$, $V_2 = 11.16\ m/s$

Solution

Using momentum conservation

In x direction

$mx10\cos60^o + 2m\frac{5}{\sqrt{2}} = \frac{mv_2}{\sqrt{2}} + 2mv_1\frac{\sqrt{3}}{2}$

$5\sqrt{2} + 10 = v^2 + \sqrt{6}V_1 \ldots\ldots(A)$

In Y-direction

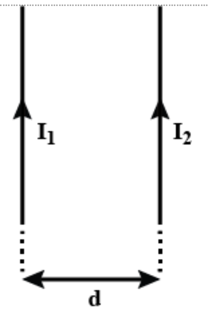
$2m\frac{5}{\sqrt{2}} - m\frac{10\sqrt{3}}{2} = \frac{2mv_1}{2} - \frac{mv_1}{\sqrt{2}}$

$10 - 5\sqrt{6} = \sqrt{2}V_1 - V_2 \ldots(B)$

Using A and B

$V_1 = 6.31\ m/s,\ V_2 = 11.16\ m/s$

#1612352
Topic: Magnetic field



Two parallel infinite wires separated by distance $'d'$ carry currents as shown in figure.

The distance from a third infinite wire be kept parallel to wire carrying current I_1, the wire such that it stays in equilibrium is

A $\frac{I_2}{I_2+I_1}d$ or $\frac{I_1}{I_1+I_2}d$

B $\frac{I_2}{I_2-I_1}d$ or $\frac{I_1}{I_1-I_2}d$

C $\frac{I_2}{I_1-I_2}d$ or $\frac{I_1}{I_1-I_2}d$

D $\frac{2I_2}{I_2+I_1}d$ or $\frac{I_1}{I_1-I_2}d$

Solution

For the case when $I_1 < I_2$

Let the length of the third wire is $\ell(\ell \to \infty)$

For equilibrium $F_1 = F_2$

$$\Rightarrow \frac{\mu_0 I_1 I}{2\pi x}\ell = \frac{\mu_0 I_2 I}{2\pi(d+x)}\ell \Rightarrow \frac{d+x}{x} = \frac{I_2}{I_1} \Rightarrow \frac{d}{x} = \frac{I_2-I_1}{I_2} \Rightarrow x = \left(\frac{I_2}{I_2-I_1}\right)d$$

For the case when $I_2 < I_1$

$F_1 = F_2$

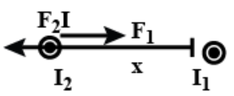
$$\frac{\mu_0 I_1 I\ell}{2\pi x} = \frac{\mu_0 I_2 I\ell}{2\pi(x-d)}$$

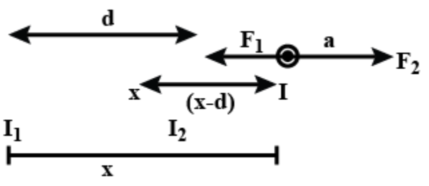
$$\Rightarrow \frac{x-d}{x} = \frac{I_2}{I_1}$$

$$\Rightarrow 1-\frac{d}{x} = \frac{I_2}{I_1} \Rightarrow \frac{I_1-I_2}{I_1} = \frac{d}{x}$$

$$\Rightarrow x = \left(\frac{I_1}{I_1-I_2}\right)d$$

$\therefore$ value of x is $\frac{I_2}{I_2-I_1}$ or $\frac{I_1}{I_1-I_2}d$





#1612353

Topic: Force and Torque

The coordinates of a particle of mass $'m'$ as function of time are given by $x = x_0 + a_1\cos(\omega_1 t)$ and $y = y_0 + a_2\sin(\omega_2 t)$. The torque on particle about origin at time $t = 0$ is:

A $(ma_1\omega_1^2 x_0)\hat{k}$

B $(ma_1\omega_1^2 x_0^2)\hat{k}$

C $(ma_1\omega_1^2 y_0)\hat{k}$

D $(ma_1\omega_1^2 x_0 y_0)\hat{k}$

Solution

$\vec{r} = (x_0 + a_1\cos(\omega_1 t))\hat{i} + (y_0 + a_2\sin(\omega_2 t))\hat{j}$

$\vec{v} = -a_1\omega_1\sin(\omega_1 t)\hat{i} + a_2\omega_2\cos(\omega_2 t)\hat{j}$

$\vec{a} = -a_1\omega_1^2\cos(\omega_1 t)\hat{i} - a_2\omega_2^2\sin(\omega_2 t)\hat{j}$

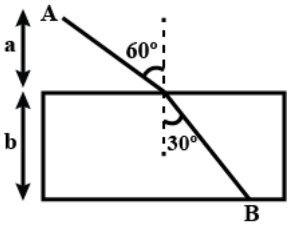
at $t = 0$, $\vec{r} = (x_0 + a_1)\hat{i} + y_0\hat{j}$

$\vec{F} = m\vec{a} = -ma_1\omega_1^2\hat{i}$

$\vec{\tau} = \vec{r} \times \vec{F} = (ma_1\omega_1^2 y_0)\hat{k}$

#1612354

Topic: Prism



For path $A \to B$ optical path is

A $2(a+b)$

B $2(a-b)$

C $a+b$

D $a-b$

Solution

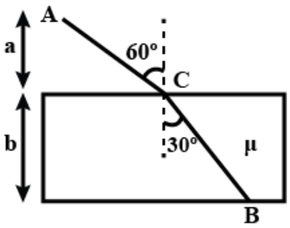
$AC = \dfrac{a}{\cos 60^o}$; $CB = \dfrac{b}{\cos 30^o}$

