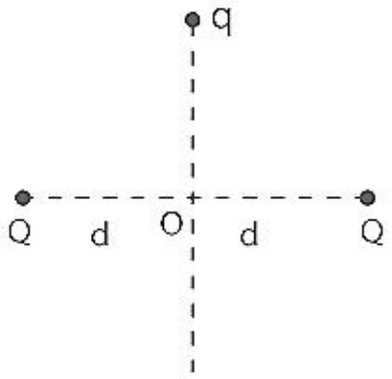
JEE-Main-29-06-2022-Shift-2 (Memory Based)

Physics

Question: Two point charge each of same magnitude 'Q' are placed as shown in figure determine distance from O at equatorial axis where force on q is maximum.



Options:

(a) $\frac{d}{\sqrt{3}}$

(b) $\frac{d}{\sqrt{2}}$

(c) $\frac{d}{\sqrt{5}}$

(d) $\frac{d}{\sqrt{7}}$

Answer: (b)

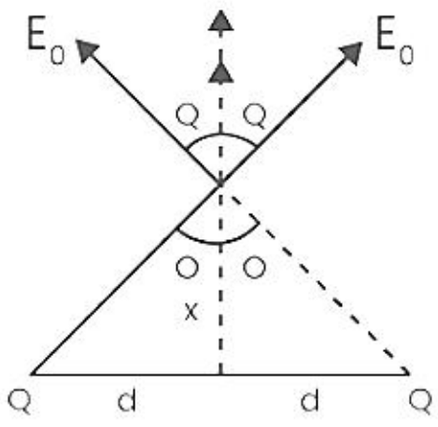
Solution:

Force on q is

$F = qE$

$$\Rightarrow F = q\frac{2kQx}{\left(x^2+d^2\right)^{\frac{3}{2}}}$$

for F = Fmax.



$$E = 2E_0\cos\theta$$

$$= \frac{2kQx}{\left(x^2+d^2\right)^{\frac{3}{2}}}$$

$$\Rightarrow \frac{d}{dx}\left[\frac{2x}{\left(x^2+d^2\right)^{\frac{3}{2}}}\right]=0 \Rightarrow x=\frac{d}{\sqrt{2}}$$

Question: A gas is expanded from volume 'V_1' to 'V_2' by three different process these three process are isothermal, adiabatic and isobaric. Work done by gas in isothermal is W_1 and that in adiabatic is W_2 and that in isobaric is W_3. Select the correct option?

Options:

(a) $W_1 > W_2 > W_3$

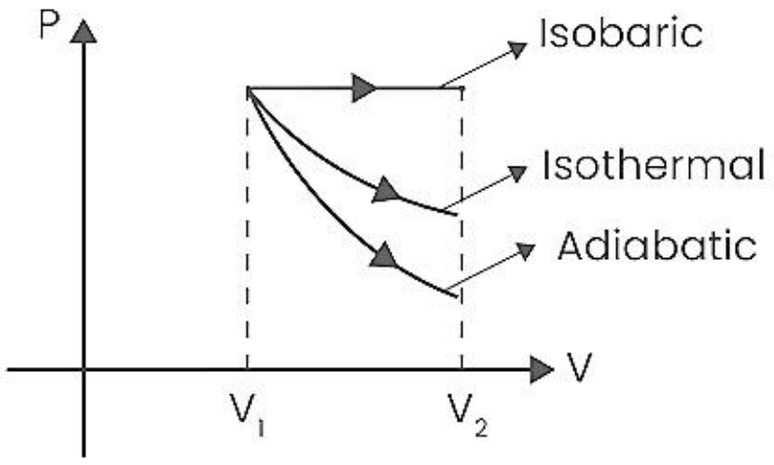
(b) $W_2 > W_1 > W_3$

(c) $W_1 = W_2 = W_3$

(d) $W_1 > W_2 = W_3$

Answer: (b)

Solution:



W= area under P-V curve

so according to graph

$W_3 > W_1 > W_2$

$V_1 \rightarrow V_2$ in three different ways

$W_1 \rightarrow$ Isothermal $W_2 \rightarrow$ Adiabatic

$W_3 \rightarrow$ Isochoric

$W_1 > W_2 > W_3$

$W_1 < W_2 < W_3$

Question: Time period of earth rotating in orbit is 7 hr. If radius is thrice then new time period of earth:

Options:

(a) 36 hr

(b) 30 hr

(c) 21 hr

(d) 28 hr

Answer: (a)

Solution:

$T^2 \times r^3$

$$\frac{7^2}{T^2} = \left(\frac{R}{3R}\right)^3$$

$$\frac{49}{T^2} = \frac{1}{27}$$

$$T^2 = 49 \times 27$$

$$T = 7 \times 3\sqrt{3} = 21 \times 1.732$$

$$= 35.7$$

Question: The Height of T.V. tower is 125 m if its range is doubled for signal, find the new height:

Options:

(a) 125 m

(b) 250 m

(c) 500 m

(d) 300 m

Answer: (c)

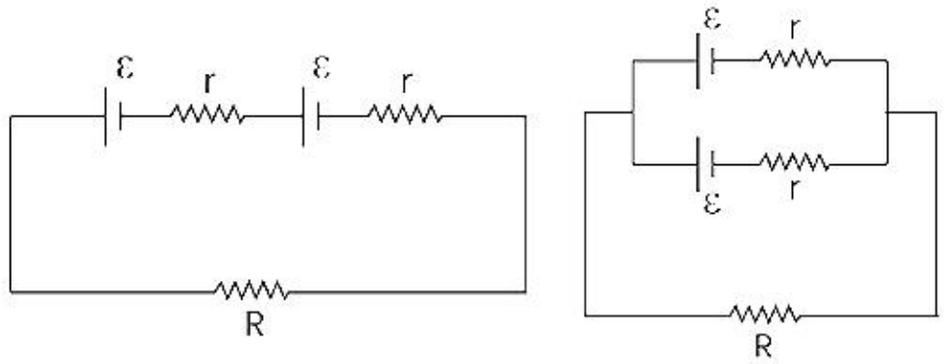
Solution:

$$d = \sqrt{2hR}$$

$$2d = \sqrt{2h^{'}R}$$

$$h^{'} = 4h = 4 \times 125 = 500\,\text{m}$$

Question: Two Identical cell give same current across R resistance when they are in series combination and when they are in parallel combination. Find internal resistance of cell?



Options:

(a) R

(b) 3R

(c) $\frac{R}{2}$

(d) 5R

Answer: (a)

Solution:

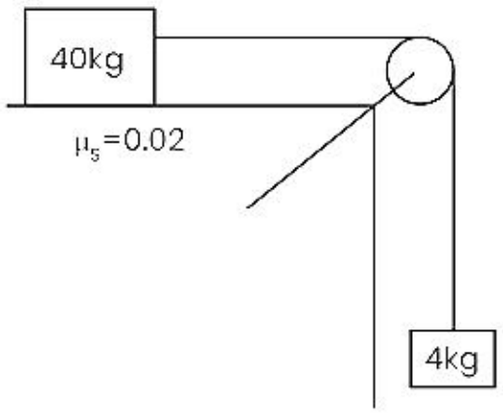
$$\frac{2\varepsilon}{R+2r} = \frac{\varepsilon}{R+\frac{r}{2}}$$

$$\Rightarrow 2R + r = R \div 2r$$

$$\Rightarrow r = R$$

$$r = R$$

Question: Find the acceleration of system shown.



Options:

(a) $\frac{4}{3}\text{m/s}^2$

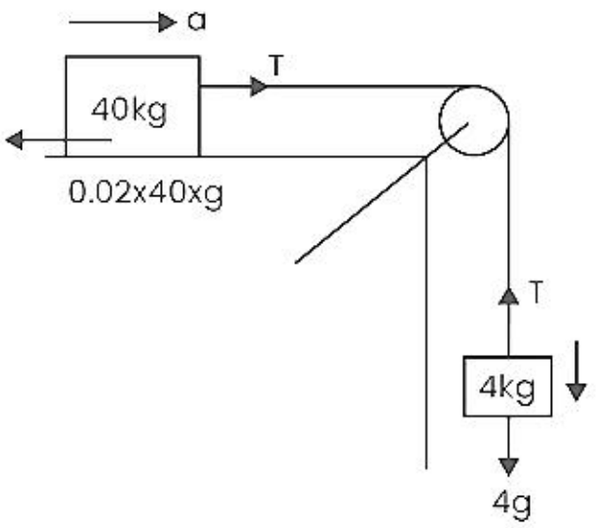
(b) $\frac{8}{12}\text{m/s}^2$

(c) $\frac{8}{9}\text{m/s}^2$

(d) $\frac{8}{11}\text{m/s}^2$

Answer: (d)

