

JEE-Main-25-07-2022-Shift-2 (Memory Based)

Physics

Question: A potentiometer shows reading of 36cm when connected with 1.2V battery, then the same potentiometer is connected to a 1.8V battery, find the difference in the lengths

Options:

- (a) 10 cm
- (b) 18 cm
- (c) 20 cm
- (d) 54 cm

Answer: (b)

Solution:

Balancing point = 36 cm

Voltage of cell = 1.2 V

$$\therefore \text{Potential gradient} = \frac{1.2}{36} = \frac{1}{30} \text{ V/cm}$$

Now, new voltage = 1.8 V

$$\therefore \text{Balancing length} = \frac{1.8}{\frac{1}{30}} \text{ or } \frac{1.8}{1.2} \times 36 = 54 \text{ cm}$$

$$\therefore \text{Difference} = 54 - 36 = 18 \text{ cm}$$

Question: Two billiard balls of mass 0.05kg moving in opposite directions with velocity of 10m/s and the time of contact between is 0.005sec, find the force of contact.

Options:

- (a) 50 N
- (b) 100 N
- (c) 180 N
- (d) 200 N

Answer: (d)

Solution:

$$\begin{aligned} |F| &= \left| \frac{\Delta \vec{P}}{\Delta t} \right| \\ &= \frac{0.05(\Delta V)}{0.005} \\ &= \frac{0.05(20)}{0.005} = 200 \text{ N} \end{aligned}$$

Question: Max amplitude of AM modulated wave is 6 & min amplitude of AM modulated wave is 2, modulation index in percentage is x% find x.

Options:

- (a) 50 N
- (b) 80 N
- (c) 120 N
- (d) 140 N

Answer: (a)

Solution:

$$\begin{aligned}\text{Modulation index} &= \frac{A_{\max} - A_{\min}}{A_{\max} + A_{\min}} \\ &= \frac{6 - 2}{6 + 2} = \frac{4}{8} = 0.5 = 50\%\end{aligned}$$

Question: A coil is having 2 turns then the magnetic field at the centre is B_1 when the coil is unwound and recoiled to 5 turns then the magnetic field would become B_2 , find $\frac{B_2}{B_1}$

Options:

- (a) $\frac{20}{3}$
- (b) $\frac{15}{6}$
- (c) $\frac{25}{4}$
- (d) $\frac{4}{25}$

Answer: (c)

Solution:

$$B = \frac{\mu_0 i}{2\pi} \left(\frac{N}{r} \right)$$

Now initial turns = n_1 (say) and radius = r_1 (say)

$$n_1 (2\pi r_1) = n_2 (2\pi r_2)$$

$$\therefore \frac{n_1}{n_2} = \frac{r_2}{r_1}$$

$$\frac{B_1}{B_2} = \frac{n_1}{n_2} \times \frac{r_2}{r_1} = \left(\frac{n_1}{n_2} \right)^2$$

$$= \left(\frac{2}{5} \right)^2 = \frac{4}{25}$$

$$\therefore \frac{B_2}{B_1} = \frac{25}{4}$$

Question: An isolated sphere with radius R_1 , when it is surrounded by concentric sphere of R_2 grounded to earth, capacity becomes n times ratio of $\frac{R_2}{R_1}$ is

Options:

(a) $\frac{n}{(n-1)}$

(b) $\frac{(n-1)}{n}$

(c) $\frac{1-n}{n}$

(d) n

Answer: (a)

Solution:

Capacity of isolated sphere $= 4\pi\epsilon_0 R_1$

Capacity of isolated sphere enclosed $= \frac{4\pi\epsilon_0 R_1 R_2}{R_2 - R_1}$

$$\therefore n4\pi\epsilon_0 R_1 = \frac{4\pi\epsilon_0 R_1 R_2}{R_2 - R_1}$$

$$\Rightarrow nR_2 - nR_1 = R_2$$

$$\Rightarrow (n-1)R_2 = nR_1$$

$$\frac{R_2}{R_1} = \frac{n}{n-1}$$

Question: Heat produced in a resistance R , carrying current I in time t is given as $H = I^2 R t$. If percentage error in measurement of current, resistance and time are 2%, 1% and 1% respectively, then error in measurement of heat would be

