Studentpad

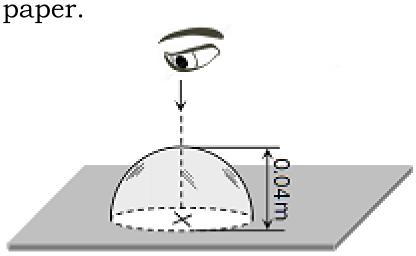
K-CET PHYSICS PAPER 2022-23

Time : 120 Min	Phy : Full Portion Paper	Marks : 60

Hints and Solutions

01) Ans: **A)** (i) At the same position of the cross mark; (ii) 0.025 m below the flat face

Sol: Case (i) : When flat face is in contact with paper.



$\frac{\mu_2}{v} - \frac{\mu_1}{u} = \frac{\mu_2 - \mu_1}{R}$, where μ_2 = R. I. of medium in which light rays are going =1

μ_1 = R. I. of medium from which light rays are coming = 1.6

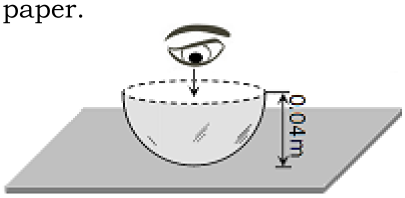
u = distance of object from curved surface= -0.04m

R = - 0.04 m.

$\therefore \frac{1}{v} - \frac{1.6}{(-0.04)} = \frac{1-1.6}{(-0.04)} \Rightarrow v = -0.04$ m

It means the image will be formed at the same position of cross.

Case (ii) : When curved face is in contact with paper.



$\mu = \frac{\text{Real depth (h)}}{\text{Apparent depth (h}')} \Rightarrow 1.6 = \frac{0.04}{h'}$

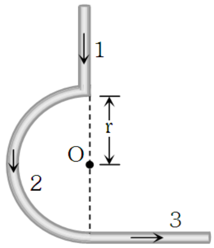
$\Rightarrow$ h' = 0.025 m (Below the flat face)

02) Ans: **A)** $19995\,\Omega$

Sol: Here, using

$R = \frac{V}{I_g} - G \Rightarrow R = \frac{100}{5\times10^{-3}} - 5 = 19{,}995\,\Omega$

03) Ans: **D)** $\frac{\mu_0 I}{4r} + \frac{\mu_0 I}{4\pi r}$



Sol: Magnetic field because of different parts are

$B_1 = 0,\ B_2 = \frac{\mu_0}{4\pi}.\frac{\pi i}{r} \odot$ and $B_3 = \frac{\mu_0}{4\pi}.\frac{i}{r} \otimes$

$\therefore B_{net} = B_2 + B_3 \Rightarrow B_{net} = \frac{\mu_0 i}{4r} + \frac{\mu_0 i}{4\pi r} \otimes$

04) Ans: **D)** $q\left(\vec{v}\times\vec{B}\right)$

Sol: Magnetic Lorentz force is given by

$\vec{F} = q\left(\vec{v}\times\vec{B}\right)$.

05) Ans: **D)** 4 : 1

Sol: For a Balmer series

$\frac{1}{\lambda_B} = R\left[\frac{1}{2^2} - \frac{1}{n^2}\right]$ ...(i) Where n=3, 4, ...

By putting $n = \infty$ in equation (i), we obtain the series limit of the Balmer series. It is the shortest wavelength of the Balmer series.

Or $\lambda_B = \frac{4}{R}$ ...(ii)

For a Lyman series,

$\frac{1}{\lambda_L} = R\left[\frac{1}{1^2} - \frac{1}{n^2}\right]$ ...(iii) where n =2, 3, 4, ...

By putting $n = \infty$ in equation (iii), we obtain the series limit of the Lyman series. This is the shortest wavelength of the Lyman series.

