JEE-Main-26-07-2022-Shift-1 (Memory Based)

Physics

Question: A charged particle is having acceleration $\overline{a} = 2\hat{i} + 4\hat{j}$ while moving in an uniform magnetic field $\overline{B} = \alpha\hat{i} - 3\hat{j}$. Find α

Options:

(a) 10

(b) 2.5

(c) 3

(d) 4.5

Answer: (d)

Solution:

$\because \overline{F} = q\left(\overline{v} \times \overline{B}\right)$

By property of cross product,

$\overline{F} \perp \overline{B}$

$\overline{a} \perp \overline{B}$

$\therefore \overline{a}.\overline{B} = 0$

$\left(2\hat{i} + 3\hat{j}\right).\left(\alpha\hat{i} - 3\hat{j}\right) = 0$

Question: If in adiabatic process gas is compressed to ⅛ th of its volume, what will be the final pressure if Initial pressure is P_0 (gas is monatomic)

Options:

(a) 12 P_0

(b) 32 P_0

(c) 42 P_0

(d) 22 P_0

Answer: (b)

Solution:

For monoatomic gas $r = \frac{5}{3}$

In adiabatic process

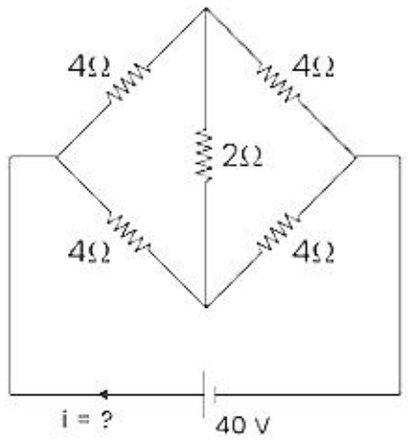
$P_1V_1^r = P_2V_2^r$

$\therefore \frac{P_2}{P_1} = \left(\frac{V_1}{V_2}\right)^r = \left(\frac{V_0}{V_0/8}\right)^{5/3}$

$= (8)^{5/3} = 32$

$\therefore P_2 = 32P_1 = 32P_0$

Question: What is the current through battery?



Options:

(a) 15 A

(b) 20 A

(c) 10 A

(d) 15 A

Answer: (c)

Solution:

Since it's a balanced Wheatstone bridge equivalent resistance becomes 4Ω. Since 2Ω resistance will not be considered.

$$\therefore i = \frac{40}{4} = 10A$$

Question: A monkey of 50 kg climbs a rope having maximum torsion 3.50 N

Case A:Monkey climbs up with 5 ms^{-2}

Case B: Monkey climbs down with 4 ms^{-2}

In which case Rope will not break

Options:

(a) Case B: Break, Case A : break

(b) Case A: Not Break, Case B : break

(c) Case A: Break, Case B : Not break

(d) Case B: Not Break, Case A : Not break

Answer: (c)

Solution:

Breaking tension = 350 N

Case A T_A = m (g +a) = 50 (10 + 5)

= 750 N

Case B T_B = m(g-a) = 50 (10-4)

= 300 N

∴ Rope will break in case A

Question: A neutron and an electron of rest masses m_n and m_e are moving with speeds v and xv resp. If their de Broglie wavelength are equal then approximate value of x is consider m_e = 9.1 x 10^{-31} kg and m_n = 1.6 x 10^{-27} kg. Do not consider relativistic effect

Options:

(a) 1600
(b) 1758
(c) 1880
(d) 1990
Answer: (b)
Solution:
Using dc Broglic eq.

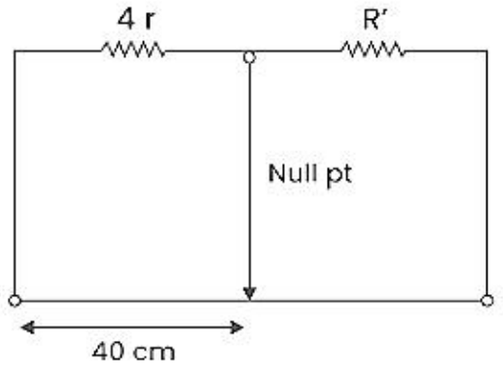
$$\lambda = \frac{h}{mv}$$

$$\therefore \lambda_e = \lambda_n$$

or
$$\frac{h}{m_e \times v} = \frac{h}{m_n v}$$

$$x = \frac{m_n}{m_e} = 1758$$

Question: A meter Bridge is an shown if a resistance of x r is connected in series with 4r, new null point comes at 80 cm. Find x?



