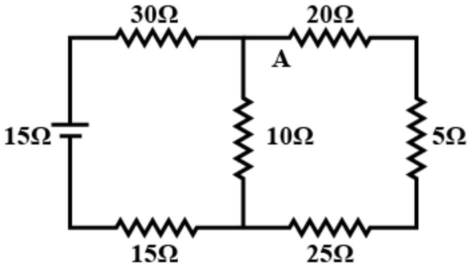
#1611023

Topic: Circuit Instruments



In the circuit given below, find the total current drawn from the battery:

A $\frac{3}{24}$

B $\frac{14}{25}$

[✓ C] $\frac{9}{32}$

D $\frac{3}{20}$

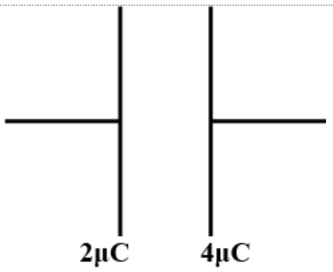
Solution

$R_{eq} = 45 + \frac{25}{3} = \frac{135 + 25}{3} = \frac{160}{3}$

$i = \frac{V}{R} = \frac{15}{\frac{160}{3}} = \frac{9}{32}$

#1611024

Topic: Types of Capacitors



In a parallel plate capacitor of capacitor $1 \mu F$ two plates are given charges $2 \mu C$ and $4 \mu C$ then the potential difference between the plates of the capacitor is:

A 2 Volt

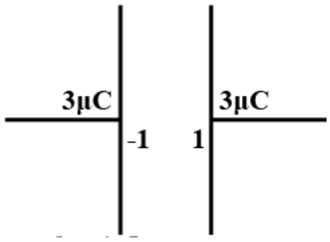
[✓ B] 1 Volt

C 4 Volt

D 3 Volt

Solution

$V = \frac{Q}{C} = \frac{1 \mu C}{1 \mu F} = 1$ Volt



#1611025

Topic: Young's Modulus

Two elastic wire $A\&B$ having length $\ell_A = 2\ m$ and $\ell_B = 1.5\ m$ and the ratio of young's modules $Y_A : Y_B$ is $7:4$. If radius of wire $B(r_B)$ is $2mm$ then choose the correct value of radiu of wire A. Given that due to application of the same force charge in length in both $A\&B$ is same

A 1.7 mm

B 1.9 mm

C 2.7 mm

D 2 mm

Solution

$$Y = \frac{F\ell}{\pi r^2 \Delta\ell}$$

$$\frac{Y_A}{Y_B} = \frac{F\ell_A}{\pi r_A^2 \Delta\ell} \times \frac{\pi r_B^2 \Delta\ell}{F\ell_B}$$

$$\frac{7}{4} = \frac{2}{1.5} \times \frac{2^2}{r_A^2} \Rightarrow r_A^2 = \frac{4 \times 2 \times 2^2}{1.5 \times 7}$$

$$r_A = 1.7\ mm$$

#1611027

Topic: Kinetic Energy

Light of wavelength λ is incident on metal surface. Work function of metal is very small compare to kinetic energy of photon. If light of wavelength λ' is incident on metal surfac then linear momentum of electron becomes 1.5 of the momentum is previous case. Choose the correct value of λ':

A $\left(\frac{9\lambda}{4}\right)$

B $\left(\frac{3\lambda}{4}\right)$

C $\left(\frac{3\lambda}{2}\right)$

D $\left(\frac{4\lambda}{9}\right)$

Solution

$$\frac{P^2}{2m} = \frac{hc}{\lambda}$$

$$\frac{(1.5P)^2}{2m} = \frac{hc}{\lambda'}$$

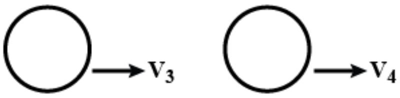
$$\frac{1}{2.25} = \frac{\lambda'}{\lambda}$$

$$\lambda' = \left(\frac{\lambda}{2.25}\right) = \left(\frac{4\lambda}{9}\right)$$

#1611029

Topic: Elastic Collisions in One-Dimension

After collision the situation is as shown



Two balls of mass m_1 and m_2 where $m_2 = 0.5m_1$, undergo head on collision as shown in figure.

