#1611906
Topic: Acceleration

$\vec{r} = 15t^2\hat{t} + (20 - 20t^2)\hat{j}$

Find magnitude of acceleration at $t = 1$ sec.

A $30\ m/s^2$

B $40\ m/s^2$

C $70\ m/s^2$

$\boxed{\text{D}}$ $50\ m/s^2$

Solution

$$\vec{a} = \frac{d^2r}{dt^2}$$

$$\Rightarrow \vec{a} = 30\hat{i} - 40\hat{j}$$

$$|a| = 50\ m/s^2$$

#1611907
Topic: Speed of Sound

A string of length $2\ m$ is fixed at two ends. It is in resonance with a tuning fork of frequency $240\ Hz$ in its third harmonic. Than speed of sound wave in string and its fundamenta frequency is:

A $240\ m/s$, $80\ Hz$

$\boxed{\text{B}}$ $320\ m/s$, $80\ Hz$

C $640\ m/s$, $80\ Hz$

D $120\ m/s$, $40\ Hz$

Solution

$$f_3 = \frac{3V}{2L} = 240$$

$$\frac{3 \times V}{2 \times 2} = 240$$

$$V = 320\ m/s$$

$$f_0 = \frac{V}{2L} = \frac{320}{2 \times 2} = 80\ Hz$$

#1611914
Topic: Organ Pipes

$A\&B$ move in opposite directions with same speed $v = 20\ m/s$, if frequency heard by A is $2000\ Hz$ than orginal frequency of B is.

A $1950\ Hz$

B $2350\ Hz$

$\boxed{\text{C}}$ $2250\ Hz$

D $2550\ Hz$

#1611917
Topic: Resistance and Resistivity

A uniform wire of resistance $R = 3\Omega$ and length ℓ is stretched to double its length. Now it is bent to form a circular loop and two points $P\&Q$ lies on the loop such that they subtend 60^o angle at centre. The equivalent resistance between two points $P\&Q$ is:

[✓ A] $\frac{5}{3}\Omega$

B 12Ω

C $\frac{3}{5}\Omega$

D $\frac{1}{12}\Omega$

#1611922

Topic: Density

A cubical block is initially floating on water such that its $\frac{4}{5}th$ volume is submersed in water. Now oil is poured on water and when block attains equilibrium its half volume is in water and half volume is in oil. then relative density of oil is:

A $\frac{4}{5}$

[✓ B] $\frac{3}{5}$

C $\frac{2}{5}$

D $\frac{5}{3}$

Solution

$$\frac{4}{5}V\rho_w g = mg \qquad ...(i)$$

$$\frac{V}{2}\rho_w g + \frac{V}{2}\rho' g = mg = \frac{4}{5}V\rho_w g$$

$$\frac{1}{2}\rho_w + \frac{\rho'}{2} = \frac{4}{5}\rho_w$$

$$\frac{\rho'}{2} = \rho_w\left[\frac{4}{5} - \frac{1}{2}\right]$$

$$\frac{\rho'}{\rho_w} = \frac{3}{5}$$

#1611931

Topic: Reflection at Plane Surface

Light of intensity $50\ W/m^2$ is incident on a area of $1m^2$ in such a way that 25% of light is reflected back. Find the the force exerted by light on surface if light incidents perpendicularly.

A $10.8 \times 10^{-8}N$

B $15.8 \times 10^{-8}N$

[✓ C] $20.8 \times 10^{-8}N$

D $25.8 \times 10^{-8}N$

Solution

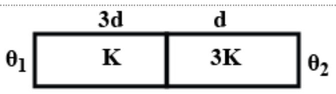
$$P = \frac{I}{C}(1 + r)$$

$$P = \frac{1.25 \times 50}{3 \times 10^8}$$

$$F = \frac{1.25 \times 50}{3 \times 10^8} \times \ = \frac{12.5 \times 50}{3 \times 10^8} = \frac{62.5}{3} \times 10^{-8}$$

$$= 20.8 \times 10^{-8}N$$

#1611935
Topic: Energy in a Capacitor



Two conductors of same crass-section and conductivities $K, 3K$ and lengths $3d$ and d respectively are connected end to end as shown in figure. Temperature of end of first conductor is θ_1 and that of second conductor is θ_2. The temperature of junction in steady state is ($\theta_2 > \theta_1$).