Or $\lambda_L = \frac{1}{R}$ ...(iv)

Dividing (ii) by (iv), we get, $\frac{\lambda_B}{\lambda_L} = \frac{4}{1}$

06) Ans: **A)** 0.04 mA

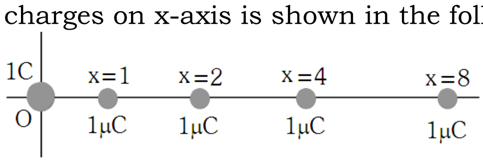
Sol: Here, $V = V_{CE} + I_C R_L$

$\Rightarrow 15 = 7 + I_C \times 2\times10^3 \Rightarrow i_C = 4$ mA

$\therefore \beta = \frac{i_C}{i_B} \Rightarrow i_B = \frac{4}{100} = 0.04$ m

07) Ans: **C)** 12000 N

Sol: The schematic diagram of distribution of charges on x-axis is shown in the following figure.



Total force acting on 1 C charge is given by

$$F = \frac{1}{4\pi\varepsilon_0}\left[\frac{1\times1\times10^{-6}}{(1)^2} + \frac{1\times1\times10^{-6}}{(2)^2} + \frac{1\times1\times10^{-6}}{(4)^2} + \frac{1\times1\times10^{-6}}{(8)^2} + \ldots\infty\right]$$

$$\Rightarrow F = \frac{10^{-6}}{4\pi\varepsilon_0}\left(\frac{1}{1} + \frac{1}{4} + \frac{1}{16} + \frac{1}{64} + \ldots\infty\right)$$

$$= 9\times10^{9}\times10^{-6}\left(\frac{1}{1-\frac{1}{4}}\right)$$

$$\Rightarrow F = 9\times10^{9}\times10^{-6}\times\frac{4}{3} \Rightarrow F = 9\times10^{3}\times\frac{4}{3} = 12000\text{ N}$$

08) Ans: **C)** It becomes maximum at a particular frequency

09) Ans: **C)** $10\sqrt{2}$ A

Sol: Power, $P = \frac{1}{2}V_0 i_0 \cos\phi$

$\Rightarrow 1000 = \frac{1}{2}\times200\times i_0\cos60^\circ \Rightarrow i_0 = 20\text{ A}$

$\therefore i_{rms} = \frac{i_0}{\sqrt{2}} = \frac{20}{\sqrt{2}} = 10\sqrt{2}\text{A}$

10) Ans: **D)** Zero

Sol: Given that, $V = 5\cos\omega t = 5\sin\left(\omega t + \frac{\pi}{2}\right)$

and $i = 2\sin\omega t$

Now, $\text{Power} = V_{r.m.s.}\times i_{r.m.s.}\times\cos\phi = 0$

(As $\phi = \frac{\pi}{2}$, thus $\cos\phi = \cos\frac{\pi}{2} = 0$)

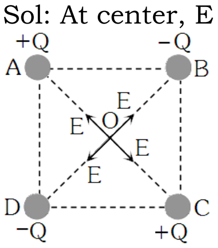
11) Ans: **D)** 7

Sol: From $n_\alpha = \frac{A - A'}{4} \Rightarrow n_\alpha = \frac{232-204}{4} = 7$

12) Ans: **A)** Fourier.

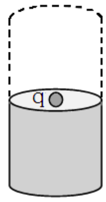
13) Ans: **D)** E = 0, V = 0

Sol: At center, E = 0 as well as V = 0



14) Ans: **B)** $\frac{q}{2\varepsilon_0}$

Sol: For applying Gauss's theorem it is essential that charge should be placed inside a closed surface. Thus, imagine another similar cylindrical vessel above it as shown in figure (dotted).



15) Ans: **B)** 8 : 1

Sol: We know, $T \propto n^3 \quad \Rightarrow \frac{T_2}{T_1} = \frac{2^3}{1^3} = \frac{8}{1}$

16) Ans: **D)** $\sqrt{2gR_E}$

Sol: The escape speed of a body from the earth's surface is

$v_e = \sqrt{\frac{2GM_E}{R_E}} = \sqrt{2gR_E}\left(\because g = \frac{GM_E}{R_E^2}\right)$ where M_E and R_E are the mass and radius of the earth respectively.

