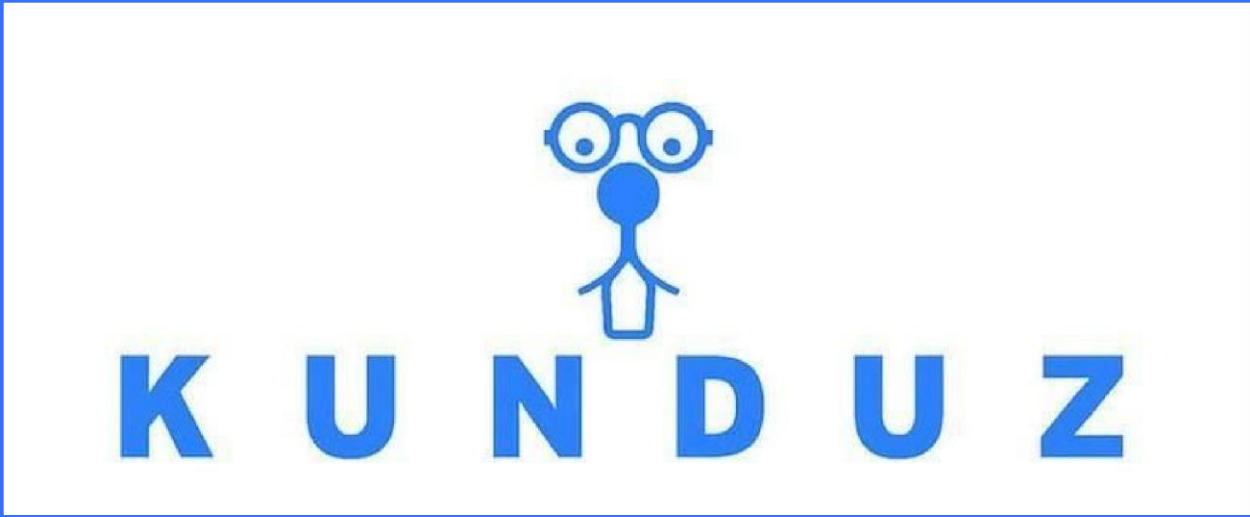


JEE Mains 5th September 2020 shift 1 Physics solutions prepared by KUNDUZ tutors

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Question number

Question and Answers

1

Q1>

A bullet of mass 5g, travelling with a speed of 210 m/s, strikes the wooden target. One half of its kinetic energy is converted into heat in the wood. The rise in temperature of the bullet if the specific heat of its material is 0.030 cal/(g-°C) (1 cal = 4.2×10^7 ergs) close to:

(1) 38.4°C (2) 83.3°C (3) 87.5°C (4) 119.2°C

Sol>

Final KE is zero

$KE_{initial} = \frac{1}{2} mv^2 = \frac{1}{2} \times (5 \times 10^{-3}) \times 210^2$

$= 110.25\ J$

heat $= Q = \frac{1}{2} \Delta KE = \frac{110.25}{2}$

$\Rightarrow Q = 55.125\ J$

Also $Q = mc\Delta T$

$\Rightarrow 2 \times 27.5625 = 5 \times 10^{-3} \times (0.03 \times 4.2 \times 10^3)\ \Delta T$

$\Rightarrow \boxed{\Delta T = 87.5\ ^\circ C}$

Thus, option 3 is correct.

2

Q2.

A galvanometer of resistance G is converted into a voltameter of range 0–1V by connecting a resistence R_1 in series with it. The additional resistence that should be connected in series R_1 to increase the range of the voltmeter to 0–2V will be:

(1) $R_1 + G$ (2) R_1 (3) $R_1 - G$ (4) G

Sol) Range of voltmeter $= V = i_g(R+G)$

$\Rightarrow 1 = i_g(R_1+G)$ — (1)

$\Rightarrow 2 = i_g(R_1+G+R')$ — (2)

$\frac{(1)}{(2)} \Rightarrow \frac{1}{2} = \frac{R_1+G}{R_1+G+R'}$

$\Rightarrow 1 + \frac{R'}{R_1+G} = 2 \Rightarrow \boxed{R' = R_1+G}$

Thus, option 1 is correct.

