JEE-Main-28-07-2022-Shift-2 (Memory Based)

Physics

Question: Two photons, first has energy twice the other. If energy of first photon is 5 times its work function, find the ratio of maximum velocities

Options:

(a) $\frac{3}{2}$

(b) $\frac{2}{3}$

(c) $\frac{4}{3}$

(d) $\frac{4}{9}$

Answer: (b)

Solution:

Max. K.E. of electron

$= E - \phi$

$\frac{1}{2}mv_1^2 = E_1 - \phi$

$\frac{1}{2}mv_2^2 = E_2 - \phi$

$\frac{v_1^2}{v_2^2} = \frac{5\phi - \phi}{10\phi - \phi} = \frac{4}{9}$

$\frac{v_1}{v_2} = \sqrt{\frac{4}{9}} = \frac{2}{3}$

Question: A capacitor has capacity C_0. When a dielectric of constant K& width $3/4^{th}$ of separation between plates is inserted, then find the new capacity.

Options:

(a) $\left(\frac{7k}{K+3}\right)C_0$

(b) $\left(\frac{5k}{K+3}\right)C_0$

(c) $\left(\frac{5k}{K+3}\right)C_0$

(d) $\left(\frac{4k}{K+3}\right)C_0$

Answer: (d)

Solution:

$$C = \frac{\varepsilon_0 A}{\left(d - t + \frac{t}{k}\right)} \text{ and } C_0 = \frac{\varepsilon_0 A}{d}$$

$$\text{Here } t = \frac{3}{4}d$$

$$\therefore C = \frac{\varepsilon_0 A}{\left(d - \frac{3}{4}d + \frac{3d}{4k}\right)} = \frac{\varepsilon_0 A}{\frac{d}{4k}(3+k)}$$

$$= \frac{4k}{(k+3)} C_0$$

Question: A chain of uniform mass desity with length 'L', mass M is hanging over an ideal smooth pulley. When $l = \frac{L}{x}$, the accelcration of chain is $\frac{g}{2}$, find x?

Options:

(a) $\frac{L}{4}$

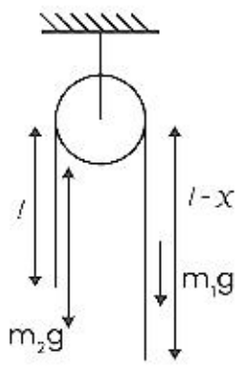
(b) $\frac{L}{2}$

(c) $\frac{L}{3}$

(d) $\frac{L}{1}$

Answer: (a)

Solution:



$$m_1 = \frac{M}{L}(L - x)g$$

$$m_2 = \frac{M}{L}xg$$

$$a = \frac{m_1 g - m_2 g}{M} = \frac{g}{2} \frac{\frac{M}{2}(L-x)g - \frac{M}{2}xg}{M} = \frac{g}{2}$$

$$\frac{L-x-x}{L}=\frac{1}{2}$$

$$L-2x=\frac{L}{2}$$

$$2x=L\frac{L}{2}=\frac{L}{2}\Rightarrow x=\frac{L}{4}$$

Question: Time period of a pendulum is measured on surface of a planet with a stop watch of 1 sec isolation is found to be 200 sec. Its length was measured as $1\pm0.001m$. percentage error in measurement of arc due to gravity is

Options:

(a) 1.1%

(b) 0.3%

(c) 2.5%

(d) 5.2%

Answer: (a)

Solution:

as $T=2\pi\sqrt{\frac{l}{g}}$

or $\frac{\Delta g}{g}=\frac{2\Delta T}{T}+\frac{\Delta l}{l}$

$\therefore \Delta g\%=2\times\frac{1}{200}\times100+\frac{0.001}{1}\times100$

$=1+0.1$

$=1.1\%$

Question: Water flows out of a pipe and hits a wall, it has horizontal velocity v and cross-sectional area A. The density of the water is p. The water does not rebound from the wall. What is the fore exerted on the wall by the water?

Options:

(a) $F=\rho v^2A$

(b) $F=\rho v^1A$

(c) $F=\rho vA$

(d) $F=\rho v^2$

Answer: (a)

Solution:

$$F=\frac{d}{dt}\left[\vec{p}_{\text{of water}}\right]=\left(\frac{dm}{dt}\right)v$$

$=\rho VA.v$

$$\boxed{F=\rho v^2A}$$

Question: Time period of a pendulum is measured on surface of a planet with a stop watch of 1 sec resolution in found to be 200 sec. Its length was measured as $1\pm0.001m$. Percentage error in measurement of are due to gravity is

Options:

(a) 1.4%

(b) 1.1%

(c) 2.2%

(d) 2.1%

Answer: (b)

Solution:

$$T = 2\pi\sqrt{\frac{l}{g}}$$

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

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

$$= 2\left(\frac{1}{200}\right) + \frac{0.001}{1}$$

$$= \frac{1}{100} + 0.001 = 0.011$$

% error = 1.1%

Question: Ball thrown upwards from a building with speed 19.6 m/s. Find maximum height achieved from point of projection? $\left(g = 9.8 m/s^2\right)$

Options:

(a) 1.96 m

(b) 2.9 m

(c) 19.6 m

(d) 12.96 m

Answer: (c)

Solution:

Maximum height $= h$ (say)

$v^2 - u^2 = 2gh$

At topmost point v = 0

And $u = 19.6 m/s$ (given)

$0^2 - (19.6)^2 = -2(9.8)(h)$

$$h = \frac{(19.6)^2}{19.6} = 19.6 m$$

Question: Time period of a simple pendulum on earth's surface is 4 sec and at height h above the earth's surface is 6 sec. Find the value of h if R = 6400 km.