17) Ans: **D)** 10^{15} cycles/s

Sol: Here, frequency $v = \frac{c}{\lambda} = \frac{3\times10^8}{3000\times10^{-10}}$

$\Rightarrow v = 10^{15}$ cycles / s

18) Ans: **C)** 11.25 N

Sol: We know,

$F \propto \frac{1}{r^2} \Rightarrow \frac{F_1}{F_2} = \left(\frac{r_2}{r_1}\right)^2 \Rightarrow \frac{5}{F_2} = \left(\frac{0.04}{0.06}\right)^2 \Rightarrow F_2 = 11.25\text{ N}$

19) Ans: **A)** Electron energy increase as n increases

Sol: In a hydrogen atom, the energy of electron in n^{th} orbit is $E_n = -\frac{13.6}{n^2}\text{eV}$

20) Ans: **C)** 7.4×10^{-12} N

Sol: Here, $F = qvB$ and $K = \frac{1}{2}mv^2$

$\therefore F = qB\sqrt{\frac{2k}{m}}$

$\Rightarrow F = 1.6\times10^{-19}\times1.5\sqrt{\frac{2\times5\times10^6\times1.6\times10^{-19}}{1.7\times10^{-27}}}$

$\Rightarrow F = 7.344\times10^{-12}$ N

21) Ans: **D)** 4 only

Sol: α-particles may not be attracted by the nucleus.

22) Ans: **C)** they are deflected by electric and magnetic fields.

23) Ans: **B)** 40

Sol: Here, $n_1\lambda_1 = n_2\lambda_2$

$\Rightarrow 60\times4000 = n_2\times6000 \quad \Rightarrow n_2 = 40$

24) Ans: **D)** 2.08×10^{-5} Weber / m^2

Sol: Horizontal component, $B_H = B\cos\phi$

Total intensity of earth's magnetic field, $B = \dfrac{B_H}{\cos\phi}$

$$\Rightarrow B = \frac{1.8\times10^{5}}{\cos 30^{o}} = \frac{1.8\times10^{-5}}{\sqrt{3}/2} = 2.08\times10^{-5}\,Wb/m^2$$

25) Ans: **B)** 6.28 and 8.88 mm/s

Sol: The relation between linear and angular velocity is given as,

$$v = r\omega = \frac{r\times2\pi}{T} = \frac{0.06\times2\pi}{60} = 6.28\ mm/s$$

$\therefore$ Magnitude of change in velocity = $|\vec{v_2} - \vec{v_1}|$

$= \sqrt{v_1^2 + v_2^2} = 8.88\ mm/s$ (As v_1=v_2=6.28 mm/s)

26) Ans: **A)** 12.42×10^{21} J, 684 m / s

Sol: We know, average translational K.E. of a molecules $= \dfrac{3}{2}kT$.

At 300 K, average K.E. $= 6.21\times10^{-21}$ J

Thus, at 600 K, average K.E. $= 2\times(6.21\times10^{-21}) = 12.42\times10^{-21}$ J and

as $v_{rms} = \sqrt{\dfrac{3kT}{m}}$, $\therefore$ At 300K, v_{rms} = 484 m /

and At 600 K, $v'_{rms} = \sqrt{2}\times484 = 684\ m/s$

27) Ans: **D)** $\dfrac{3}{2}MR^2\omega$

Sol: Here, angular momentum about origin

$= L_{translation} + L_{rotation}$

$$= MvR + I_c\omega = M(R\omega)R + \frac{1}{2}MR^2\omega = \frac{3}{2}MR^2\omega$$

28) Ans: **D)** $1\times10^{-6}\ \Omega$ m

Sol: Given,

$l = 50\,cm = 50\times10^{-2}$ m, $A = 1\,mm^2 = 1\times10^{-6}\ m^2$,

$V = 2V, I = 4$ A

According to Ohm's law, $V = IR$

or $R = \dfrac{V}{I} = \dfrac{2}{4} = \dfrac{1}{2}\Omega$ ...(i)

Resistance of a wire is $R = \rho\dfrac{l}{A}$ (Using (i))

$$\therefore \rho = \frac{A}{2l} = \frac{10^{-6}}{2\times50\times10^{-2}} = 10^{-6}\,\Omega\,m$$

29) Ans: **D)** $20\,\Omega$

Sol: Here, $V_{AB} = 4 = \dfrac{5X + 2\times10}{X+10} \Rightarrow X = 20\,\Omega$

30) Ans: **C)** 0.6 V

31) Ans: **D)** Sound waves

Sol: Light waves are EM waves. Water waves are transverse as well as longitudinal. Wave on a plucked string is stationary wave.