3

Q3
A helicopter rises from rest on the ground vertically upwards with a constant acceleration g. A food packet is dropped from the helicopter when it is at a height h. The time taken by the packet to reach the ground is close to [g is the acceleration due to gravity]:

1) $t=\frac{2}{3}\sqrt{\frac{h}{g}}$ 2) $t=\sqrt{\frac{2h}{3g}}$ 3) $t=3.4\sqrt{\frac{h}{g}}$ 4) $t=1.03\sqrt{\frac{h}{g}}$

Sol) Let the speed of helicopter at height h be v

$$\Rightarrow \quad v=\sqrt{2gh}$$

For food packet.

$$u=\sqrt{2gh}\ , \quad s=-h\ , \quad a=-g\ , \quad t=?$$

$$\Rightarrow ut+\frac{1}{2}at^2=s \Rightarrow -h=\sqrt{2gh}\,t-\frac{1}{2}gt^2$$

$$\Rightarrow \quad gt^2-2\sqrt{2gh}\,t-2h=0$$

$$\Rightarrow t=\frac{2\sqrt{2gh}\pm\sqrt{8gh+8gh}}{2g}$$

$$\Rightarrow t=\sqrt{\frac{h}{g}}\,(\sqrt{2}+2) \quad = \boxed{3.4\sqrt{\frac{h}{g}}}$$

Thus, option 3 is correct.

4

Q4.
An electrical power line, having a total resistance of 2Ω, delivers 1kW at 220V. The efficiency of the transmission line is approximately:

(1) 85% (2) 91% (3) 96% (4) 72%

sol> we know that $P = VI$

$$\Rightarrow I = \frac{P}{V} = \frac{1000}{220} = \frac{50}{11} A$$

$$\Rightarrow P_{Total} = 1000 + I^2R$$

$$= 1000 + \left(\frac{50}{11}\right)^2 \times 2$$

$$= 1000 + 41.32 = 1041.32W$$

$$\Rightarrow \eta = \frac{P}{P_{Total}} \times 100 = \frac{1000}{1041.32} \times 100$$

$$\Rightarrow \boxed{\eta = 96\%}$$

Thus, option 3 is correct.

5

Q5. A square loop of side $2a$, and carrying current I, is kept in xz plane with its centre at origin. A long wire carrying the same current I is placed parallel to the z-axis and passing through the point $(a, b, 0)$, $(b \gg a)$. The magnitude of the torque on the loop about z-axis is given by:

(1) $\frac{2\mu_0 I^2 a^2}{\pi b}$

(2) $\frac{\mu_0 I^2 a^2}{2\pi b}$

(3) $\frac{2\mu_0 I^2 a^3}{\pi b^2}$

(4) $\frac{\mu_0 I^2 a^3}{2\pi b^2}$

Sol> magnetic field due to wire at origin $= B$

$\Rightarrow B = \frac{\mu_0 I}{2\pi b}$

We know that torque $= \tau = |\vec{M} \times \vec{B}|$

$\Rightarrow \tau = MB \sin\theta$, here $\theta = 90°$

$\Rightarrow \tau = MB$

$M = iA = i \times (2a)^2 = 4a^2 i$

$\Rightarrow \tau = 4a^2 i \times \frac{\mu_0 i}{2\pi b}$

$\Rightarrow \boxed{\tau = \frac{2\mu_0 i^2 a^2}{\pi b^2}}$

Thus, option 1 is correct.

6

Q6.

The value of the acceleration due to gravity is g_1 at a height $h = R/2$ (R = radius of earth) from the surface of the earth. It is again equal to g_1 at a depth d below the surface the earth. The ratio $\left[\frac{d}{R}\right]$ equals:

① $\frac{4}{9}$ ② $\frac{1}{3}$ ③ $\frac{5}{9}$ ④ $\frac{7}{9}$

Sol> $g_1 = \frac{GM}{(R+h)^2} = \frac{GM}{(R+R/2)^2}$

$\Rightarrow \boxed{g_1 = \frac{2^2 GM}{(3R)^2}}$

Acceleration due to gravity at depth d is given by; $g_1 = \frac{GM(R-d)}{R^3}$

$\Rightarrow \frac{2^2 MG}{(3R)^2} = \frac{GM}{R^3}(R-d) \Rightarrow \frac{2^2 R^3}{3^2 R^2} = R-d$

$\Rightarrow \frac{4R}{9} = R-d \Rightarrow \boxed{d = \frac{5R}{9}}$

$\Rightarrow \boxed{\frac{d}{R} = \frac{5}{9}}$

Thus, option 3 is correct.

