# 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 $\alpha$

**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

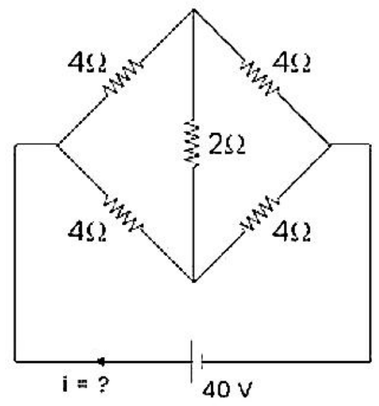
$P_1V_1^r = P_2V_2^r$

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

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

$\therefore P_2 = 32P_1 = 32P_0$

**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

$\therefore$ 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 $m_e = 9.1 \times 10^{-31}$ kg and $m_n = 1.6 \times 10^{-27}$ kg. Do not consider relativistic effect

**Options:**

(a) 1600
(b) 1758
(c) 1880
(d) 1990

**Answer:** (b)

**Solution:**

Using dc Broglic eq.

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

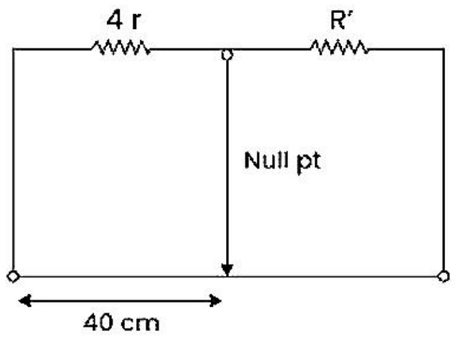
$$\therefore \lambda_e = \lambda_n$$

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

or

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

**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)

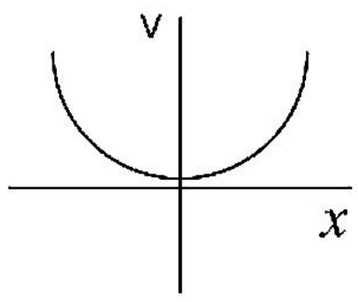
**Solution:**

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

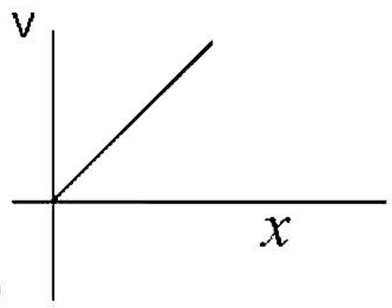
$$\frac{B_1}{B_2} = \frac{N_1}{N_2} = \frac{200}{400} = \frac{1}{2}$$

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

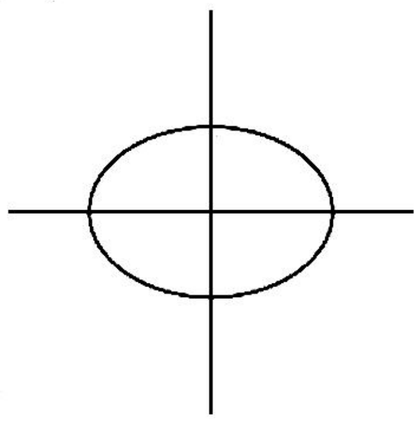
**Options:**



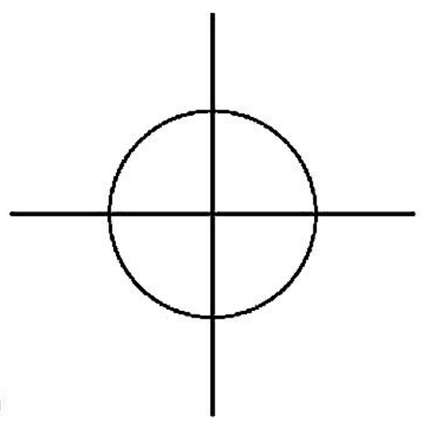

(a)




(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

$$X_L = R$$

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

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

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

$$X_L = X_C$$

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

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

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

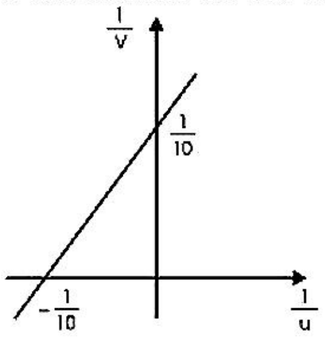
$E_0 = ?$

$E_0 = B_0C$

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

$E_0 = 6N/C$

**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

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

$$f=10cm$$

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

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

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

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

**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) $7.536 \times 10^{-3} J$

(b) $7.536 \times 10^{2} J$

(c) $7.536 \times 10^{3} J$

(d) $75.36 \times 10^{-3} J$

**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

$W_D = 75 \times 10^{-5+4} \times 4\pi$

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

$W_D = 7.536 \times 10^{-3} J$

**Question:** Four capacitors having capacity 1,2,3,4 $\mu F$ 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 $\mu F$ 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

$q = C_{eq} V$

$q = 10 \times 20 \mu C$

$q = 200\mu C$

**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 $\omega$ of disc when mass reaches bottom.

**Options:**

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

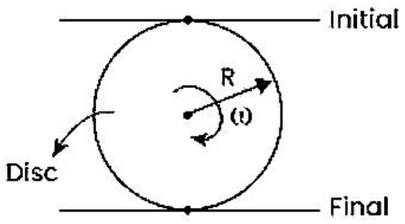
(b) $\sqrt{\frac{8g}{3R}}$

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

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

**Answer:** (b)

**Solution:**




$\omega$ = 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)

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

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

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

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

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

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