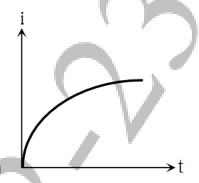
32) Ans: **C)** $\dfrac{2\pi m}{qB}$

Sol: $\dfrac{2\pi m}{qB}$

33) Ans: **D)** change in the focal length of eye lens

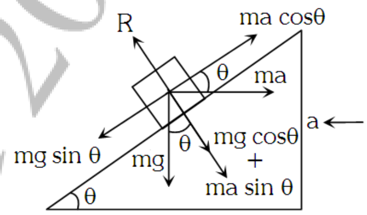
Sol: The eye lens is surrounded by a different medium than air. This will change the focal length of the eye lens. The eye cannot accommodate all images as it would do in air.

34) Ans: **C)**



Sol: As we know, $i = i_0\left(1 - e^{-\frac{R}{L}t}\right)$.

35) Ans: **D)** mg / cos θ



Sol:

Pseudo force (ma) works on a block towards right, when the whole system is accelerated towards left. For the condition of equilibrium,

$mg\sin\theta = ma\cos\theta \Rightarrow a = \dfrac{g\sin\theta}{\cos\theta}$

$\therefore$ Force exerted by the wedge on the block,

$R = mg\cos\theta + ma\sin\theta$ i.e.

$$R = mg\cos\theta + m\left(\frac{g\sin\theta}{\cos\theta}\right)\sin\theta$$

$$\Rightarrow = \frac{mg(\cos^2\theta + \sin^2\theta)}{\cos\theta} \Rightarrow R = \frac{mg}{\cos\theta}$$

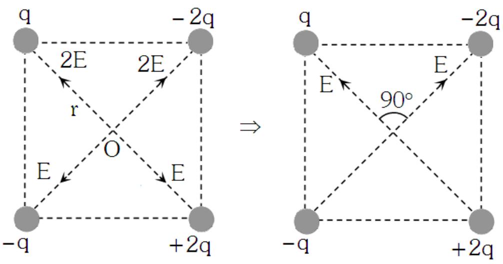
36) Ans: **D)** 1.02 x 10^7 N/C upwards

Sol: Given, side of square a = 5 x 10^{-2} m

Half of the diagonal of the square, $r = \dfrac{a}{\sqrt{2}}$

Electric field at center because of charge q is

$$E = \frac{kq}{\left(\frac{a}{\sqrt{2}}\right)^2}$$



Now field at $O = \sqrt{E^2 + E^2} = E\sqrt{2} \quad = \dfrac{kq}{\left(\dfrac{a}{\sqrt{2}}\right)^2}.\sqrt{2}$

$= \dfrac{9\times10^9\times10^{-6}\times\sqrt{2}\times2}{(5\times10^{-2})^2} = 1.02\times10^7\ N/C$ (upward)

37) Ans: **B)** $\vec{E} = a\hat{i}; \vec{B} = c\hat{k} + a\hat{i}$

Sol: The electric field may deviate the path of the particle in the shown direction only when it is along negative y-direction. In the given options $\vec{E}$ is either zero or along x-direction. Therefore it is the magnetic field which is really responsible for its curved path. Options (1) and (3) can't be accepted as the path will be helix in that case (when the velocity vector makes an angle other than 0°, 180° or 90° with the magnetic field, path is a helix) option (4) is wrong because in that case component of net force on the particle also comes in k direction which is not acceptable as the particle is moving in x-y plane. Only in option (2) the particle can move in x-y plane.

