# JEE-Main-24-06-2022-Shift-2 (Memory Based)

## Physics

**Question:** A proton, deuteron and an alpha particle enter a magnetic field with same energy find the ratio of their radii of curvature

**Options:**

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

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

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

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

**Answer: (b)**

**Solution:** Correct option is B

$$\frac{mv^2}{R} = qvB$$

For proton, $R_p = \frac{mv}{Bq} = \frac{\sqrt{2M_pE}}{q_pB}$

Similarly for deuteron and $\alpha-$particle

$R_d = \frac{\sqrt{2M_dE}}{q_dB}$ and $R_\alpha = \frac{\sqrt{2M_\alpha E}}{q_\alpha B}$

According to the question

$\therefore R_p : R_d : R_\alpha$

Or, $\frac{\sqrt{M_p}}{q_p} : \frac{\sqrt{M_d}}{q_d} : \frac{\sqrt{M_\alpha}}{q_\alpha}$

$\therefore \frac{\sqrt{1}}{1} : \frac{\sqrt{2}}{1} : \frac{\sqrt{4}}{2}$

Or $1:\sqrt{2}:1$.

**Question:** Read the assertion and reason carefully to mark the correct option out of the options given below.

**Assertion:** An ac circuit can be created with 0 reactance.

**Reason:** An ac circuit without power is not possible.

**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.

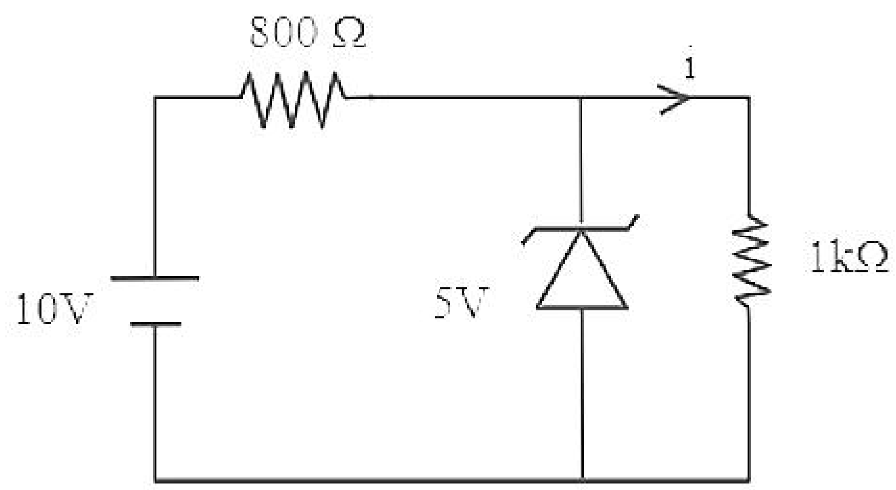
(c) If assertion is true, but reason is false.

(d) If both the assertion and reason are false.

**Answer: (c)**

**Solution:** In a circuit, reactance can be zero either if there are no inductors and capacitors in the circuit, or the individual reactance of inductors and capacitors cancel each other, making net reactance zero. So, statement 1 is true.
But an ac circuit will always consume some power.
So, Reason is false.

**Question:** For the circuit diagram shown below, calculate the load current across $1k\Omega$ resistor.
$i = ?$




**Answer: 5.00**
**Solution:**
Voltage across $1k\Omega$ resistor

$V = 5v$

$$I = \frac{5}{1\times10^3} = 5\times10^{-3}A = 5mA$$

**Question:** Two intensities are in ratio 9:4. Find ratio of $I_{max} : I_{min}$
**Answer: 25.00**
**Solution:**
Given $\frac{I_2}{I_1} = \frac{9}{4}$

Maximum intensity $I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2$

Minimum Intensity $I_{min} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2$