7

Q7.

Assume that the displacement (s) of air is proportional to the pressure difference (Δp) created by a sound wave. Displacement (s) further depends on the speed of sound (v), density of air (ρ) and the frequency (f). If $\Delta p \sim 10$ Pa, $v \sim 300$ m/s, $\rho \sim 1$ kg/m^3 and $f \sim 1000$ Hz, then s will be of the order of (take the multiplicative constant to be 1)

(1) 1 mm (2) $\frac{3}{100}$ mm (3) 10 mm (4) $\frac{1}{10}$ mm

Sol> We know that $s = \frac{p_0}{Bk}$

$$k = \frac{2\pi}{\lambda}, \quad \lambda = \frac{v}{f}$$

$$\Rightarrow k = \frac{2\pi f}{v} = \frac{\omega}{v}$$

Also $B = \rho v^2$

$$\Rightarrow s = \frac{p_0}{\rho v^2 \times \frac{\omega}{v}} = \frac{p_0}{\rho \omega v}$$

$$\Rightarrow s = \frac{10}{1 \times 1000 \times 300} \text{ m}$$

$$\Rightarrow s = \frac{1}{30} \text{ mm} \approx \boxed{\frac{3}{100} \text{ mm}}$$

Thus, option 2 is correct

8

Q8. A wheel is rotating freely with an angular speed ω on a shaft. The moment of inertia of the wheel is I and the moment of inertia of the shaft is negligible. Another wheel of moment of inertia 3I initially at rest is suddenly coupled to the same shaft. The resultant fractional loss in the kinetic energy of the system is:

(1) $\frac{3}{4}$ (2) $\frac{1}{4}$ (3) 0 (4) $\frac{5}{6}$

Sol) By conservation of angular momentum:

$$I\omega = (I+3I)\omega'$$

$$\Rightarrow \boxed{\omega' = \omega/4}$$

$$KE_{initial} = \frac{1}{2}I\omega^2 = KE_i$$

$$KE_{final} = KE_f = \frac{1}{2}(I+3I)\omega'^2$$

$$= \frac{4I}{2} \times \frac{\omega^2}{16} = \frac{I\omega^2}{8}$$

$$\Rightarrow \Delta KE = \frac{I\omega^2}{2} - \frac{I\omega^2}{8} = \frac{3I\omega^2}{8}$$

$$\Rightarrow \frac{\Delta KE}{KE_i} = \frac{3I\omega^2}{8} \times \frac{2}{I\omega^2} = \boxed{\frac{3}{4}}$$

Thus, option 1 is correct.

9

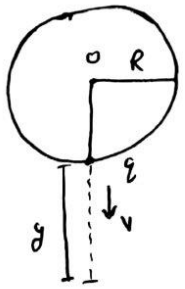
89.
A solid sphere of radius R carries a charge Q+q distributed uniformly over its volume. A very small point like piece of it of mass m gets detached from the bottom of the sphere and falls down vertically under gravity. This piece carries charge q. If it acquires a speed v when it has fallen through a vertical height y (see figure), then (assume the remaining portion to be spherical)

(1) $v^2 = 2y\left[\frac{QqR}{4\pi\varepsilon_0(R+y)^3 m} + g\right]$

(2) $v^2 = y\left[\frac{qQ}{4\pi\varepsilon_0 R^2 \gamma m} + g\right]$

(3) $v^2 = y\left[\frac{qQ}{4\pi\varepsilon_0 R(R+y)m} + g\right]$

(4) $v^2 = 2y\left[\frac{qQ}{4\pi\varepsilon_0 R(R+y)m} + g\right]$



sol> Electrostatic energy at surface $= \frac{KQq}{R}$

Energy at distance $y = \frac{KQq}{R+y}$

$KE = \frac{1}{2}mv^2$, $\Delta PE = -mgy$

=> By conservation of energy ->

$\frac{1}{2}mv^2 + \left(\frac{KQq}{R+y} - \frac{KQq}{R}\right) = mgy$

solving this we get $v^2 = 2y\left[\frac{qQ}{4\pi\varepsilon_0 R(R+y)m} + g\right]$

Thus, option 4 is correct.