Solution:



$T - 8 = 40a$

$4g - T = 4a$

$32 = 44a$

$a = \frac{8}{11}\text{m/s}^2$

Question: A particle starts from rest along straight-line path with cost acceleration. If covers 10 m distance in first t, sec. Find distance covered by it in nest t sec:

Options:

(a) 20 m

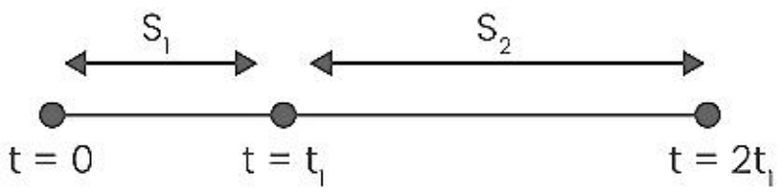
(b) 30 m

(c) 40 m

(d) 50 m

Answer: (b)

Solution:



$S_1 = \frac{1}{2}at_1^2$

$\Rightarrow S_1 + S_2 = \frac{1}{2}a(2t_1)^2 = \frac{1}{2}a4t_1^2$

$\Rightarrow S_1 : S_1 + S_2 = 1:4$

$\Rightarrow S_1 : S_2 = 1:3$

Here $S_1 = 10\,\text{m}$

So, $S_2 = 30\,\text{m}$

Question: Electric Potential varies as $V = 3x^2$ find electric field at the point having Co-ordinates (1, 0,3).

Options:

(a) $-6\,\text{V/m}$

(b) $-8\,\text{V/m}$

(c) $9\,\text{V/m}$

(d) $10\,\text{V/m}$

Answer: (a)

Solution:

We know that

$E = -\frac{dv}{dx}$

$\Rightarrow E = -\frac{d}{dx}(3x^2) = -6x$

at $(1,0,3), E = -6$

Question: If maximum possible range of a projectile is 100 m what will be the maximum possible height for same speed:

Options:

(a) 100 m

(b) 200 m

(c) 50 m

(d) 25 m

Answer: (a)

Solution:

$R_{\max} = u^2/\text{g} = 100\,\text{m}$

$H_{\max} = u^2/2g = 50m$

Question: Electric field of light is given by $E = 200\left[\sin\left(6\times10^{15}t\right) + \sin\left(9\times10^{15}\right)\right]$. It is incident on a metal surface of work function 2.5 eV find the maximum kinetic energy of emitted electrons:

Options:

(1) 3.4 eV

(2) 2.5 eV

(3) 3.8 eV

(4) 4 eV

Answer: (a)

Solution:

$$KE_{max} = E - \phi$$

$$= \frac{h\omega}{2\pi} - \phi$$

$$= \frac{4.14\times10^{-15}\times9\times10^{15}}{2\times3.14} - 2.5 = 5.9 - 2.5 = 3.4eV$$

Question: A block of mass M is released from rest from height of y. When it fall down by y. its kinetic energy is:

Options:

(a) $mg(y - y_0)$

(b) $1/2\,mgy_0$

(c) $mg\,y_0$

(d) mgy_{0^2}

Answer: (a)

Solution:

W by gravity $= mgh$

$h = y - y_0$

Question: In the decay process $^{182}_{74}D \xrightarrow[\alpha]{} D_1 \xrightarrow[\beta]{} D_2 \xrightarrow[\alpha]{} D_3 \xrightarrow[\gamma]{} D_4$ find the atomic number and mass number of element D_4 :

Options:

(a) 174, 171

(b) 176, 72

(c) 174, 70

(d) 176, 71

Answer: (a)

Solution:

$$^{182}_{74}D \xrightarrow[\alpha]{} {}^{178}_{72}D_1 \xrightarrow[\beta]{} {}^{178}_{73}D_2 \xrightarrow[\alpha]{} {}^{174}_{71}D_3 \xrightarrow[\gamma]{} {}^{174}_{71}D_4$$

Question: Equation of a simple pendulum is $\theta = \theta_0 \sin(\pi t + \phi)$. Find the length of pendulum:

Options:

(a) 1 m

(b) 2 m

(c) 0.5 m

(d) 4 m

Answer: (a)

Solution:

$\omega = \pi$

$\sqrt{\frac{g}{\ell}} = \pi$

$g = \pi^2 \ell$

$\ell = \frac{g}{\pi^2} = 1\ m$

Question: Statement-1 : Electric field changes the speed of change particle but magnetic field does not change the speed.