Thus ratio of maximum to minimum intensities $\frac{I_{max}}{I_{min}} = \frac{\left(1 + \frac{\sqrt{I_2}}{\sqrt{I_1}}\right)}{\left(1 - \frac{\sqrt{I_2}}{\sqrt{I_1}}\right)^2}$

$$\therefore \frac{I_{max}}{I_{min}} = \frac{\left(1+\frac{3}{2}\right)^2}{\left(1-\frac{3}{2}\right)^2}$$

Or $\frac{I_{max}}{I_{min}} = \frac{(2+3)^2}{(2-3)^2} = \frac{25}{1}$

**Question:** A 100 gram nail is being hit by a hammer of 1.5kg with velocity of 60 m/s, if one fourth of the energy is being utilized to melt the nail, then find the change in temperature. (Specific heat of nail = 0.42 J per gram per degree Celsius)

**Answer:** 2.00

**Solution:** Heat given $\Delta Q = Q$

$$\Delta\omega = \frac{Q}{4}$$

From FLOT

$$\Delta Q = \Delta\omega + \Delta U$$

$$\Rightarrow \Delta U = Q - \frac{Q}{4} = \frac{3Q}{4}$$

For mono atomic gas

$$\Delta U = \frac{3}{2} nR\partial T = \frac{3Q}{4}$$

$$\Rightarrow Q = 2nR\partial T$$

So, $2nR\partial T = nC_p\partial T$

$$C_p = 2R$$

**Question:** A particle of mass 5kg is thrown upwards air friction is 10N find ratio of time of flight of ascent and descend

Options:

(a) 1:1

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

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

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

**Answer: (b)**

**Solution:**

Correct option is (B)

$$v = u + at$$

$$0 = u + -(g+2)t$$

$$t = \frac{u}{g+2}$$

$$0 - u^2 = 2as - u^2 = 2 \times -(g+2)s$$

$$s = u^2 / 2(g+2)$$

$$s=\frac{1}{2}aT^2$$

$$\frac{u^2}{2(g+2)}=\frac{1}{2}\times(g-2)T^2$$

$$\frac{u}{\sqrt{(g^2-4)}}=T$$

$$\frac{t}{T}=\frac{\sqrt{g-2}}{\sqrt{g+2}}=\sqrt{\frac{8}{12}}=\sqrt{\frac{2}{3}}$$

**Question:** A Carnot engine absorbs 5000 kcal from reservoir at 727°C and rejects to the sink at 127°C. Find the work done by engine

**Answer: 12.6**
**Solution:**

$$Q_1=5000\text{kcal}$$

$$T_1=727+273=1000\text{ K}$$

$$T_2=127+273=400\text{ K}$$

$$\eta=\frac{T_1-T_2}{T_1}=\frac{1000-400}{1000}=0.6$$

Also,

$$\eta=\frac{Q_1-Q_2}{Q_1}=\frac{5000-Q_2}{3000}=0.6$$

$$\Rightarrow Q_2=5000-3000=2000\text{kcal}$$

$$W=Q_1-Q_2=5000-2000=3000\text{kcal}$$

$$\Rightarrow W=3\times4.2\times10^6\text{ J}=12.6\times10^6\text{ J}$$

**Question:** Two massless springs, with spring constants 2k and 9k respectively having 50g and 100g attached at free and, both have same Vmax, then find ratio of amplitudes of vibrations.

**Answer: 3:1**
**Solution:**
Masses are executive SHM
Given,

$$V_1=V_2$$

$$A_1\omega_1=A_2\omega_2$$

$$\frac{A_1}{A_2}=\frac{\omega_2}{\omega_1}\text{...(i)}$$

we know that

$$T=2\pi\sqrt{\frac{m}{k}}$$

$$\Rightarrow\frac{2\pi}{\omega}=2\pi\sqrt{\frac{m}{k}}$$

$\Rightarrow \omega = \sqrt{\frac{k}{m}}$

$\omega = \sqrt{\frac{2k}{50g}}$ and $\omega_2 = \sqrt{\frac{9k}{100g}}$

From…(i)