Options:

(a) 4%

(b) 3%

(c) 6%

(d) 5%

Answer: (c)

Solution: As $H = I^2 R t$

$$\therefore \left[\frac{\Delta H}{H} = \frac{2\Delta I}{I} + \frac{\Delta R}{R} + \frac{\Delta t}{t} \right] \times 100\%$$

$$\Rightarrow \Delta H\% = 2 \times 2 + 1 + 1\% = 6\%$$

Question: A ball is projected with 15 m/s at an angle θ such that the range and maximum height is same, then find $\tan \theta$

Options:

(a) 0

(b) 2

(c) 4

(d) 6

Answer: (c)

Solution:

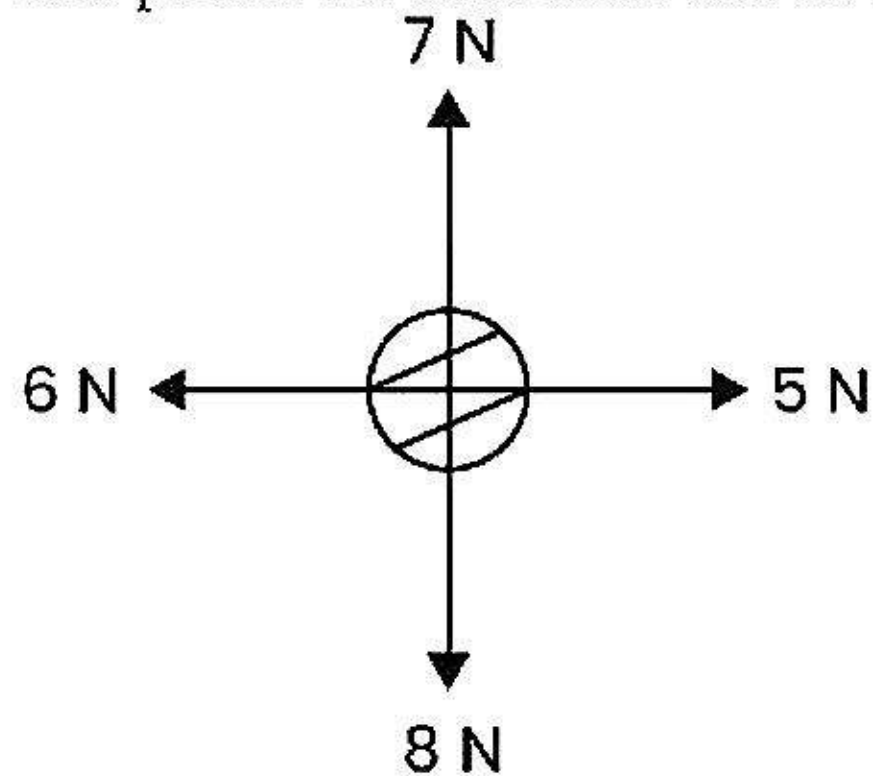
$$R = H$$

$$\frac{v^2 \sin 2\theta}{g} = \frac{u^2 \sin^2 \theta}{2g}$$

$$\Rightarrow 2 \sin \theta \cos \theta = \frac{\sin^2 \theta}{2}$$

$$\Rightarrow \boxed{\tan \theta = 4}$$

Question: It's the FBD given for an object, then find the value of force required and its angle with positive x-axis such that its net acceleration becomes zero



Options:

(a) $\sqrt{2}$ and angle 45°

(b) $\sqrt{6}$ and angle 55°

(c) $\sqrt{10}$ and angle 60°

(d) $\sqrt{15}$ and angle 30°

Answer: (a)

Solution:

1 N with angle 45 degrees with x-axis

Net force in x-direction = $-1N$

Net force in y-direction = $-1N$

$\therefore$ Force required to balance = $1\hat{i} + 1\hat{j}$

$\therefore$ Angle it makes is 45° with x-axis

Question: The phenomenon which makes metal detector alarm is?