$\sin 60^o = \mu \sin 30^o$

$\mu = \sqrt{3}$

optical path $= AC + \mu CB$

$= \dfrac{a}{cos 60^o} + \mu\dfrac{\beta}{cos 30^o} = 2a + \sqrt{3}\dfrac{\frac{6}{\sqrt{3}}}{2} = 2(a+b)$



#1612355

Topic: Introduction to Kinetic Theory

Rms speed of O_2 molecule is $200\ m/s$ at $T = 300\ K$ and $P = 3atm$. If diameter of molecule is $0.3\ nm$ then collision frequency is:

A $2.9 \times 10^7 s^{-1}$

B $2.9 \times 10^6 s^{-1}$

C 2.9×10^8

D 2.9×10^5

Solution

Collision frequency $= \sqrt{\dfrac{8kT}{\pi m}} \cdot \dfrac{\sqrt{2}\pi d^2 N_A P}{RT}$

$= \sqrt{\dfrac{8}{\pi} \times \dfrac{25}{3} \cdot \dfrac{300}{32}} \dfrac{\sqrt{2}\pi \times 9 \times 10^{-29} \times 6.023 \times 10^{23} \times 10^5}{\frac{25}{3} \times 300} = \dfrac{722.14}{25} \times 10^6$

$= 28.8 \times 10^6 = 2.9 \times 10^7 s^{-1}$

#1612356

Topic: Gas Laws

He is kept in a rigid container of volume 67.2 ltr at STP. The heat supplied to the gas to increase its temperature by 20^oC is:

A $780\,J$

B $748\,J$

C $718\,J$

D $680\,J$

Solution

$Q = nC_v\Delta T = \frac{67.2}{22.4}.\frac{3R}{2}.20 = 3\times\frac{3}{2}\times 8.314\times 20 = 748J$

#1612357

Topic: Nature of Electromagnetic Waves

Some devices and electromagnetic wave are given in Column -I and Column - II, match the device with electromagnetic wave work:

Column - I	Column - II
(A) Mobile	(P) Microwave
(B) Sonar	(Q) IR
(C) Radar	(R) Radio wave
(D) Optical fiber	(S) Ultra sound

A $(A\rightarrow S);(B\rightarrow Q),(C\rightarrow P),(D\rightarrow R)$

B $(A\rightarrow Q);(B\rightarrow S),(C\rightarrow P),(D\rightarrow R)$

C $(A\rightarrow Q);(B\rightarrow S),(C\rightarrow R),(D\rightarrow P)$

D $(A\rightarrow S);(B\rightarrow Q),(C\rightarrow R),(D\rightarrow P)$

Solution

1)$Mobile - IR$;

IR wireless is the use of wireless technology in devices or systems that convey data through infrared (IR) radiation. Infrared is electromagnetic energy at a wavelength or wavelengths somewhat longer than those of red light.the Infrared feature or IR LED as is popularly known, smartphones can now be used as a remote controller for TVs, set tc boxes, AC etc

2)$SONAR - Ultrasound$

The ultrasonic sensor uses sonar to determine the distance to an object.

3)$Radar - Microwave$

Microwave Radar Sensor module has been designed as an alternative to the common PIR motion sensors widely used in burglar alarms and security lights. Like the PIR (https://robu.in/product-category/sensors/ir-and-pir-sensors/)sensor this sensor also detects only movements within its detection range.

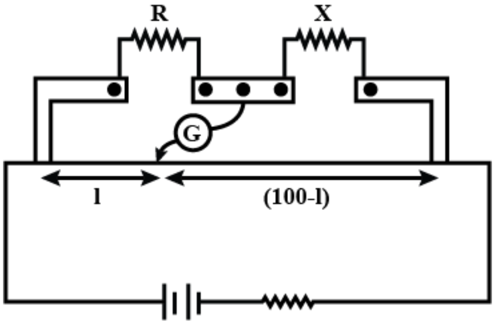
4)$OpticalFiber - Radiowaves$

Radio over fiber (RoF) or RF over fiber (RFoF) refers to a technology whereby light is modulated by a radio frequency signal and transmitted over an optical fiber (https://en.wikipedia.org/wiki/Optical_fiber) link. Main technical advantages of using fiber optical links are lower transmission losses and reduced sensitivity to noise and electromagnetic interference compared to all-electrical signal transmission.

$(A\rightarrow Q);(B\rightarrow S),(C\rightarrow P),(D\rightarrow R)$

#1612358

Topic: Potentiometer



Which of the above is incosistent for the given meter bridge:

S.N	R	ℓ
1.	1000Ω	60 cm
2.	100Ω	13 cm
3.	10Ω	1.5 cm
4.	1Ω	1 cm

A 1

B 2

C 3

D 4

Solution

1)$X = \frac{R(100-\ell)}{\ell}$

$= \frac{1000(100-60)}{60}$

$= \frac{40,000}{60}$

666.66Ω

2)$X = \frac{R(100-\ell)}{\ell}$

$\frac{100(100-13)}{13}$

$= \frac{8700}{13}$

$= 669.23\Omega$

3)$X = \frac{R(100-\ell)}{\ell}$

$= \frac{10(100-15)}{15}$

$= \frac{850}{15}$

$= 56.66\Omega$

4)$X = \frac{R(100-\ell)}{\ell}$

$= \frac{1(100-1)}{1}$

$= 99\Omega$

so answer is 4

#1612360

Topic: Circuit Instruments

Full scale deflection current for a galvanometer is $10^{-4}A$. a resistance of $2 \times 10^{6}\Omega$ is connected in series. Calculate shunt required to correct in into an ammeter of range $0mA + 10mA$.

Solution

$R_s = \frac{I_g R_g}{I - I_g}$

$\frac{10^{-4} \times (2 \times 10^6)}{0 + 10}$

$= \frac{200}{10}$

20Ω