In option (4) : $\vec{F}_{net} = q\vec{E} + q(\vec{v}\times\vec{B})$

Initial velocity is along x-direction. Thus, let $\vec{v} = v\hat{i}$

$\therefore\ \vec{F}_{net} = qa\hat{i} + q[(v\hat{i})\times(c\hat{k} + b\hat{j}] = qa\hat{i} - qvc\hat{j} + qvb\hat{k}$

In option (2),

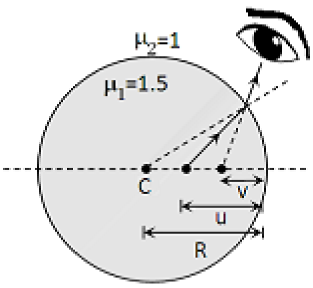
$\vec{F}_{net} = q(a\hat{i}) + q[(v\hat{i})\times(c\hat{k} + a\vec{i}) = qa\hat{i} - qvc\hat{j}$

38) Ans: **A)** 1.2 cm

Sol: Given, v = 1 cm, R = 2 cm

By using, $\dfrac{\mu_2}{v} - \dfrac{\mu_1}{u} = \dfrac{\mu_2 - \mu_1}{R}$

$\Rightarrow \dfrac{1}{-1} - \dfrac{1.5}{u} = \dfrac{1-1.5}{-2} \quad \Rightarrow u = -1.2\ cm$



39) Ans: **D)** transverse.

Sol: Transverse waves can be polarized only.

40) Ans: **A)** It repels a known magnet.

Sol: The repulsion is the sure test of magnetism.

41) Ans: **B)** A

Sol: We know, $R_{Parallel} < R_{Series}$. From graph it is clear that slope of the line A is lower than the slope of the line B. Also slope = resistance, therefore line A represents the graph for parallel combination.

42) Ans: **B)** a

Sol: As $P = \dfrac{\sqrt{abc^2}}{d^3} \quad \Rightarrow \dfrac{\Delta P}{P}\times100$

$= \left[\dfrac{1}{2}\dfrac{\Delta a}{a} + \dfrac{1}{2}\dfrac{\Delta b}{b} + \dfrac{\Delta c}{c} + 3\dfrac{\Delta d}{d}\right]\times 10($

$= \left[\dfrac{1}{2}\times2\% + \dfrac{1}{2}\times3\% + 2\% + 3\times1\%\right]$

$= \left[1\% + \dfrac{3}{2}\% + 2\% + 3\%\right]$

Hence, the minimum amount of error is contributed by the measurement of a.

43) Ans: **C)** 24 C

Sol: We know, dQ = $I\,dt$

$\Rightarrow Q = \int_{t=2}^{t=3} Idt \left[2\int_2^3 tdt + 3\int_2^3 t^2dt\right]$

$= \left[t^2\right]_2^3 + \left[t^3\right]_2^3$ = (9 - 4) + (27 - 8) ⇒ Q = 5+19 = 24C

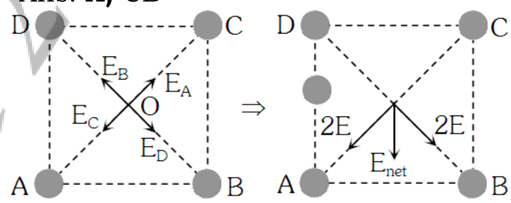
44) Ans: **B)** straight line.

Sol: Let $y_1 = a_1 \sin\omega t$ and $y_2 = a_2\sin(\omega t + \pi)$

$\Rightarrow \dfrac{y_1}{a_1} + \dfrac{y_2}{a_2} = 0 \Rightarrow y_2 = -\dfrac{a_2}{a_1}y_1$

This equation represents the straight line.

45) Ans: **A)** CB



Sol:

From the figures above,

$E_A = E, E_B = 2E, E_C = 3E, E_D = 4E$

46) Ans: **C)** 39.2 °F

Sol: As we know, max. density of water is at 4° C,

$\therefore \dfrac{C}{5} = \dfrac{F-32}{9} \Rightarrow \dfrac{4}{5} = \dfrac{F-32}{9} \Rightarrow F = 39.2^\circ F$

47) Ans: **A)** 1200 m

Sol: As an aeroplane flies 400 m north and 300 m south, the net displacement is 100 m towards north.

And then it flies 1200 m upward

$\therefore\ r = \sqrt{(100)^2 + (1200)^2} \Rightarrow = 1204\ m \simeq 1200\ m$

The option should be 1204 m, as this value mislead one into thinking that net displacement is in upward direction only.