If $v_3 = 0.5v_1$ value of v_4 is

[✓ A] $v_4 = v_1 + v_2$

B $v_4 = v_1 + 2v_2$

C $v_4 = 2v_1 + v_2$

D $v_4 = 2v_1 + 3v_2$

#1611031

Topic: Electric Dipole

A electric dipole having charge q and $-q$ are placed at distance $'d'$ is in equilibrium in a uniform electric filed E. Each charge has mass $'m'$. If dipole is displayed by small angl

Then its angular frequency of oscillation is:

A $\sqrt{\frac{3qE}{md}}$

B $\sqrt{\frac{qE}{2md}}$

[✓ C] $\sqrt{\frac{2qE}{md}}$

D $\sqrt{\frac{2qE}{3md}}$

Solution

$$\omega^2 = \frac{pE}{I} = \frac{qd(E)}{\frac{md^2}{4} + \frac{md^2}{4}} = \frac{2qdE}{md^2}$$

$$\omega^2 = \frac{2qE}{md}$$

$$\omega = \sqrt{\frac{2qE}{md}}$$

#1611032

Topic: Vector Addition

$\vec{A}_1$ and $\vec{A}_2$ are two vectors such that $|\vec{A}_1| = 3$, $|\vec{A}_2| = 5$ and $|\vec{A}_1 + \vec{A}_2| = 5$ the value of $(2\vec{A}_1 + 3\vec{A}_2) \cdot (2\vec{A}_1 - 2\vec{A}_2)$ is

A $\frac{237}{2}$

[✓ B] -123

C $\frac{-337}{2}$

D $\frac{337}{2}$

Solution

$(\vec{A}_1 + \vec{A}_2) \cdot (\vec{A}_1 + \vec{A}_2) = |\vec{A}_1 + \vec{A}_2|^2$

$9 + 25 + 2(\vec{A}_1 \cdot \vec{A}_2) = 25$

$(\vec{A}_1 \cdot \vec{A}_2) = \frac{-9}{2}$

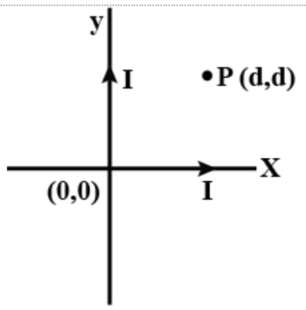
$$(2\vec{A}_1 + 3\vec{A}_2) \cdot (2\vec{A}_1 - 2\vec{A}_2) = 4|\vec{A}_1|^2 - 4\vec{A}_1 \cdot \vec{A}_2 + 6\vec{A}_2 \cdot \vec{A}_1 = 6|\vec{A}_2|^2$$

$$= 4A_1^2 - 4A_1 \cdot A_2 + 6A_1 \cdot A_2 - 6A_2^2$$

$$= 4 \times 9 + 2 \times \left(\frac{-9}{2}\right) - 6 \times 25 = -123$$

#1611034

Topic: Magnetic field



Two perpendicular infinite wires are carrying current i as shown in the figure. The magnetic field at point P is:

A $\frac{\mu_0 I}{\pi d}$

B $-\frac{\mu_0 I}{2\pi d}$

C $\frac{\mu_0 I}{2\pi d}$

[✓ D] Zero

Solution

$B_1 = \frac{\mu_0 I}{2\pi y}$

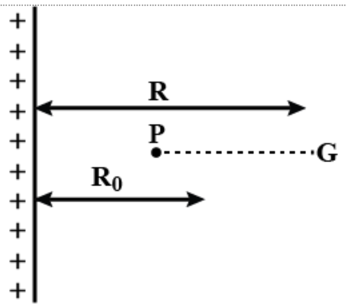
$B_2 = \frac{\mu_0 I}{2\pi x}$

$B = \frac{\mu_0 I}{2\pi y} - \frac{\mu_0 I}{2\pi x} = 0$

$x = y = d$

#1611036

Topic: Gauss's Law



A charge particle q released at a distance R_0 from the infinite long wire of linear charge density λ. then velocity at distance R from the wire will be proportional to:

A R^3

B e^{R/R_0}

C R^2

$\boxed{\text{D}}$ $\left[\ell n\left(\frac{R}{R_0}\right)\right]^{1/2}$

Solution

$\Delta KE + \Delta U = 0$

$$\left(\frac{1}{2}mv^2 - 0\right) + q(v_f - v_i) = 0$$

$$\frac{1}{2}mv^2 + q\left[-2k\lambda \ell n\left(\frac{R}{R_0}\right)\right] = 0$$

$$\frac{1}{2}mv^2 = 2k\lambda q \ell n\left(\frac{R}{R_0}\right)$$

$$v = \left[\frac{4k\lambda q}{m}\ell n\left(\frac{R}{R_0}\right)\right]^{1/2}$$

#1611037

Topic: Free, Forced and Damped Oscillations

A particle is performing damped oscillation with frequency $5Hz$. After every 10 oscillations its amplitude becomes half. find time from beginning after which the amplitude becomes $\frac{1}{1000}$ of its initial amplitude:

A $10\,s$

$\boxed{\text{B}}$ $20\,s$

C $25\,s$

D $50\,s$

Solution

$f = 5$

so $T = \frac{1}{5}$

$$10T = \frac{10}{5} = 2$$

$$\frac{A_0}{1000} = A_0\left(\frac{1}{2}\right)^{t/2}$$

$$(2)^{t/2} = 1000$$

$$\left(\frac{t}{2}\right)log2 = 3$$

$$t = \frac{6}{log2} = 20s$$

#1611039

Topic: Potentiometer

A battery of $emf E$ and internal resistance r. The value of external resistance R so that the power across external resistance is maximum:

$\boxed{\text{A}}$ r

B $2r$

C $\frac{r}{2}$

D $\frac{'}{4}$

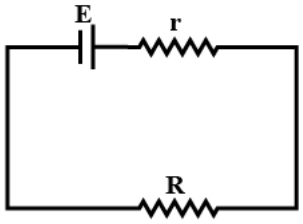
Solution

$i = \frac{E}{(R + r)}$

P across $R = i^2 R = \frac{E^2}{(R + r)^2} \times R$

$\frac{dP}{dR} = 0$

$R = r$



#1611040

Topic: Units - Definitions and Systems

If Planck's constant (h), surface tension (s) and moment of inertia (I) are taken as fundamental quantities, then dimensions of linear momentum (p) will be given as:

A $hs^2 I^{1/2}$

B $h^{1/2} s^{1/2} I$

[✓ C] $h^0 s^{1/2} I^{1/2}$

D None of these

Solution

$p \equiv h^x T^y I^z$

$MLT^{-1}(ML^2T^{-1})^x(MT^{-2})^y(MI^2)^z$

$MLT^{-1} = M^{x+y+z} \cdot L^{2x+2z} \times T^{-x-2y}$

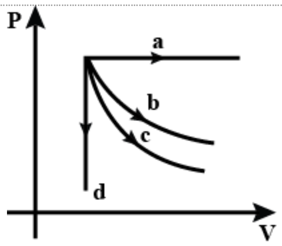
$$\left.\begin{array}{l} x + y + z = 1 \\ x + z = \frac{1}{2} \end{array}\right\} \Rightarrow y = \frac{1}{2}$$

$x + 2y = 1 \Rightarrow x + 1 = 1 \Rightarrow x = 0$

$P \equiv h^0 s^{1/2} I^{1/2}$

#1611043

Topic: Adiabatic Processes



The pressure v/s volume graph of an ideal gas is given in different thermodynamics process which of the following option in relevant order: (Isochoric, isobaric, isothermal, adiabatic)

[✓ A] d, a, b, c

B a, d, c, b

C a, c, d, b

D a, b, c, d

#1611181
Topic: Acceleration due to Gravity

A simple pendulum undergoes 20 oscillation's in 30 seconds. What is the percentage error in the value of acceleration due to gravity provided length of pendulum is $55\ cm$, least count for measurement of time and length are $1\ s$ and $1\ mm$ respectively.