A $\dfrac{10\theta_2 + 9\theta_1}{19}$

B $\dfrac{\theta_2 + 9\theta}{10}$

[✓ C] $\dfrac{9\theta_2 + \theta_1}{10}$

D $\dfrac{9\theta_2 + 10\theta_1}{19}$

Solution

Equating heat current in both slabs

$$\frac{K(\theta - \theta_1)}{3d} = \frac{3K(\theta_2 - \theta)}{d}$$

$\theta - \theta_1 = 9\theta_2 - 9\theta$

$10\theta = 9\theta_2 + \theta_1$

$$\theta = \frac{9\theta_2 + \theta_1}{10}$$

#1611941
Topic: Antenna Height and Range

Height of antenna of transmitter and receiver is proportional to:

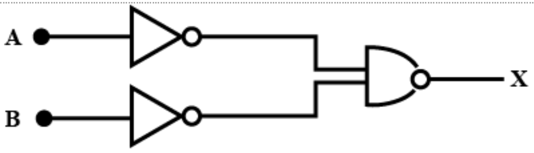
A Frequency of carrier wave

[✓ B] $\dfrac{1}{modulation\ frequency}$

C Both

D None of these

#1611943
Topic: Logic Gates



The output of the given combination of gates is equivalent to:

A NAND

[✓ B] OR

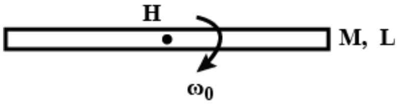
C AND

D NOR

Solution

$\overline{\bar{A}\cdot\bar{B}} = A + B$

#1611946
Topic: Angular velocity



A uniform rod of mass M and length L hinged at centre is rotating in horizontal plane with angular speed ω_0. Now two objects each of mass m are kept on rod near the hinge c both sides. They starts sliding towards ends. Find ω of rod finally.

A $\frac{M\omega_0}{6M+m}$

$\boxed{\text{B}}$ $\frac{M\omega_0}{M+6m}$

C $\frac{6M\omega_0}{M+m}$

D $\frac{M\omega_0}{M+2m}$

Solution

Applying conservation of angular momentum.

$$\left(\frac{ML^2}{12} + m0^2 + m0^2\right)\omega_0 = \left(\frac{ML^2}{12} + m\left(\frac{L}{2}\right)^2 + m\left(\frac{L}{2}\right)^2\right)\omega$$

$$\Rightarrow \frac{ML^2}{12}\omega_0 = \left(\frac{ML^2}{12} + \frac{ML^2}{2}\right)\omega$$

we get, $\omega = \frac{M\omega_0}{M+6m}$

#1611949

Topic: Moment of Inertia of Common Bodies

The moment of inertia of a rigid body is $1.5\ kg \times m^2$ and its initial angular velocity is zero. it starts rotating with uniform angular acceleration $\alpha = 20\ rad/sec^2$ to achieve a rotational $KE = 1200\ J$. find the time required for this:

A 20 sec

B 200 sec

$\boxed{\text{C}}$ 2 sec

D 0.2 sec

Solution

From $\omega = \omega_0 + \alpha t$

we get $\omega = 20t$

Rotational $KE \Rightarrow \frac{1}{2}Iw^2 = 1200\ J$

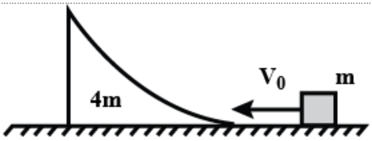
$\frac{1}{2}(105)(20t)^2 = 1200$

$t^2 = 4$

$t = 2$ sec.