10

Q.10
A physical quantity z depends on four observables a, b, c and d as $z = \frac{a^2 b^{2/3}}{\sqrt{c}\, d^3}$. The percentage error in the measurement of a, b, c and d are 2%, 1.5%, 4% and 2.5% respectively. The percentage of error in z is:

(1) 13.5% (2) 16.5% (3) 14.5% (4) 12.25%

sol) $Z = \frac{a^2 b^{2/3}}{\sqrt{c}\, d^3}$

$\Rightarrow \ln(z) = 2\ln(a) + \frac{2}{3}\ln(b) - \frac{1}{2}\ln(c) + (-3\ln d)$

Differentiating all the terms.

$\Rightarrow \frac{dz}{z} = 2\frac{da}{a} + \frac{2db}{3b} - \frac{dc}{2c} - 3\frac{d(d)}{d}$

$\Rightarrow \frac{dz}{z} \times 100\% = (2\times 2) + \left(\frac{2}{3}\times 1.5\right) - \left(\frac{1}{2}\times 4\right)) - (3\times 2.5)$

$= 4 + 1 + 2 + 7.5$

$= \boxed{14.5\%}$

Thus, option 3 is correct.

11

Q.11.
Number of molecules in a volume of $4cm^3$ of a perfect monoatomic gas at some temperature T and at a pressure of 2cm of mercury is close to? (Given, mean kinetic energy of a molecule (at T) is 4×10^{-14} erg, $g = 980\ cm/s^2$, density of mercury $= 13.6\ g/cm^3$).

(1) 5.8×10^{16} (2) 4.0×10^{16} (3) 4.0×10^{18} (4) 5.8×10^{18}

Sol > we know that

$$PV = nRT \Rightarrow PV = N_A KT$$

Also energy $= U = \frac{3}{2}KT$

$$\Rightarrow \frac{PV}{U} = \frac{2N_A}{3} \Rightarrow N_A = \frac{3PV}{2U}$$

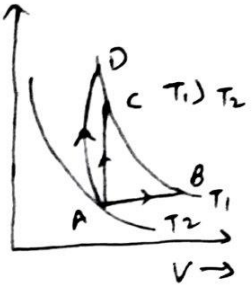
$$\Rightarrow N_A = \frac{3\times2\times980\times13.6\times4}{2\times4\times10^{-14}}$$

$$\Rightarrow \boxed{N_A = 4\times10^{18}}$$

Thus, option 3 is correct.

12

812. Three different processes that can occur in an ideal monoatomic gas are shown in the P vs V diagram. The paths are labelled as $A \to B$, $A \to C$ and $A \to D$. The change in internal energies during these process



are taken as E_{AB}, E_{AC} and E_{AD} and the work done as W_{AB}, W_{AC} and W_{AD}. The correct relation between these parameters are:

(1) $E_{AB} > E_{AC} > E_{AD}$, $W_{AB} < W_{AC} < W_{AD}$

(2) $E_{AB} = E_{AC} = E_{AD}$, $W_{AC} = 0$, $W_{AB} > 0$, $W_{AD} > 0$

(3) $E_{AB} < E_{AC} < E_{AD}$, $W_{AB} > 0$, $W_{AC} > W_{AD}$

(4) $E_{AB} = E_{AC} < E_{AD}$, $W_{AB} > 0$, $W_{AC} = 0$, $W_{AD} < 0$

Sol) Internal energy is given by $nC_v\Delta T$

Since ΔT all the three are same.