Options:

(a) 1200

(b) 2400

(c) 3200
(d) 3500
Answer: (c)
Solution:

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$\therefore \frac{T_1}{T_2} = \sqrt{\frac{g_2}{g_1}} = \sqrt{\frac{\frac{GM}{(R+h)^2}}{\frac{GM}{R^2}}}$$

$$\frac{4}{6} = \frac{R}{R+h}$$

$$\Rightarrow 4R + 4h = 6R \Rightarrow 4h = 2R$$

$$h = \frac{R}{2} = 3200$$

Question: For the given equation, please select incorrect statement, where K is Boltzmann constant, T is absolute temperature.

$$\sin\theta = \alpha\beta \ln\left[\frac{Bx}{KT}\right]$$

Options:
(a) Dimension of β is same as force
(b) Dimension of $\alpha^{-1}x$ is same as energy
(c) Dimension of α and β is same
(d) Dimension of KT is same as energy
Answer: (c)
Solution:

$$[B] = \frac{[KT]}{[x]} = \frac{M^1L^2T^{-2}}{L} = \left[M^1L^1T^{-2}\right]$$

$$\alpha = \frac{M^0L^0T^0}{\beta} = \left[M^{-1}L^{-1}T^{+2}\right]$$

Question: Assertion: Resistance of 80Ω is cut equally in 4 parts and all resistances are kept parallelly the net resistance is 5Ω
Reason: When 2R and 3R connected in parallel, ratio of heat dissipated in them is 3 : 2
correct statement is/are
Options:
(a) If both assertion and reason are true and the reason is the correct explanation of the assertion.
(b) If both assertion and reason are true, but the reason is not the correct explanation of the assertion.
(c) If assertion is true, but reason is false.
(d) If both the assertion and reason are true.

Answer: (d)
Solution:

Assertion: Let r be resistance of each cut part then $r = \frac{80}{4} = 20\Omega$

Now 4 resistors of 20Ω in parallel $R_{eff} = \frac{20}{4} = 5\Omega$

Reason: $\frac{H_1}{H_2} = \frac{\frac{V^2}{R_1}}{\frac{V^2}{R_2}} = \frac{R_2}{R_1} = \frac{3}{2}$

Question: Two light rays incident on surface of a metal with energies 5 times and 6 times the work function f metal respectively. The ratio of speeds of electrons, ejected with maximum kinetic energies in each case, respectively is

Options:

(a) $\frac{4}{5}$

(b) $\frac{2}{5}$

(c) $\frac{4}{\sqrt{5}}$

(d) $\frac{2}{\sqrt{5}}$

Answer: (d)
Solution:

As $KE_{\max} = \frac{1}{2}mv^2 = hf - W$

$\therefore \frac{1}{2}mv_1^2 = 5W - W = 4W$

And $\frac{1}{2}mv_2^2 = 6W - W = 5W$

$\therefore \left(\frac{V_1}{V_2}\right)^2 = \frac{4}{5}$

Or $\frac{V_1}{V_2} = \frac{2}{\sqrt{5}}$

Question: Work done by gas in expansion is 150J and degrees of freedom = 8 find heat (q)
Options:

(a) 250

(b) 350

(c) 650

(d) 750

Answer: (d)

Solution:

$$\omega = \rho\Delta V = nR\Delta T = 150J \ldots.(1)$$

$$Q = nC_p\Delta T$$

$$= n\left(\frac{f+2}{2}\right)R\Delta T$$

$$= \left(\frac{8+2}{2}\right)150 = 5\times150 = 750$$

Question: Work done by gas in isobaric expansion is 150J and degrees of freedom = 8. Find heat (q)

Options:

(a) 750 J

(b) 650 J

(c) 550 J

(d) 450 J

Answer: (a)

Solution:

$$\Delta U = \frac{nf}{2}R\Delta T = 4nR\Delta T$$

$$\Delta W = 150J = nR\Delta T$$

$$\Delta Q = \Delta W + \Delta U$$

$$= nR\Delta T + 4nR\Delta T$$

$$= 5nR\Delta T$$

$$= 5(150) = 750J$$

Question: The ratio of magnetic field at the centre of circular coil and at a distance of $\sqrt{3}R$ from centre on axis of the coil is

Options:

(a) 1: 1

(b) 4 :2

(c) 7 : 3

(d) 8 : 1

Answer: (d)

Solution:

$$B_{centre} = \frac{\mu_0 i}{2R}$$

$$B_{axis} = \frac{\mu_0 iR^2}{2\left(R^2 + x^2\right)^{3/2}}$$

$$= \frac{\mu_0 i R^2}{2\left(3R^2 + R^2\right)^{3/2}} = \frac{\mu_0 i}{16R}$$

$$\Rightarrow \frac{B_{centre}}{B_{axis}} = \frac{8}{1}$$