Options:
(a) $x = 30$
(b) $x = 20$
(c) $x = 10$
(d) $x = 30$
Answer: (b)
Solution:

$$\frac{4r}{40} = \frac{R'}{60} \ldots(1)$$

$$\& \frac{4r + xr}{80} = \frac{R'}{20} \ldots(2)$$

Solving 1 and 2

$$\frac{4r + xr}{8r} = 3$$

$$\boxed{x = 20}$$

Question: If intensity of a wave is 10 wm^{-2} & it is passing through area of 1 cm^2 & wavelength of wave is 900 nm. Find No. of photons passing per second.
Options:

(a) 6.51 x 10^{16} photos / sec
(b) 8.51 x 10^{16} photos / sec
(c) 3.51 x 10^{16} photos / sec
(d) 4.51 x 10^{16} photos / sec
Answer: (d)
Solution:
G. that
$I = 100\ w/m^2$
$A = 1\ cm^2 = 1 \times 10^{-4}\ m^2$
$\lambda = 900\ nm = 900 \times 10^{-9}\ m$

$$\text{No. of photos} = \frac{IAd}{GC}$$

$$= \frac{100 \times 1 \times 10^{-4} \times 900 \times 10^{-9}}{6.64 \times 10^{-34} \times 3 \times 10^{2}}$$

$= 4.51 \times 10^{16}$ photos / sec

Question: If in YDSE fringe width is 12 mm. What is new fringe width if whole setup is immersed in water $\mu = \frac{4}{3}$

Options:
(a) 3 mm
(b) 9 mm
(c) 4 mm
(d) 12 mm
Answer: (b)
Solution:
Given that $\beta = 12mm$

Now set up is immersed in water $\left(\mu = \frac{4}{3}\right)$

$$\beta' = \frac{\beta}{\mu}$$

$$\beta' = \frac{12}{4} \times 3$$

$$\boxed{\beta' = 9mm}$$

Question: Ratio of magnetic field at centre of two circular coils carrying same current and same radius with number of turns 200 and 400. Radius given was 20 cm for both
Options:
(a) $\frac{1}{2}$
(b) $\frac{2}{3}$

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

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

Answer: (a)

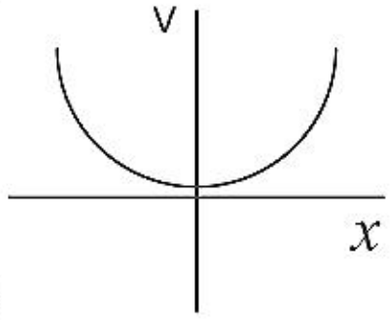
Solution:

$$B = N\frac{\mu_0 i}{2R}$$

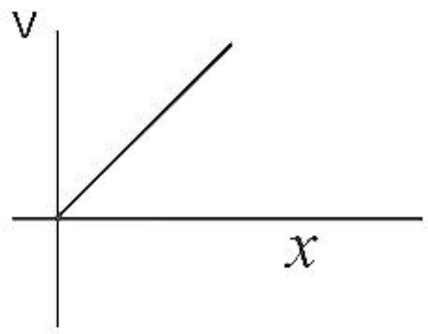
$$\frac{B_1}{B_2} = \frac{N_1}{N_2} = \frac{200}{400} = \frac{1}{2}$$

Question: In linear SHM, variation of velocity of body against it's displacement is best represented by,