$\Rightarrow E_{AB} = E_{AC} = E_{AD}$

$W_{AC} = 0$ { since $\Delta V = 0$ }

Since $\Delta V > 0$ for AB and AD

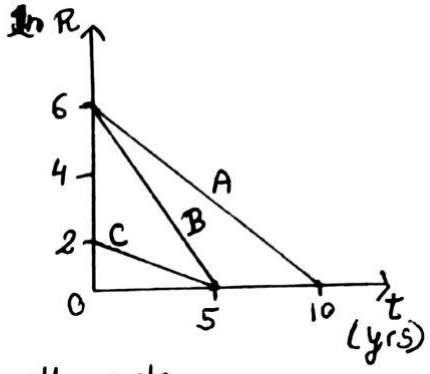
$\Rightarrow W_{AB} > 0$, $W_{AD} > 0$

Thus, option 2 is correct.

13

Q13.

Activities of three radioactive substance A, B and C are represented by the curves A, B and C, in the figure. Then their half-lives



$T_{\frac{1}{2}}(A) : T_{\frac{1}{2}}(B) : T_{\frac{1}{2}}(C)$ are in the ratio:

① 2:1:3 ② 3:2:1 ③ 4:3:1 ④ 2:1:1

Sol> we know that $R = R_0 e^{-\lambda t}$

$$\Rightarrow \ln\left(\frac{R}{R_0}\right) = -\lambda t$$

$$\Rightarrow \lambda = \frac{\ln(R_0)}{t} - \frac{\ln(R)}{t}$$

$$\Rightarrow \lambda_A = \frac{\ln(R_0)}{t} - \frac{\ln(R_A)}{t}$$

Slope = $\lambda_A, \lambda_B, \lambda_C$

Also $t_{1/2} = \frac{\ln(2)}{\lambda}$

$$\Rightarrow t_A : t_B : t_C = \frac{1}{\lambda_A} : \frac{1}{\lambda_B} : \frac{1}{\lambda_C}$$

$$= \frac{10}{6} : \frac{5}{6} : \frac{5}{2}$$

$$= \boxed{2:1:3}$$

Thus, option 1 is correct

14

Q14.
In a resonance tube experiment when the tube is filled with water up to a height of 17.0 cm from bottom, it resonates with a given turning fork. When the water level is raised the next resonance with the same turning occurs at a height of 24.5cm. If the velocity of sound in air is 330 m/s, the running fork frequency is:

(1) 2200 Hz (2) 1100 Hz (3) 3300 Hz (4) 500 Hz

Sol> Second resonance occurs only when height of water difference covers $\lambda/2$.

$$\Rightarrow 24.5 - 17 = \frac{\lambda}{2} \Rightarrow \boxed{\lambda = 15 \text{ cm}}$$

$$\Rightarrow f = \frac{V}{\lambda} = \frac{330}{15 \times 10^{-2}} = 2200 \text{ Hz}$$

$$\Rightarrow \boxed{f = 2200 \text{ Hz}}$$

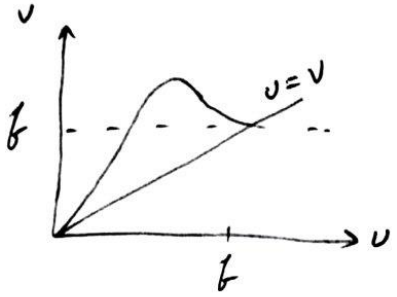
Thus, option 1 is correct.

15

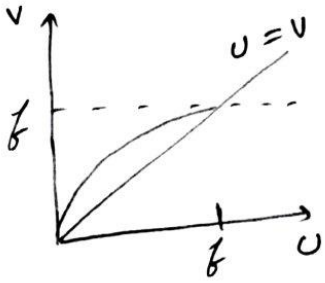
Q15

For a concave lens of focal length f, the relation between object and image distance μ and v, respectively, from its hole can best the represented by ($v = v$ is the reference line):

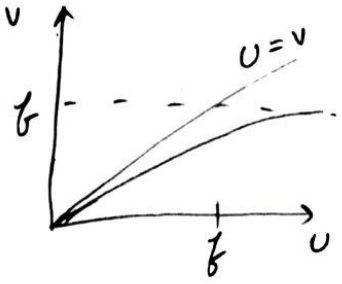
1)



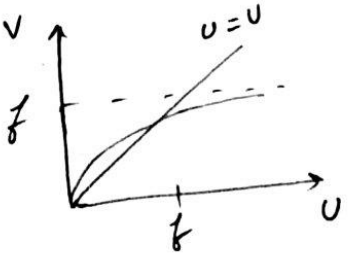
2)