A 3.4%

[✓ B] 6.8%

C 5.5%

D 11%

Solution

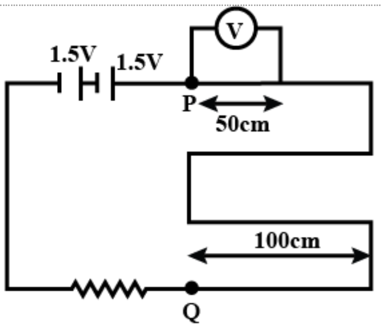
$$g = \frac{4\pi^2\ell}{T^2}$$

$$\frac{\Delta g}{g} = \frac{\Delta\ell}{\ell} + 2\frac{\Delta T}{T}$$

$$= \frac{0.1}{55} + 2\frac{1}{30}$$

$$\frac{\Delta g}{g} \times 100 = \frac{10}{55} + \frac{20}{3} = 6.85\% \approx 7\%$$

#1611183
Topic: Circuit Instruments



If potential gradient on wire PQ is $0.01\ V/m$ then the reading of voltmeter is:

A $3\ mV$

[✓ B] $5\ mV$

C $7\ mV$

D $9\ mV$

Solution

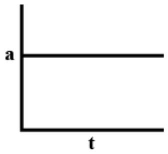
Reading $=$ Potential gradient $\times$ length

$= 0.01 \times 0.5$

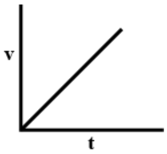
$= 5 \times 10^{-3} V = 5\ mV$

#1611184
Topic: Uniformly Accelerated Motion

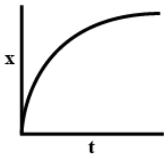
(A)



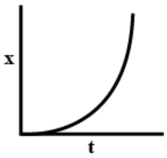
(B)



(C)



(D)



A particle start from rest, with uniform acceleration at time t, choose the correct option.

A A

B A, B, C

[✓ C] A, B, D

D B, C

Solution

$a =$ Constant Hence (A)

$v = at$ Hence (B)

$x = \frac{1}{2}at^2$ Hence (D)

#1611187

Topic: Nuclear Structure

The ratio of density of nuclei of O^{16} and Ca^{40} is:

[✓ A] 1:1

B 1:2

C 1:3

D 1:4

#1611188

Topic: LCR circuits

AC source of voltage of $V = V_0 \sin(100t)$ is connected with box which contain ether RL or RC circuit. If voltage leads the current by phase $\frac{\pi}{4}$, then choose the correct option:

[✓ A] $R = 1K\Omega, L = 10H$

B $R = 1K\Omega, L = 1H$

C $R = 1K\Omega, C = 10\mu F$

D $R = 1K\Omega, C = 1\mu F$

Hint

$\tan\phi = \frac{X_L}{R}$ voltage lead so Circuit is RL

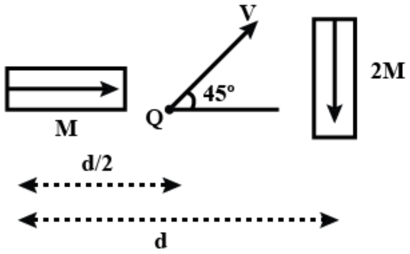
$X_L = R$

$\omega L = R$

$100L = R$

#1611193

Topic: Magnetic Moment



Two magnetic dipoles are lying as shown in figure. the separation 'd between them is very large. A point charge Q is projected with some speed v as shown. The force experienced by the charged particle is:

[✓ A] 0

B $\frac{4\sqrt{2}\mu_0 MQv}{\pi d^3}$

C $\frac{\sqrt{2}\mu_0 MQv}{\pi d^3}$

D $\frac{2\sqrt{2}\mu_0 MQv}{\pi d^3}$

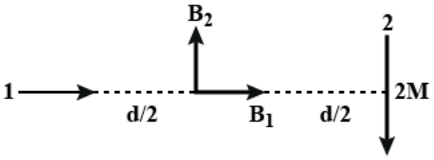
Solution

$B_1 = 2\left(\frac{\mu_0}{4\pi}\right) \cdot \frac{M}{(d/2)}; B_2 = \left(\frac{\mu_0}{4\pi}\right) \cdot \frac{2M}{(d/2)^3}$

$B_1 = B_2$

∴ Net magnetic field will be at 45^o

∴ The direction of B_{net} & vel. of charge is same, hence charge will experience no force.