48) Ans: **A)** 0.125

Sol: By using conservation of momentum,

$P_{daughter} = P_\alpha$

$\Rightarrow \dfrac{E_d}{E_\alpha} = \dfrac{m_\alpha}{m_d} \Rightarrow E_d = \dfrac{E_\alpha\times m_\alpha}{m_d}$

$\Rightarrow E_d = \dfrac{6.7\times4}{214} = 0.125\ MeV$

49) Ans: **B)** $RT\log_e\frac{V_2}{V_1}$

Sol: For isothermal process, we have

$PV = RT \Rightarrow P = \frac{RT}{V}$

$\therefore W = PdV = \int_{V_1}^{V_2}\frac{RT}{V}dV = RT\log_e\frac{V_2}{V_1}$

50) Ans: **B)** 7 cm

Sol: We know, electric force $qE = ma \Rightarrow a = \frac{QE}{m}$

$\therefore a = \frac{1.6\times10^{-19}\times1\times10^3}{9\times10^{-31}} = \frac{1.6}{9}\times10^{15}$

$u = 5\times10^6$ and $v = 0$

$\therefore$ From the equation, $v^2 = u^2 - 2as \Rightarrow s = \frac{u^2}{2a}$

$\therefore$ Distance, $s = \frac{(5\times10^6)^2\times9}{2\times1.6\times10^{15}} = 7\text{ cm.(approx.)}$

51) Ans: **B)** 10 A

Sol: Here, current

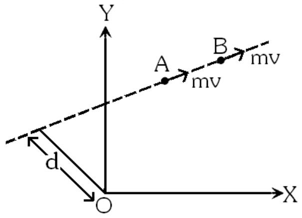
$i = \frac{ne}{t} \Rightarrow i = \frac{62.5\times10^{18}\times1.6\times10^{-19}}{1} = 10\text{ ampere}$

52) Ans: **A)** $L_A = L_B$

Sol: In this case,

Angular momentum = Linear momentum x Perpendicular distance of line of action of linear momentum about the origin i.e. $L_A = P_A$ x d And $L_B = P_B$ x d

As linear momentum are equal i.e., $P_A = P_B = mV$ therefore, $L_A = L_B$.



53) Ans: **A)** pressure.

Sol: We know that, Isothermal elasticity $K_i = P$.

54) Ans: **D)** Both (2) and (3).

Sol: Here, Density of metal$=\rho$, Density of liquid$=\sigma$

If V is the volume of sample, then according to problem, $210 = V\rho g$ ...(i)

$180 = V(\rho - 1)g$ ...(ii) $120 = V(\rho - \sigma)g$ ...(iii)

On solving (i), (ii) and (iii), we get $\rho = 7$ and $\sigma = 3$.

55) Ans: **A)** NIA

Sol: The magnetic dipole moment of coil is N I A.

56) Ans: **D)** Towards + X direction

Sol: The direction of $\vec{E}\times\vec{B}$ represents the direction of EM wave.

57) Ans: **D)** all the charges.

Sol: The electric field is because of all charges present whether inside or outside the given surface.

58) Ans: **C)** $e = -\frac{d}{dt}(A.B)$

Sol: $e = -\frac{d}{dt}(A.B)$

59) Ans: **C)** 36

Sol: As, the bomb of mass 12 kg divides into two masses m_1 and m_2, then $m_1 + m_2 = 12$ ...(i)

and $\frac{m_1}{m_2} = \frac{1}{3}$ ...(ii)

Solving equations (i) and (ii),

we get, $m_1 = 3kg$ and $m_2 = 9kg$.

$\therefore$ Kinetic energy of smaller part = $\frac{1}{2}m_1v_1^2 = 216J$

$\therefore$ $v_1^2 = \frac{216\times2}{3} \Rightarrow v_1 = 12$ m/s

Therefore its momentum = m_2v_1

= 3 x 12 = 36 kg-m/s

Because both parts possess same momentum,

$\therefore$ momentum of each part is 36 kg-m/s

60) Ans: **B)** fusion of light nuclei.

Sol: Energy of stars is because of the fusion of light hydrogen nuclei into He. In this process, much energy is released.