Statement-2: Charge particle travels perpendicular to electric field and parallel to magnetic field

Options:

(a) Statement-1 is false, statement-2 is true

(b) Both statement is true & statement 2 is not the correct explanation of statement-1.

(c) Statement-1 is true, statement-2 is false.

(d) Statement-1 is true, statement-2 is true and statement-2 is the correct explanation of statement -1

Answer: (c)

Solution:

Question: Moment of inertia of a rod about its and is I_1 Rod is bent into a ring and its moment of inertia about diameter is I_2 Find the $I_1 - I_2$.

Options:

(a) $m\ell^2\left[\frac{1}{3}+\frac{1}{4\pi^2}\right]$

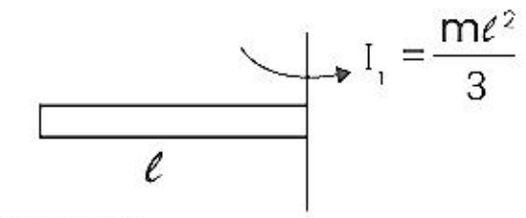
(b) $m\ell^2\left[\frac{1}{3}-\frac{1}{2\pi^2}\right]$

(c) $m\ell^2\left[\frac{1}{3}+\frac{1}{8\pi^2}\right]$

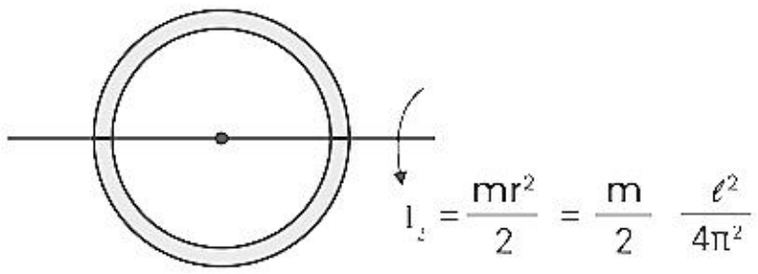
(d) $m\ell^2\left[\frac{1}{3}-\frac{1}{8\pi^2}\right]$

Answer: (d)

Solution:



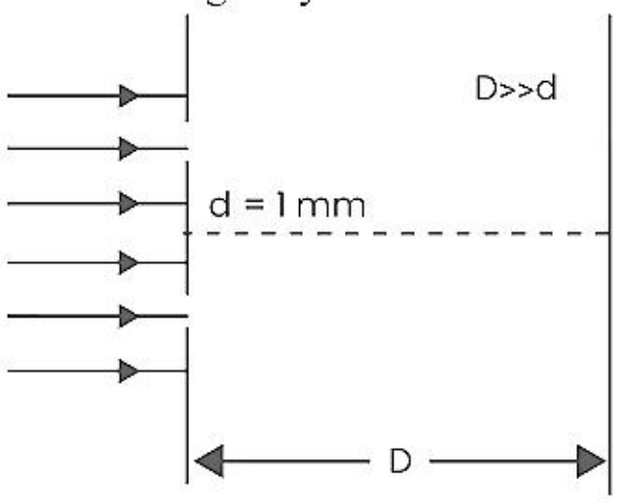
$\ell = 2\pi r$



$$I_2 = \frac{m\ell^2}{\delta\pi^2}$$

$$I_1 - I_2 = m\ell^2\left[\frac{1}{3} - \frac{1}{8\pi^2}\right]$$

Question: If in YDSE set up screen is shifted towards plane of slit by 0.3 metre then fringe width changes by 0.4 mm. Determine wavelength 'λ' of light.