#1611198

Topic: Escape velocity

The temperature of H_2 gas at which rms speed of H_2 molecule is equal to escape speed of a particle from earth surface is:

A $10^3 K$

B $2 \times 10^3 K$

[✓ C] $10^4 K$

D $10^5 K$

Solution

$\sqrt{\frac{3RT}{m}} = 11.2\ km/s$

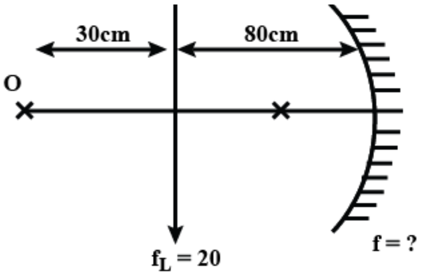
$\frac{3 \times \frac{25}{3} \times T}{2 \times 10^{-3}} = (11.2 \times 10^3)^2$

$T = 10035.2K$

$\simeq 10^4 K$

#1611200

Topic: Refraction at Spherical Surfaces



A convex lens ($f = 20\ cm$) is placed at $80\ cm$ from a concave mirror. An object is placed at $30\ cm$ in front the lens such that position of its final image is same or without the mirr

The maximum distance of object and mirror for virtual image to be formed if only mirror is present is:

[✓ A] 10 cm

B 20 cm

C 30 cm

D 50 cm

Solution

Using lens formula $\frac{1}{v} - \frac{1}{-30} = \frac{1}{20} \Rightarrow v = 60\ cm$

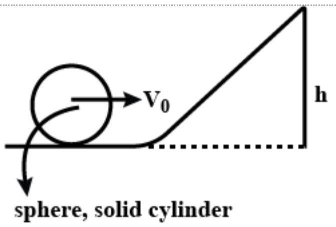
Distance of this Image form Mirror is $20\ cm$. As per given condition Image should form at COC of Mirror.

So that $20\ cm = 2f_M \Rightarrow f_M = 10\ cm$.

hence Maximum distance for virtual image is focal length $= 10\ cm$.

#1611203

Topic: Rolling Motion



A solid sphere and solid cylinder are in pure rolling on a rough curved surface with the same speed of centre of mass. The ratio of maximum heights reached by the two bodie if they roll without slipping is:

A $\frac{4}{5}$

[✓ B] $\frac{14}{15}$

C $\frac{7}{10}$

D $\frac{10}{13}$

Solution

$v = Rw$

for sphere,

$$mgh_1 = k_1 = \frac{1}{2}Iw^2 + \frac{1}{2}mv^2$$

$$= \frac{1}{2} \times \frac{2}{5}mR^2w^2 + \frac{1}{2}mv^2$$

$$= mv^2\left(\frac{1}{5} + \frac{1}{2}\right) = mv^2\left(\frac{7}{10}\right)$$

For solid cylinder,

$$mgh_2 = k_2 = \frac{1}{2}mv^2 + \frac{1}{2} \times \frac{mR^2}{2}w^2 = mv^2\left(\frac{1}{2} + \frac{1}{4}\right) = \frac{3mv^2}{4}$$

$$\therefore \frac{k_1}{k_2} = \frac{\frac{7}{10}}{\frac{3}{4}} = \frac{7}{10} \times \frac{4}{3} = \frac{14}{15} \Rightarrow \frac{h_1}{h_2} = \frac{14}{15}$$

#1611209

Topic: Electric Field

In Region of Electric field Given by $\vec{E} = (Ax + B)\hat{i}$. Where $A = 20$ unit and $B = 10$ unit. If Electric potential at $x = 1\,m$ is V_1 and at $x = -5\,m$ is V_2. Then $V_1 - V_2$ is equal to