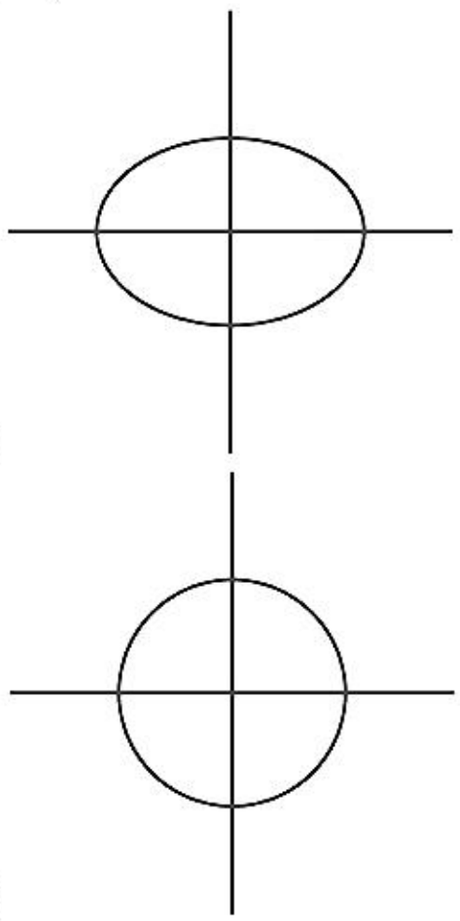
Options:



(a)



(b)



(c)

(d)

Answer: (c)

Solution:

$$v = \pm\omega\sqrt{A^2 - x^2}$$

$$v^2 = \omega^2\left(A^2 - x^2\right)$$

$$v^2 = \omega^2 A^2 - \omega^2 x^2$$

$$v^2 + \omega^2 x^2 = \omega^2 A^2$$

$$\frac{v^2}{\omega^2 A^2} + \frac{\omega^2 x^2}{\omega^2 A^2} = 1$$

$$\frac{v^2}{(\omega A)^2} + \frac{x^2}{A^2} = 1 \quad (\text{ellipse})$$

Question: In LR circuit $X_L = R$ and in LCR circuit $X_L = X_C$. Ratio of power factor in wo situations is.

Options:

(a) $\frac{1}{2}$

(b) $\frac{1}{\sqrt{2}}$

(c) $\sqrt{2}$

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

Answer: (b)

Solution:

Given that

For LR circuit

$$X_L = R$$

$$\cos\phi = \frac{R}{Z}$$

$$\cos\phi = \frac{R}{\sqrt{R^2 + R^2}}$$

$$(\cos\phi) = \frac{1}{\sqrt{2}} \quad ....(1)$$

$$X_L = X_C$$

$$\cos\phi = \frac{R}{Z}$$

$$(\cos\phi)_Z = \frac{R}{R} = 1 \quad ...(2)$$

From equation (1) and (2)

$$\frac{(\cos\phi)}{(\cos\phi)_Z} = \frac{1}{\sqrt{2}}$$

Question: Two projectiles at angles $30°$ and $45°$ reach their maximum heights in same time. Find the ratio of their initial velocities.

Options:

(a) $1:1$

(b) $1:2$

(c) $2:1$

(d) $\sqrt{2}:1$

Answer: (d)

Solution:

$$\frac{2u_1 \sin 30°}{g} = \frac{2u_2 \sin 45°}{g}$$

$$\frac{u_1}{u_2} = \frac{\sin 45°}{\sin 30°} = \frac{\left(\frac{1}{\sqrt{2}}\right)}{\frac{1}{2}} = \sqrt{2}:1$$

Question: If in EM wave $B_0 = 2\times10^{-8}T$ find the amplitude of electric field

Options:

(a) $2NC^{-1}$

(b) $3NC^{-1}$

(c) $6NC^{-1}$

(d) $8NC^{-1}$

Answer: (c)

Solution:

Given that $B_0 = 2\times10^{-8}T$

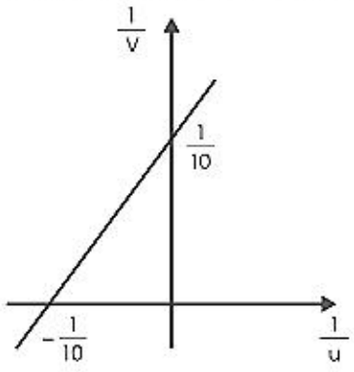
$E_0 = ?$

$E_0 = B_0C$

$E_0 = 2\times10^{-8}\times3\times10^{8}$

$E_0 = 6N/C$

Question: For an equiconvex lens made of refractive index 1.5, following graph is given. Find radius of curvature of lens.