$\frac{A_1}{A_2} = \sqrt{\frac{9k}{100} \times \frac{50}{2k}} = \frac{3}{2}$

**Question:** Photon of 3.2 ev and 1.4 ev are bombarded on metal with work function 0.8 ev. Then the ratio of maximum velocities of ejected electrons are

**Answer: 2:1**

**Solution:**

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

$k_1 = 3.2 - 0.8 = 2.4\text{eV}$

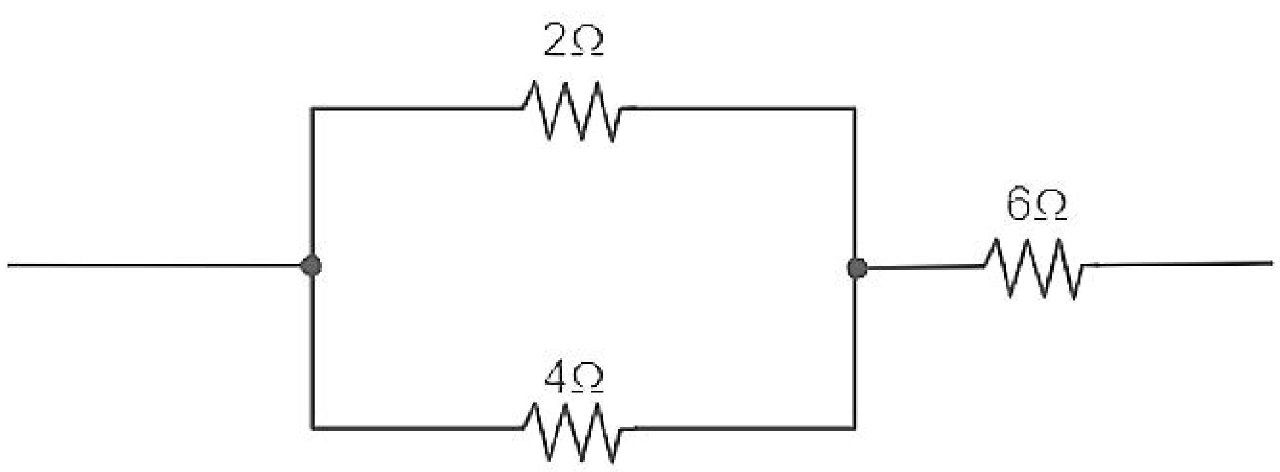
$k_2 = 1.4 - 0.8 = 0.6\text{eV}$

$\frac{k_1}{k_2} = \frac{2.4}{0.6} = \frac{\frac{1}{2}mv_1^2}{\frac{1}{2}mv_2^2}$

$\Rightarrow \left(\frac{v_1}{v_2}\right)^2 = \frac{4}{1}$

$\Rightarrow \frac{v_1}{v_2} = \frac{2}{1}$

**Question:** If $A = 2\Omega, B = 4\Omega 8C = 6\Omega$. Arrange such that $\text{Req} = \frac{22}{3}\Omega$




**Answer: 22:3**

**Solution:**

$\frac{1}{R'} = \frac{1}{2} + \frac{1}{4}$

$R' = \frac{8}{6} = \frac{4}{3}\Omega$

$R_{eq} = \frac{4}{3} + 6 = \frac{4+18}{3} = \frac{22}{3}\Omega$

**Question:** The number of turns in a coil are 1000 with the area as 1 $m^2$ present in a uniform magnetic field of 0.07T. It is rotating along its vertical diameter with one revolution per second, find the maximum emf generated.