A 150 V

B 170 V

C 140 V

[✓ D] 180 V

Solution

$$v_f - v_i = -\int E.\,dx$$

$$v_1 - v_2 = \int_{-5}^{1}(Ax + B)dx$$

$$= -\left(\frac{Ax^2}{2} + Bx\right)^1$$

$$= -\left[\left(\frac{A}{2} + B\right) - \left(\frac{25A}{2} - 5B\right)\right]$$

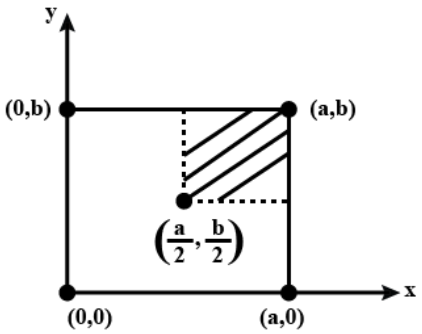
$$= -\left[\frac{20}{2} + 10 - 250 + 50\right]$$

$$= [10 + 10 + 50 - 250]$$

$$= +180$$

#1611218

Topic: Centre of mass



From a rectangular sheet of uniform density a rectangle is cut out as shown in figure. Find new co-ordinate of centre of mass with respect to origin:

A $\left(\frac{a}{12}, \frac{b}{12}\right)$

$\boxed{\text{B}}$ $\left(\frac{5a}{12}, \frac{5b}{12}\right)$

C $\left(\frac{7a}{12}, \frac{7b}{12}\right)$

D None of these

Solution

$$x_{cm} = \frac{(ab) \times \left(\frac{a}{2}\right) - \left(\frac{3a}{4}\right) \times \frac{ab}{4}}{(ab) - \left(\frac{ab}{4}\right)}$$

$$\frac{a\left[\frac{1}{2} - \frac{3}{16}\right]}{1 - \frac{1}{4}} = \frac{a\left[\frac{5}{16}\right]}{\frac{3}{4}} = \frac{5a}{12} \Rightarrow x_{cm} = \frac{5a}{12}$$

Similarly, $y_{cm} = \frac{5b}{12}$

#1611222

Topic: Basics of Projectile Motion

A projectile is thrown from earth with minimum kinetic energy E such that it escapes to infinity. How much energy is required to escape same projectile from surface of moon. Assume density of moon and earth are same and volume of earth is 64 times the volume of moon

A $\frac{E}{64}$

B $\frac{E}{8}$

C $\frac{E}{32}$

$\boxed{\text{D}}$ $\frac{E}{16}$

Solution

Let moss of moon be M_m.

$\therefore$ Mass of Earth $m_e = 64\,M_m$.

$$\frac{M_e}{M_m} = \frac{\frac{4}{3}\pi R_e^3 \times \rho}{\frac{4}{3}\pi R_m^3 \times \rho} = 64 \Rightarrow \frac{R_e^3}{R_m^3} = 64 \Rightarrow R_e = 4R_m$$

$$\frac{E}{E'} = \frac{\frac{GM_e m}{R_e}}{\frac{GM_m m}{R_m}} = \frac{M_e R_m}{M_m R_e} = \left(\frac{M_e}{M_m}\right) \times \left(\frac{R_m}{R_e}\right) = (64) \times \left(\frac{1}{4}\right) = 16$$

$$\Rightarrow \frac{E}{E'} = 16 \Rightarrow E' = \frac{E}{16}$$

#1611224

Topic: Basics of AC

An a.c. circuit has input voltage $\varepsilon = \varepsilon_0 \sin(100\,t)$ such that phase difference between current and voltage is $\frac{\pi}{4}$. then the suitable circuit components

A $C = 10\mu F$, $R = 1K\Omega$

[✓ B] $R = 10K\Omega$, $C = 1\mu F$

C $L = 1\,mH$, $R = 10K\Omega$

D $L = 10\,mH$, $R = 1K\Omega$

#1611233

Topic: Amplitude Modulation

The distance between a receiver and transmitter is $50\,km$. the height of transmitter tower if height of receiver is $35\,m$ is (given Radius of earth $= 6400\,km$)

[✓ A] $65\,m$

B $70\,m$

C $80\,m$

D $90\,m$