Options:

(a) $\frac{10^{-3}}{3} mm$

(b) $\frac{7}{3} \times 10^{-3} mm$

(c) $\frac{4}{3} \times 10^{-3} mm$

(d) $\frac{5}{3} \times 10^{-3} mm$

Answer: (c)

Solution:

$$\beta = \frac{\lambda D}{d}$$

$$\beta' = \frac{\lambda (D - 0.3)}{d}$$

$$\beta - \beta' = \frac{\lambda \times 0.3}{d}$$

$$0.4 = \frac{\lambda \times 0.3 \times 10^3}{1}$$

$$\lambda = \frac{4}{3} \times 10^{-3} mm$$

Question: Time taken by a capacitance to reduce its energy by half is t_1& time taken by the same capacitor to reduce its charge by $1/8^{th}$ is t_2. The value of t_1/t_2 will be

Options:

(a) 1/3

(b) 1/6

(c) 1/2

(d) 1/4

Answer: (b)

Solution:

$$q = Qe^{-\frac{t}{\tau}} \qquad U = \frac{q^2}{2C}$$

$$\frac{Q}{\sqrt{2}} = Qe^{-\frac{t_1}{\tau}}$$

$$t_1 = \tau \ell n \sqrt{2}$$

$$\frac{Q}{8} = Qe^{-\frac{t_2}{\tau}}$$

$$t_2 = \tau \ell n 8$$

$$\frac{t_1}{t_2} = \frac{\tau \ell n \sqrt{2}}{\tau \ell n 8} = \frac{\frac{1}{2} \tau \ell n 2}{3 \tau \ell n 2} = \frac{1}{6}$$

Question: Verneir constant of verneir scale = 0.1 mm on measuring diameter of shaft. Main scale reading = 1.7 cm. If main scale coincides with 5 division of verneir scale & zero error is -0.05 cm. Diameter of shaft in cm is:

Options:

(a) 1.80 cm

(b) 2.80 cm

(c) 4.80 cm

(d) 6.80 cm

Answer: (a)

Solution:

Reading = MSR + L.C × $V_{S.R + correction}$

Correction = - zero error = 0.05 cm

Reading = $1.7 + 0.1 \times 10^{-1}$ (5) + 0.05

= 1.7 + 0.05 + 0.05

⇒ 1.80 cm

Question: Two long wires are separated by 8 cm the magnetic field at the mid-point is 300 μT. Two wire carries current of same value which is:

Options:

(a) 30 A in opposite direction

(b) 30 A in same direction

(c) 60 A in same direction

(d) 60 A in opposite direction

Answer: (a)

Solution:

Current is opposite direction

$$B = \frac{2\mu_0 i}{2\pi 4cm} \Rightarrow 300\times10^{-6} = \frac{2\times2\times10^{-7}\times i}{4\times10^{-2}} \Rightarrow I = 30Amp$$

Question: If normal force exerted is 1/4th weight of box find acceleration of lift.

Options:

(a) 3g/4

(b) g/4

(c) g/2

(d) g

Answer: (a)

Solution:

$$mg - N = ma$$

$$\frac{mg - mg}{4} = mg$$

$$a = \frac{3g}{4}$$

Question: Half-life of a radioactive sample is 5 years. Find time taken to reduce the sample 6.25% of its initial value.

Options:

(a) 20 years

(b) 15 years

(c) 25 years

(d) 50 years

Answer: (a)

Solution:

Time taken in 50% is T_H

Time take in 25% is $2T_H$

Time take in 12.5% is $3T_H$

Time take in 6.25% is $4T_H$

So $4T_H = 4 \times 5 = 20$ years

Question: In resonance tube first resonance is obtain at 20 cm, then third resonance length will be: (frequency of source = 400 Hz, speed of sound in air = 336 m/s)

Options:

(a) 60 cm

(b) 104 cm

(c) 64 cm

(d) 100 cm

Answer: (b)

Solution:

$$\text{Wavelength of wave} \Rightarrow \lambda = \frac{V}{f} = \frac{336}{400} = 84\,cm$$

At first resonance

$$\frac{\lambda}{4} = \ell + e \Rightarrow \frac{84}{4} = 20 + e$$

$$\Rightarrow e = 1$$

So third resonance length

$$5\frac{\lambda}{4} = \ell_2 + e$$

$$5(21) = \ell_2 + 1$$

$$\ell_2 = 104\,cm$$