Options:

(a) Hall effect

(b) EMI

(c) Interference of EM waves

(d) Gauss law

Answer: (b)

Solution:

The operation of metal detectors is based upon the principles of electromagnetic induction. Metal detectors contain one or more inductor coils that are used to interact with metallic elements on the ground.

Question: A 9.8kg bag is hanging with a rope then a bullet of 200g moving with 10m/s get embedded in it, find the loss in kinetic energy

Options:

- (a) 9.8 J
- (b) 5.8 J
- (c) 7.8 J
- (d) 4.8 J

Answer: (a)

Solution:

$$m_1 u_1 + m_2 u_2 = (m_1 + m_2) v$$

$$0.2(10) + 9.8(0) = (9.8 + 2) v$$

$$2 = 0.2 m / s$$

$$\text{Initial K.E} = \frac{1}{2}(0.2)(10)^2$$

$$= 10 \text{ J}$$

$$\text{Final K.E} = \frac{1}{2}(0.2)(0.2)^2$$

$$+ \frac{1}{2}(9.8)(0.2)^2$$

$$= \frac{1}{2}(10)(0.2)^2$$

$$= 0.2 J$$

$$\therefore \text{Loss in K.E} = 9.8 \text{ J}$$

Question: A body is taken from surface of earth to a height of $5R/4$ from length of earth, where R is radius of earth. Percentage decrease in weight of body at height is

Options:

- (a) 33.33%
- (b) 64%
- (c) 25%
- (d) 36%

Answer: (d)

Solution:

$$\begin{aligned}
 g_h &= \frac{GM}{\left(5\frac{R}{4}\right)^2} \\
 &= \frac{16}{25} g_e \\
 \% \text{ change} &= \frac{g_h - g_e}{g_e} \times 100\% \\
 &= \left[\left(\frac{16}{25} \right) - 1 \right] \times 100\% \\
 &= -36\%
 \end{aligned}$$

Question: A second pendulum is taken to a height of $h=2R$, find the length of the pendulum at that place.

Options:

- (a) $\frac{1}{7}m$
- (b) $\frac{1}{9}m$
- (c) $\frac{1}{5}m$
- (d) $\frac{1}{6}m$

Answer: (b)

Solution:

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

At $h = 2R$

$$g = \frac{GM}{(R + 2R)^2} = \frac{GM}{9R^2} = \frac{g}{9}$$

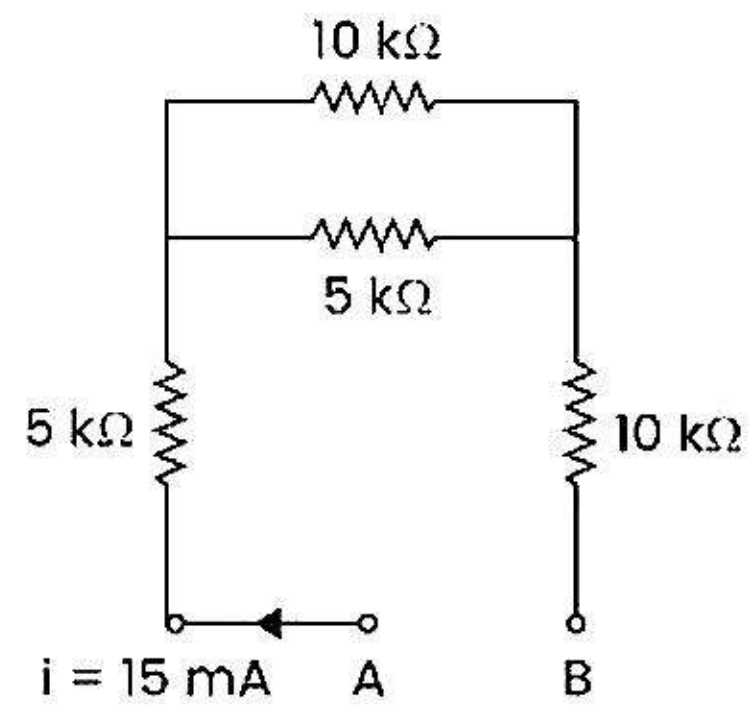
$$\therefore T = 2\pi \sqrt{\frac{l}{g/9}} = 6\pi \sqrt{\frac{l}{g}}$$