#1611952

Topic: Static Friction



A wedge of mass $4\ m$ is initially at rest on frictionless horizontal surface. A small block of mass m moving with speed v_0 and climbs on wedge. Find maximum height achieved b block.

A $\frac{5v_0^2}{2g}$

$\boxed{\text{B}}$ $\frac{2}{5}\frac{v_0^2}{g}$

C $\frac{v_0^2}{2g}$

D $\frac{2v_0^2}{g}$

Solution

Applying conservation of linear momentum,

$mv_0 = (m + 4m)v$

we get, $v = \frac{v_0}{5}$

Applying conservation of mechanical energy,

$$\frac{1}{2}mv_0^2 = \frac{1}{2}(m + 4m)v^2 + mgH$$

$$mgH = \frac{1}{2}mv_0^2 = \frac{1}{2}\frac{mv_0^2}{5} = \frac{1}{2}mv_0^2\frac{4}{5}$$

$$mgH = \frac{4mv_0^2}{10}$$

$$H = \frac{2}{5}\frac{v_0^2}{g}$$

#1611962

Topic: Magnetic field

A galvanometer of number of turns 175, having $1\,cm^2$ area, turns through 1^o when a current of $1mA$ is passed. Find magnetic field if torsional constant of spring is $10^{-6}N - m$

A $10^{-4}T$

$\boxed{\text{B}}$ $10^{-3}T$

C $10^{-5}T$

D $10^{-2}T$

Solution

$t_M = \tau s$

BINA $= C\phi$

$$B = \frac{C\phi}{INA} = \frac{10^{-6}}{10^{-3}\times 175\times 10^{-4}}\frac{\pi}{180} = \frac{\pi}{18\times 175} = 0.0010 = 10^{-3}T$$

#1611967

Topic: Dual Nature

Two particles of de-broglie wavelength λ_x and λ_y are moving in opposite directions. find dBroglie wavelength after perfectly inelastic collision:

$\boxed{\text{A}}$ $\frac{\lambda_x\lambda_y}{|\lambda_x - \lambda_y|}$

B $\frac{2\lambda_x\lambda_y}{\lambda_x - \lambda_y}$

C $\frac{\lambda_x\lambda_y^2}{\lambda_x - \lambda_y}$

D $\lambda_y - \lambda_x$

Solution

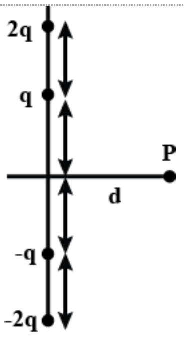
$$\frac{h}{\lambda_x} - \frac{h}{\lambda_y} = \frac{h}{\lambda}$$

$$\frac{1}{\lambda} = \frac{\lambda_y - \lambda_x}{\lambda_x \lambda_y}$$

$$\frac{\lambda_x \lambda_y}{\lambda_y - \lambda_x} \text{ or } \frac{\lambda_x \lambda_y}{\lambda_x - \lambda_y}$$

#1611973

Topic: Electric Charge



Four charges are arranged on y-axis as shown in figure. then the electric field at point P is proportional to:

A $\frac{1}{d}$

$\boxed{\text{B}}$ $\frac{1}{d^2}$

C $\frac{1}{d^4}$

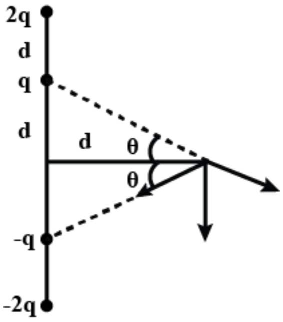
D 0

Solution

$$E = 2\frac{kq}{(d^2+d^2)}\frac{d}{\sqrt{d^2+d^2}} + \frac{k2q}{(d^2+4d^2)}\frac{2d}{\sqrt{d^2+4d^2}}$$

$$\frac{kqd}{d^2 d}\left[\frac{2}{2\sqrt{2}} + \frac{8}{5\sqrt{5}}\right]$$

$$= \frac{kq}{d^2}\left[\frac{1}{\sqrt{2}} + \frac{8}{5\sqrt{5}}\right]$$



#1611980

Topic: Moving Coil Galvanometer

Maximum current that can pass through galvanometer is $0.002A$ and resistance of galvonometer is $R_g = 50\Omega$. find out shunt resistance to convert in into ammeter of range 0.5