3)



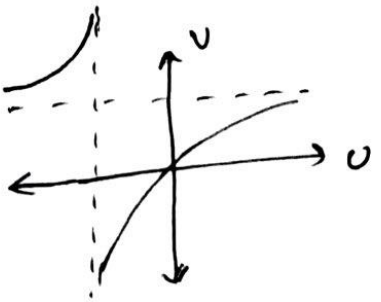
4)



sol) we know that $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\Rightarrow \frac{1}{u} = \frac{1}{f} + \frac{1}{v}$

Thus, graph looks →



This is hyperbola shifted from axis.

Thus, option 3 is correct.

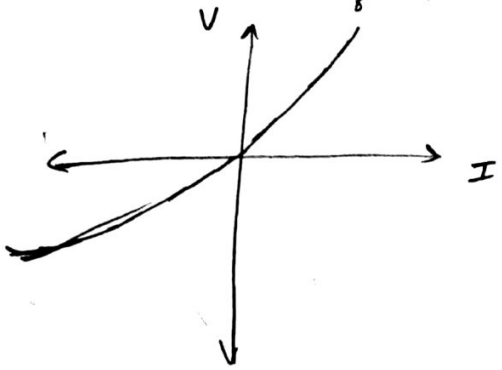
16

Q16

With increasing biasing voltage of a photo diode, the photocurrent magnitude:

(1) remains constant
(2) increases initially and saturates finally
(3) increases linearly
(4) increases initially and after attaining certain value, it decreases.

Sol> V-I Characteristic of diode looks like

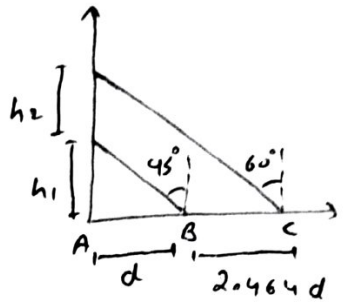


Thus, current increase initially but then saturates finally.

Thus, option 2 is correct.

17

Q17. A balloon is moving up in air vertically above a point A on the ground. When it is at a height h_1, a girl standing at a distance d (point B) from A (see figure) sees it at an angle 45° with respect to the vertical. When the balloon climbs up a further height h_2, it is seen at an angle 60° with respect to the vertical if the girl moves further by a distance $2.464d$ (point C). Then the height h_2 is (given $\tan 30° = 0.5774$):



(1) $0.732d$ (2) $0.464d$ (3) $1.464d$ (4) d

Sol) $\tan(45°) = \frac{h_1}{d} \Rightarrow \boxed{h_1 = d}$

$\tan(30°) = \frac{h_1 + h_2}{3.464d}$

$\Rightarrow 0.5774 = \frac{d + h_2}{3.464d}$

$\Rightarrow 2d = d + h_2 \Rightarrow \boxed{h_2 = d}$

Thus, option 4 is correct.

18

Q18. A hollow spherical shell at outer radius R floats just submerged under the water surface. The inner radius of the shell is r. If the specific gravity of the shell material is $\frac{27}{8}$ with respect to water, the value of r is:

(1) $\frac{1}{3}R$ (2) $\frac{4}{9}R$ (3) $\frac{2}{3}R$ (4) $\frac{8}{9}R$

Sol) To float, weight = Buoyant force.

$$\text{weight} = \frac{4}{3}\pi(R^3 - r^3) \times \frac{27}{8} \times g$$

$$\text{Buoyant force} = \frac{4}{3}\pi R^3 \times 1 \times g$$

$$\Rightarrow \frac{4}{3}\pi(R^3 - r^3) \times \frac{27}{8} g = \frac{4}{3}\pi R^3 \times g$$

$$\Rightarrow \frac{27}{8}(R^3 - r^3) = R^3$$

$$\Rightarrow r^3 = \left(1 - \frac{8}{27}\right) R^3$$

$$\Rightarrow r = \left(\frac{19}{27}\right)^{1/3} R$$

$$\Rightarrow \boxed{r = 0.89R} \Rightarrow \boxed{r \simeq \frac{8}{9}R}$$

Thus, option 4 is correct.