Options:

(a) 10 cm

(b) 20 cm

(c) 15 cm
(d) 20 cm
Answer: (a)
Solution:

$$\frac{1}{f}=\frac{1}{v}-\frac{1}{u}$$

$$\frac{1}{f}=y-x$$

From graph

$$\frac{1}{f}=0-\left(-\frac{1}{10}\right)$$

$$f=10cm$$

$$\frac{1}{f}=\left(\mu_R-1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$

$$\frac{1}{10}=(1.5-1)\left(\frac{1}{R}+\frac{1}{R}\right)$$

$$\frac{1}{10}=\frac{1}{2}\left(\frac{2}{R}\right)$$

$$\boxed{R=10cm}$$

Question: Radio can tune into 6MHz. Find the corresponding wavelength band
Options:
(a) 20m
(b) 30m
(c) 50m
(d) 70m
Answer: (a)
Solution:

We know $\lambda=\frac{c}{f}$

So, $\lambda=\frac{C}{f_1}$

$$\lambda_1=\frac{3\times10^8}{6\times10^6}=50m$$

And $\lambda_2=\frac{c}{f_2}$

$$=\frac{3\times10^8}{10\times10^6}=30m$$

So wavelength bond $=\lambda_1-\lambda_2$

$$=50-30=20m$$

Question: Find the work done in splitting water droplet of radius R = 1 cm into 729 droplets. Surface tension $T = 75 dyne/cm^2$.

Options:

(a) $7.536\times10^{-3} J$

(b) $7.536\times10^{2} J$

(c) $7.536\times10^{3} J$

(d) $75.36\times10^{-3} J$

Answer: (a)

Solution:

According to question $\frac{4}{3}\pi r^3 = n\times\frac{4}{3}\pi r^3$

$(1)^3 = 729(r)^3$

$(r)^3 = \frac{1}{729}$

$\boxed{r = \frac{1}{9} m}$

W_D = Surface tension $\times$ crave in area

$W_D = 75\times10^{-5+4}\times4\pi$

$\left(729\times\left(\frac{1}{9}\right)^2 - (1)^2\right)$

$W_D = 7.536\times10^{-3} J$

Question: Four capacitors having capacity 1,2,3,4 μF connected in parallel. If 20V battery is connected across the system then find the charge flown through the battery

Options:

(a) $50\mu C$

(b) $100\mu C$

(c) $150\mu C$

(d) $200\mu C$

Answer: (d)

Solution:

If 1,2,3,4 μF capacitors are connected in parallel then

$C_{eq} = 1+2+3+4 = 10\mu F$

Given: $V = 20 volt$

So charge flown from the battery

$q = C_{eq}V$

$q = 10\times20\mu C$

$q = 200\mu C$

Question: A mass of M is attached at Top of find disc of same mass M and radius R. If point mass is given gentle push. Find ω of disc when mass reaches bottom.

Options:

(a) $\sqrt{\frac{9g}{3R}}$

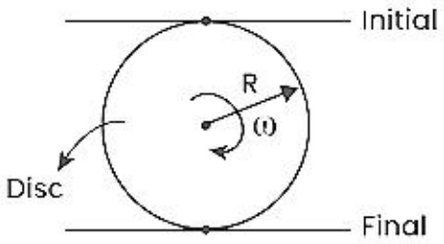
(b) $\sqrt{\frac{8g}{3R}}$

(c) $\sqrt{\frac{R}{3g}}$

(d) $\sqrt{\frac{g}{R}}$

Answer: (b)

Solution:



ω = angular velocity at the instant.

When ball is at bottom.

As here is no friction as well as external force,

So, from conservation of mechanical energy

We have, $\Delta k = -\Delta v$

Let as assume K_i (Initial kinetic energy = 0)

$$\therefore K_f - K_i = -(mg \times 2R)$$

$$\Rightarrow \frac{1}{2} I\omega^2 = mg \times 2R$$

$$\Rightarrow \frac{1}{2} \times \left(\frac{mR^2}{2} + mR^2 \right) \omega^2 = mg \times 2R$$

$$\Rightarrow \frac{3}{4} mR^2\omega^2 = mg \times 2R$$

$$\Rightarrow \omega^2 = \frac{8g}{3R}$$

$$\Rightarrow \omega = \sqrt{\frac{8g}{3R}}$$