A 0.5Ω

$\boxed{\text{B}}$ 0.2Ω

C 0.7Ω

D 0.9Ω

Solution

$$Rs = \frac{I_g R_g}{I - I_g} = \frac{2 \times 10^{-3} \times 50}{0.5 - 2 \times 10^{-3}} = \frac{0.1}{0.498} = 0.2\Omega$$

#1611982

Topic: Kinematics of Circular Motion

Mass density of sphere of radius R varies as $\frac{K}{r^2}$, where K is constant and r is distance from centre. A particle is moving near surface of s[here along circular path of radius R witl time period T. Then

A $\frac{T^2}{R} =$ constant

$\boxed{\text{B}}$ $\frac{T}{R} =$ constant

C $\frac{T}{R^2} =$ constant

D $\frac{T^2}{R^3} =$ constant

Solution

$$\int_0^R \left(\frac{G}{R^2}\frac{K}{r^2}4\pi r^2 dr\right) m = m\left(\frac{2\pi}{T}\right)^2 \times R$$

$$\frac{GK4\pi}{R^2} \times m = m\left(\frac{2\pi}{T^2}\right) \times R$$

$$\frac{T^2}{R^2} = \text{constant}$$

$$\frac{T}{R} = \text{constant}$$

#1611987

Topic: Spherical Mirrors

For position of real object at x_1 and $x_2 (x_2 > x_1)$ magnification is equal to 2. Find out $\frac{x_1}{x_2}$. if focal length of converging lens $f = 20\ cm$.

$\boxed{\text{A}}$ $\frac{1}{2}$

B $\frac{1}{4}$

C 2

D 4

Solution

$$m=\left(\frac{f}{f+u}\right)$$

$$-2=\frac{20}{20-x_2}$$

$$-10x_2=10$$

$$x_2=20\ cm$$

$$m=2=\frac{20}{20-x_1}$$

$$20-x_1=10$$

$$x_1=10$$

$$\frac{x_1}{x_2}=\frac{10}{20}=\left(\frac{1}{2}\right)$$

#1611993

Topic: Scalars and Vectors

A vector is inclined at $\frac{\pi}{4}$ rad with x-axis & $\frac{\pi}{3}$ rad with y-axis then find angle of vector with z-axis.

[✓ A] $\frac{2\pi}{3}$ rad

B $\frac{5\pi}{3}$ rad

C $\frac{\pi}{4}$ rad

D $\frac{\pi}{2}$ rad

Solution

$$cos^2\frac{\pi}{4}+\cos^2\frac{\pi}{3}+\cos^2 z=1$$

$$\cos^2 z=1-\frac{1}{2}-\frac{1}{4}=\frac{1}{4}$$

$$\cos z=\ \pm\frac{1}{2}\Rightarrow z=60^o,120^o\Rightarrow\frac{\pi}{3}\text{ or }\frac{2\pi}{3}\text{ rad}$$

#1612001

Topic: Energy in a Capacitor

Two capacitor of capacitance 'C' and 'nC' are connected in parallel. A battery of emf 'V' is connected across the combination. Now the battery is removed and a dielectric constant K is inserted filling the space between the plates of capacitor of capacitance C. the final potential difference across the system is

A $\frac{n+k}{n+1}$

[✓ B] $\frac{n+1}{n+k}$

C $\frac{n-1}{n+k}V$

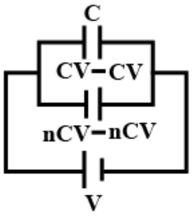
D $\frac{n+1}{n-k}V$

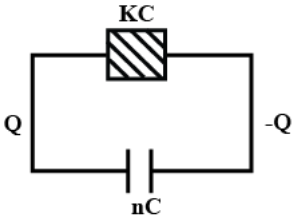
Solution

Total charge on system after battery is removed is $Q=(n+1)CV$ and it remains constant. final situation