19

Q19.
An electron is constrained to move along the y-axis with a speed of 0.1c (c is the speed of light) in the presence of electromagnetic wave, whose electric field is $\vec{E} = 30\hat{j}\sin(1.5\times10^{7}t - 5\times10^{-2}x)$ V/m. The maximum magnetic force experience by the electron will be: (given $c = 3\times10^{8}\ ms^{-1}$ and electron charge $= 1.6\times10^{-19}$ C)

(1) 2.4×10^{-18} N
(2) 1.6×10^{-19} N
(3) 4.8×10^{-19} N
(4) 3.2×10^{-18} N

Sol) we know that $B_0 = \frac{E_0}{c}$

$\Rightarrow B_0 = \frac{30}{c}$ T

Force $= qVB$

$\Rightarrow F_{max} = qVB_0 = \frac{qVE_0}{c}$

$\Rightarrow F_{max} = \frac{1.6\times10^{-19}\times0.1c\times30}{c}$

$= 1.6\times3\times10^{-19} = \boxed{4.8\times10^{-19}\ N}$

Thus, option 3 is correct.

20

Q20
Two capacitors of capacitances C and 2C are charged to potential difference V and 2V, respectively. These are then connected in parallel in such a manner that the positive terminal of one is connected to negative terminal of the other. The final energy of this configuration is:

① $\frac{25}{6}CV^2$ ② $\frac{9}{2}CV^2$ ③ zero ④ $\frac{3}{2}CV^2$

Sol> $Q = CV$

$Q' = 2C \times 2V = 4CV$

$(-Q) + Q' =$ constant {+ve of one connected to -ve of other}

Let the common potential be V'

$\Rightarrow -CV + 4CV = (C + 2C)V'$ → C_{eq} in parallel

$\Rightarrow 3CV = 3CV' \Rightarrow \boxed{V' = V}$

$U_{initial} = U_i = \frac{1}{2}CV^2 + \frac{1}{2}2C(2V)^2$

$= \frac{1}{2}CV^2(1+8) = \frac{9CV^2}{2}$

$U_{final} = U_f = \frac{1}{2}CV^2 + \frac{1}{2}2CV^2$

$= \boxed{\frac{3CV^2}{2}}$

Thus, option 4 is correct.

21

Q21
A force $\vec{F} = (\hat{i} + 2\hat{j} + 3\hat{k})$ N acts at a point $(4\hat{i} + 3\hat{j} - \hat{k})$m. Then the magnitude of torque about the point $(\hat{i} + 2\hat{j} + \hat{k})$m will be $\sqrt{x}$ N-m. The value of x is.....

Sol> we know that $\vec{\tau} = \vec{\varepsilon} \times \vec{F}$

Given $\vec{\varepsilon} = (4-1)\hat{i} + (3-2)\hat{j} + (-1-1)\hat{k}$

$= 3\hat{i} + \hat{j} - 2\hat{k}$

$\vec{F} = \hat{i} + 2\hat{j} + 3\hat{k}$

$$\Rightarrow \vec{\tau} = \vec{\varepsilon} \times \vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 1 & -2 \\ 1 & 2 & 3 \end{vmatrix}$$

$= \hat{i}(7) - \hat{j}(11) + \hat{k}(5)$

$\Rightarrow |\vec{\tau}| = \sqrt{7^2 + 11^2 + 5^2}$

$= \sqrt{195}$

$\Rightarrow \sqrt{x} = \sqrt{195} \Rightarrow \boxed{x = 195}$

22

Q.22

A particle of mass 200 MeV/c^2 collides with a hydrogen atom at rest. Soon after the collision the particle comes to rest, and the atom recoils and goes to its first excited state. The initial kinetic energy of the particle (in eV) is $\frac{N}{4}$. The value of N is:

(Given: the mass of the hydrogen atom to be 1 GeV/c^2)...