But it's a second's pendulum

So time period is 2 sec

$$\therefore 2 = 6\pi \sqrt{\frac{l}{g}} \Rightarrow l \approx \frac{1}{9}m$$

Question: Find potential difference at AB



Options:

- (a) 475 V
- (b) 385 V
- (c) 275 V
- (d) 365

Answer: (c)

Solution:

Equivalent resistance
 $= 5 + (5 \& 10 \text{ in parallel})$
 $+ 10$

$$= 5 + \frac{50}{15} + 10$$

$$= 15 + \frac{10}{3} = \frac{55}{3}$$

$$\therefore V = iR$$

$$= 15 \times 10^{-3} \times \frac{55}{3} \times 10^3$$

$$= 275 \text{ V}$$

Question: The heat developed in a resistor H has a % error of x % if % error in i is 2%, R is 2%, t = 3%, t = 3% find x.

Options:

- (a) 9%
- (b) 11%
- (c) 6%
- (d) 10%

Answer: (a)

Solution:

$$H = i^2 R t$$

$$\frac{DH}{H} = \frac{2\Delta i}{i} + \frac{\Delta R}{R} + \frac{\Delta t}{t}$$

$$\therefore \% \text{ error in } H = 2(2) + 2 + 3$$

$$= 9\%$$

Question: Magnetic flux as a function of time is given as $8t^2 - 9t + 5$, and a resistor of 20Ω is connected with it, find the value of induced current at $t = 0.25$ sec.

Options:

- (a) 0.35 mA
- (b) 0.15 mA
- (c) 0.45 mA
- (d) 0.25 mA

Answer: (d)

Solution:

$$\phi = 8t^2 - 9t + 5$$

$$R = 20\Omega$$

$$\varepsilon = -\frac{d\phi}{dt} = -(16t - 9)$$

$$\text{At } t = 0.25$$

$$\varepsilon = 5V$$

$$\therefore i = \frac{\varepsilon}{R} = \frac{5}{20}$$

$$= 0.25$$

Question: De Broglie wavelength of proton and neutron have ratio $1:\sqrt{2}$ find the ratio of their potential difference through which they were accelerated

Options:

- (a) 6:1
- (b) 3:1
- (c) 1:1
- (d) 4:1

Answer: (d)

Solution:

$$\lambda = \frac{h}{\sqrt{2mqv}}$$

$$\frac{\lambda_p}{\lambda_d} = \sqrt{\frac{m_d v_d q_d}{m_p v_p q_p}}$$

$$\frac{1}{\sqrt{2}} = \sqrt{\frac{m_d v_d q_d}{m_p v_p q_p}}$$

$$\frac{1}{2} = \frac{m_d v_d q_d}{m_p v_p q_p} = \left(\frac{2}{1}\right) \left(\frac{v_d}{v_p}\right) \left(\frac{1}{1}\right)$$

$$\Rightarrow \frac{v_d}{v_p} = \frac{1}{4} \text{ or } \frac{v_p}{v_d} = 4:1$$

Question: If electric field of EM wave is $540 \sin \pi \times 10^4 (x - ct)$ and speed of light is 3×10^8 m/s then find the amplitude of magnetic field

Options:

- (a) 15×10^7 T
- (b) 18×10^{-7} T
- (c) 14×10^{-6} T
- (d) 11×10^{-7} T

Answer: (b)

Solution:

$$\begin{aligned} B_0 &= \frac{E_0}{C} = \frac{540}{3 \times 10^8} \\ &= 180 \times 10^{-8} \\ &= 18 \times 10^{-7} T \end{aligned}$$