$C_{eq}=nC+kc=(n+1)C$

$$V=\frac{Q}{C_{eq}}=\frac{(n+1)CV}{(n+k)C}=\frac{n+1}{n+k}V$$





#1612039

Topic: Refraction at Plane Surfaces

An small object is kept at 18 cm from combination of a convex lens and plane mirror to get the image on object itself. Now the space between lens and mirror is filled with liqui of refractive index μL. Now we need to keep the object at 27 cm to get the image on object. Find μL.

$\boxed{\text{A}}$ $\frac{4}{3}$

B $\frac{8}{3}$

C $\frac{3}{2}$

D $\frac{7}{3}$

Solution

Power for equivalent mirror $P = 2P_L$

Focal length for equivalent mirror $F = -\frac{1}{P} = -\frac{1}{2P_L} = \frac{-1}{2 \times \frac{1}{F_L}} = \frac{F_L}{2}$

According to question

$2F = -18$

$\Rightarrow -\frac{2F_L}{2} = -18 \Rightarrow F_L = 18\,cm$

$(1.5 - 1)\frac{2}{R} = \frac{1}{18}$

$R = 18\,cm$

$$\frac{1}{F_L} = (\mu L - 1)\left(\frac{1}{-18} - \frac{1}{\infty}\right) = \frac{\mu_L - 1}{78} = \frac{1 - \mu_L}{18}$$

$$\frac{1}{F_{eq}} = \frac{1}{F_L} + \frac{1}{F_L} = \frac{1}{18} + \frac{1 - \mu_L}{18} = \frac{2 - \mu_L}{18}$$

According to question

$P = P_{equivalent\,mirror} = 2P_L + 2P_L$

$$= 2\left(\frac{1}{F_L} + \frac{1}{F_L}\right) = 2\left[\frac{2 - \mu_L}{18}\right] = \frac{\mu_L}{9}$$

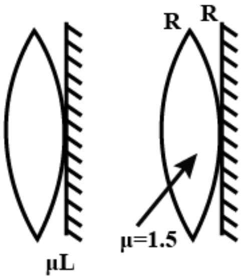
f_{eq} for mirror $= \frac{-1}{P} = \frac{9}{\mu_L - 2} = F'$

According to question

$2F' - 27$

$\Rightarrow \frac{2 \times 9}{\mu_L - 2} = -27$

$\Rightarrow \mu_L = \frac{4}{3}$



#1612052

Topic: Speed and Velocity

The position of particles is given as $x = at + bt^2 - ct^3$ find out velocity when acceleration is zero

$\boxed{A}$ $v = a + \frac{b^2}{3C}$

B $v = a - \frac{b^2}{3c}$

C $v = 2a - \frac{b^2}{3c}$

D None of these

Solution

$$\frac{dx}{dt} = a + 2bt - 3ct^2$$

$$\frac{d^2x}{dt^2} = 0 + 2b - 6ct = 0$$

$$t = \frac{b}{3c}$$

$$V = a + 2b\left(\frac{b}{3c}\right) - 3c\left(\frac{b}{3c}\right)^2$$

$$V = a + \frac{2b^2}{3c} - \frac{b^2}{3c} = a + \frac{b^2}{3c}$$

$$V = a + \frac{b^2}{3c}$$

#1612064
Topic: Inelastic Collisions

Two bodies of masses m and $2m$ are moving in same direction with speed $2v$ and v respectively, just after collision body of mass $2m$ splits in two equal parts which move at 45 from initial direction of motion. Find out speed of one part after collision

$\boxed{\text{A}}$ $2\sqrt{2}v$

B $\sqrt{2}v$

C $2v$

D None of these

#1612073
Topic: Heat, Internal Energy and Work

During a process ideal gas expands to compress the spring such that $10\ KJ$ energy is stored in spring and $2\ KJ$ heat is released from gas to surrounding. Find the change in internal energy of gas