**Answer: 439.6V**

**Solution:**

$\varepsilon = 2\pi fNAB\sin\omega t$

$\varepsilon_{max} = 2\pi fNAB$

$\varepsilon_{max} = 2\pi\times1\times1000\times1\times0.07$

$\varepsilon_{max} = 439.6\,V$

**Question:** A glass slab shows the lateral displacement of $4\sqrt{3}$ cm when a light is incident at an angle of 60 degrees, the refractive index of slab is $\sqrt{3}$, the light emerges parallel to its original path, then the thickness of slab would be __ (Integer type)

**Answer: 12.00**

**Solution:**

Lateral shift $d = \frac{t\sin(i-r)}{\cos r}$

Given $i = 30^\circ$ and $n = \sqrt{3}$

$n_1\sin i = n_2\sin r$

$\sin 60^\circ = \sqrt{3}\sin r$

$\frac{\sqrt{3}}{2} = \sqrt{3}\sin r$

$r = 30^\circ$

$d = u\sqrt{3} = \frac{t\sin\left(60^\circ - 30^\circ\right)}{\cos 30^\circ}$

$\Rightarrow u\sqrt{3} = t\tan 30^\circ = \frac{1}{\sqrt{3}}$

$\Rightarrow t = 4\times3 = 12\,cm$

**Question:** A particle is thrown from ground such that at t = 2 sec its velocity is 20 ms-1 & it makes an angle of 45° with horizontal. Find max height?

**Answer:** 58.28

**Solution:**

At t = 2 sec

$V_x = 20\cos 45^o = \frac{20}{\sqrt{2}}\,m/s$

$V_y = V_y - gt$

$U_y = \frac{20}{\sqrt{2}} + 20 = 10\sqrt{2} + 20$

$H_{max} = \frac{v_y^2}{2g} = \frac{\left(10\sqrt{2}+20\right)^2}{20} = 58.28m$

**Question:** If the distance between the sun and earth is 3 times the present distance then find the new time of revolution of earth around sun in years.

**Answer:** $3\sqrt{3}$

**Solution:**

$$T_1^2 = r^3$$

$$T_2^2 = (3r)^3$$

$$\left(\frac{T_2}{T_1}\right)^2 = \left(\frac{3r}{r}\right)^3$$

$$\frac{T_2}{1} = (3)^{3/2}$$

$$T_2 = 3\sqrt{3} \text{ years}$$

**Question:** A string tied to an object of mass m on one end is rotated in a vertical circle with uniform velocity v, then tension in the string is

**Options:**

(a) Same throughout

(b) Maximum at top

(c) Minimum at top

(d) Minimum at bottom

**Answer:** (a, b)

**Solution:**

For bottom position

$$T = Mg + \frac{mv^2}{r}$$

For Top position

$$T = Mg + \frac{mv^2}{r} - mg$$

So Tension is minimum at top.

**Question:** Charge on capacitor is increased by 2C and energy stored becomes 44%. Find initial charge

**Answer:** 10 C

**Solution:**

We know that $E = \frac{Q^2}{2C}$

Increase in energy

$$= \frac{\frac{Q_f^2}{2C} - \frac{Q_1^2}{2C}}{\frac{Q_i^2}{2C}} \times 100 = 44 \qquad \text{....(i)}$$

Given

$Q_f = Q_i = 2$ .....(ii)

$2(Q_f + Q_i) = 0.44Q_1^2$

$2(2 + 2Q_i) = 0.44Q_1^2$

$11Q_i^2 - 100Q_i - 100 = 0$

$11Q_i^2 - 110Q_j + 10Q_j - 100 = 0$

$11Q_i(Q_i - 10) + 10(Q_i - 10) = 0$

$(Q_i - 10)(10Q_i + 10) = 0$

$Q_i = 10C$

**Question:** Q heat is given to a system containing monatomic gas. Q/4 work is done by the gas, then molar heat capacity of the gas is?

**Answer:** 2R

**Solution:**

Heat given $\Delta Q = Q$

$\Delta\omega = \frac{Q}{4}$

From FLOT

$\Delta Q = \Delta w + \Delta V$

$\Rightarrow \Delta V = Q = \frac{Q}{4} = \frac{3Q}{4}$

For monoatomic gas

$\Delta V = \frac{3}{2}nRdT = \frac{3Q}{4}$

$\Rightarrow Q = 2nRdT$

So,

$2nRdT = nC_p dT$

$C_P = 2R$