Sol> mass of particle = $m = 200$ MeV/c^2

mass of hydrogen = 1 GeV/c^2 = $5m$

By conservation of momentum:

$$mv = 5mv' \Rightarrow v' = v/5$$

$$\Rightarrow KE_i = \frac{1}{2}mv^2$$

$$\Rightarrow KE_f = \frac{1}{2} \times 5m \times \left(\frac{v}{5}\right)^2 = \frac{1}{2}\frac{mv^2}{5}$$

$$\Rightarrow \Delta KE = \frac{1}{2}mv^2\left(1 - \frac{1}{5}\right) = \frac{2mv^2}{5}$$

Energy needed by hydrogen to go to first excited state = $13.6\left(1 - \frac{1}{4}\right)$

$$\Rightarrow 13.6 \times \frac{3}{4} = \frac{2}{5} \times mv^2 = \frac{4}{5}KE_i$$

$$\Rightarrow KE_i = 13.6 \times \frac{3}{4} \times \frac{5}{4} = 12.75$$

$$\Rightarrow N/4 = 12.75 \Rightarrow \boxed{N = 51}$$

23

Q23

Two concentric circular coils, C_1 and C_2 are placed in the XY plane. C_1 has 500 turns, and a radius of 1 cm. C_2 has 200 turns and radius of 20 cm. C_2 carries a time dependent current $I(t) = (5t^2 - 2t + 3)$ A where t is in s. The emf induced in C_1 (in mV), at the instant t 1s is $\frac{4}{x}$. The value of x is.....

Sol) Given $I = (5t^2 - 2t + 3)$ A

we know that magnetic field due to ring $= B = \frac{\mu_0 I N_2}{2R}$

$\Rightarrow \phi = BA = \frac{\mu_0 I N_2}{2R} \times \pi r^2$

$\Rightarrow \frac{d\phi}{dt} = \mu_0 \frac{N_2 \pi r^2}{2R} \frac{dI}{dt}$

$\Rightarrow emf = N_1 \frac{d\phi}{dt} = \frac{\mu_0 N_1 N_2 \pi r^2}{2R} (10t - 2)$

at $t = 1$ sec

$emf = \frac{\mu_0 N_1 N_2 \pi r^2}{2R} \times (10 - 2)$

$\Rightarrow emf \simeq 0.8$ mV $\Rightarrow \frac{4}{x} = 0.8$

$\Rightarrow \boxed{x = 5}$

24

Q.24 A beam of electrons of energy E scatters from a target having atomic spacing of 1 Å. The first maximum intensity occurs at $\theta = 60^\circ$. Then E (in eV) is .....

(Plank constant $h = 6.64 \times 10^{-34}$ Js, $1\,eV = 1.6 \times 10^{-19}$ J, electron mass $m = 9.1 \times 10^{-31}$ kg).

Sol> We know that path difference = $d \sin(\theta)$

$\Rightarrow d \sin(\theta) = n\lambda$, for maxima.

Atomic spacing = 1 Å

$\Rightarrow d =$ 2 × atomic spacing = 2 Å

Given $\theta = 60^\circ$

$\Rightarrow 2\,Å \times \frac{\sqrt{3}}{2} = (1) \times \lambda$

$\Rightarrow \lambda = \sqrt{3}\,Å$

$E = e \times V$

$\Rightarrow \sqrt{3} = \sqrt{\frac{150}{V}} \Rightarrow V = 50$

$\Rightarrow \boxed{E = 50\,eV}$

25

Q25
A compound microscope consists of an objective lens of focal length 1 cm and an eye piece of focal length 5cm with a separation of 10cm. The distance between an object and the objective lens, at which the strain on the eye is minimum is $\frac{n}{40}$ cm. The value of n is.....

Sol) Strain on eye is minimum when final image is at ∞.

Given $L = 10$ cm

$f_e = 5$cm, $f_o = 1$cm

For v_e to be ∞, $u_e = f_e$

$\Rightarrow v_e = 5$ cm

$v_o = 10 - 5 = 5$cm

$$\Rightarrow \frac{1}{f_o} = \frac{1}{v_o} - \frac{1}{u_o}$$

$$\Rightarrow \frac{1}{1} = \frac{1}{5} - \frac{1}{u_o}$$

$$\Rightarrow \frac{1}{u_o} = \frac{1}{5} - 1$$

$$\Rightarrow u_o = -\frac{5}{4} \text{ cm}$$

$$\Rightarrow \frac{n}{40} = \frac{5}{4} \Rightarrow \boxed{n = 50}$$

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