$\boxed{\text{A}}$ $12\ KJ$

B $10\ KJ$

C $8\ KJ$

D $6\ KJ$

Solution

Here, $W = 10\ KJ$

$\theta = -2\ KJ$

$\Delta U = \theta - w$

$= 10 - (-2)$

$= 12\ KJ$

#1612084
Topic: Heat, Internal Energy and Work

A block of mass $500\ g$ and specific heat $400\ J/kg\,K$ is attached with a spring of spring constant $800\ N/m$. Now block is dipped in water of mass $1\ kg$ and specific heat $4184\ J/kg\,K$. Now the spring is elongated by $2m$ and released. Find rise in temperature of water and block system when block finally comes to rest.

A $7.64 \times 10^{-4}K$

B $3.64 \times 10^{-3}K$

$\boxed{\text{C}}$ $3.64 \times 10^{-5}K$

D $3.64 \times 10^{-6}K$

Solution

$$\frac{1}{2}kA^2 = m_1s_1\Delta T + m_2s_2\Delta T$$

$$\frac{1}{2}\times 800\times\left(\frac{2}{100}\right)^2 = \frac{1}{2}\times 400\times\Delta T + 4184\times\Delta T$$

$$\Delta T = \frac{400\times\left(\frac{2}{100}\right)^2}{200+4184} = 3.64\times 10^{-5}K$$

#1612093

Topic: Atomic Spectra and Spectral Series

If He^+ ion is in its first excited state that its ionization energy is:

[✓ A] 13.6 eV

B 48.8 eV

C 54.4 eV

D $-13.6\ eV$

Solution

$$E_n = -13.6\frac{z^2}{n^2}$$

in first excited state for He^+

$$E = -13.6\times\frac{(2)^2}{(2)^2} = 13.6\ eV$$

$\therefore$ Ionization energy is 13.6 eV

#1612109

Topic: Resistance and Resistivity

If in conductor, number density of electrons is $8.5\times 10^{28}/m^3$ average relaxation time 25 femtosecond mass of electron being $9.1\times 10^{31}kg$, the resistivity would be of the order.

A 10^{-5}

B 10^{-6}

C 10^{-7}

[✓ D] 10^{-8}

Solution

$$\sigma = \frac{ne^2C}{m_e} \Rightarrow e = \frac{m_e}{ne^2C} = \frac{9.1\times 10^{-31}}{8.5\times 10^{28}\times(1.6\times^{-19})^2\times 25\times 10^{-15}}$$

$$= \frac{9.1}{8.5\times(1.6)^2\times 25}\times 10^{-6}$$

$$e = 1.6\times 10^{-8}$$

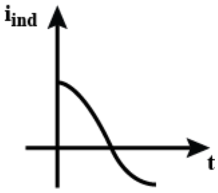
$$e \simeq 10^{-8}$$

#1612116

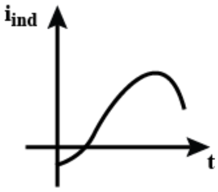
Topic: Solenoid and Toroid

If current is solenoid is $i_1 = \alpha te^{-\beta t}$. Which of the following is correct graph between induced current and time (α and β are positive)

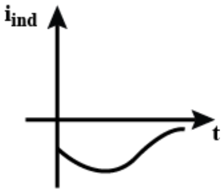
A



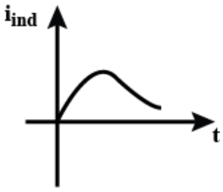
B



C



D



Solution

$i_{ind} \alpha \frac{di}{dt} = \frac{d}{dt}(\alpha\, t\, e^{-\beta t})$

$= \alpha\, e^{-\beta t} + \alpha t\, e^{-\beta t}(-\beta)$

$= \alpha e^{-\beta t}(1 - \beta t)$

Check value at $t = 0$