KARNATAKA ICSE SCHOOLS ASSOCIATION

ISC STD. XII Preparatory Examination 2024

Subject – Physics Paper I

Answer Key and Marking scheme

SECTION A – 14 MARKS

Question 1 **{ Each answer 1 mark}**

(A) i) d) Power consumed by B is more than A

ii) b) 3: 2

iii) b) Assertion and Reason are correct, but reason is not the correct explanation of assertion.

iv) c) act as a convex lens irrespective of the side on which the object lies.

v) a) Order of wavelength of light

vi) a) X- rays

vii) c) doped with pentavalent impurities

(B) i) solar cell

ii) 4m long wire

iii) zero

iv) cylindrical

v) diamagnetic substances

vi) The source which emits a light wave with the same frequency, wavelength and phase or having a constant phase difference is known as a coherent source.

vii) electron and positron come closer to each other, they combine to give gamma ray photons or any nuclear fusion or fission reaction in which mass defect converts to energy.

SECTION B – 14 MARKS

Question 2

i) a) No change in flux ----------[1]

b) No change in flux ----------[1]

OR

ii) $1/C_s = 1/6 + 1/3 \Rightarrow C_s = 2\mu F$

and $1/C_s = 1/4 + 1/4 \Rightarrow C_s = 2\mu F$ ----------[1]

$C_p = 2 + 2 = 4\mu F$ ----------[1]

Question 3

Work done is zero ----------[1]

as it is an equipotential surface ----------[1]

Question 4

i) higher the BE/ nucleon, greater the stability of the nuclei ----------[1]

ii) $\lambda \propto \frac{1}{m}$ i.e., $\lambda_p : \lambda_d = 2m/m = 2:1$ ----------[1]

Question 5

i) 0.2+0.6+0.7 = I + 0.5+0.4 ----------[1]

therefore, I = 0.6 A ----------[1]

{ substitution 1 mark & final answer with unit 1 mark}

OR

ii) $E = \frac{E_1 r_2 + E_2 r_1}{r_1 + r_2} = \frac{6 \times 1 - 8 \times 0.5}{1+0.5}$ ----------[1]

= 1.33 V ----------[1]

{ substitution 1 mark & final answer with unit 1 mark}

Question 6

$\theta = (n_v - n_{R)A}$ = (1.531-1.510) x 5 ----------[1]

= 0.011 ----------[1]

{ substitution 1 mark & final answer with unit 1 mark}

Question 7

i) current produced due to time varying electric field ----------[1]

ii) microwaves ----------[1]

Question 8

Formation of eddy currents ----------[1]

This opposes the motion of copper plates ----------[1]

SECTION C– 27 MARKS

Question 9

On equatorial line

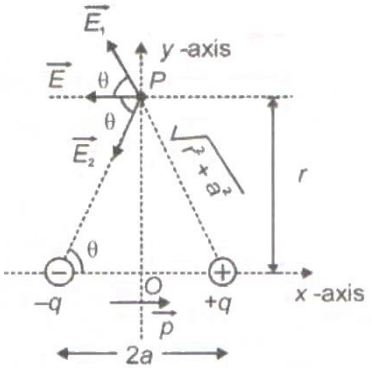
$\vec{p} = 2aq\hat{i}$

Electric field vector due to $+q$ is

$$\vec{E_1} = \frac{q}{4\pi\varepsilon_0 (r^2 + a^2)} [-\cos\theta\hat{i} + \sin\theta\hat{j}]$$

Electric field vector due to $-q$ is

$$\vec{E_2} = \frac{q}{4\pi\varepsilon_0 (r^2 + a^2)} [-\cos\theta\hat{i} - \sin\theta\hat{j}]$$



----------[1]

Resultant field at P is $\vec{E} = \vec{E_1} + \vec{E_2}$

$$\Rightarrow \vec{E} = \frac{-2q\cos\theta\hat{i}}{4\pi\varepsilon_0 (r^2 + a^2)}$$

$$\Rightarrow \vec{E} = \frac{-2q\hat{i}}{4\pi\varepsilon_0 (r^2 + a^2)} \cdot \frac{a}{\sqrt{r^2 + a^2}} \quad \left[\because \cos\theta = \frac{a}{\sqrt{r^2 + a^2}}\right]$$

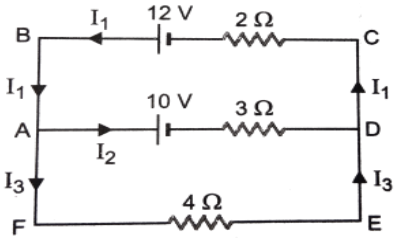
----------[1]

$$\Rightarrow \vec{E} = \frac{-2aq\hat{i}}{4\pi\varepsilon_0 (r^2 + a^2)^{3/2}}$$

$$\Rightarrow \vec{E} = \frac{-\vec{p}}{4\pi\varepsilon_0 (r^2 + a^2)^{3/2}} \quad [\because \vec{p} = 2aq\hat{i}]$$

----------[1]

Question 10



i) $I_1 = I_2 + I_3$

loop BADCB , $2 I_1 + 3 I_2 = 12-10$-----(i)

loop AFEDA, $4 I_3 - 3 I_2 = 10$ --------(ii)

Any one equation correct -------1 mark

On solving,

$I_1 = 22/13$ A, $I_2 = -6/13$ A and $I_3 = 28/13$A

Any two currents correct ----------1 mark

All three correct ---------- 2 mark

OR

ii) a) drift velocity decreases ----------1 mark

because drift velocity is inversely proportional to area of cross section ----------1 mark

b) drift velocity remains the same/ v ----------1 mark

Question 11

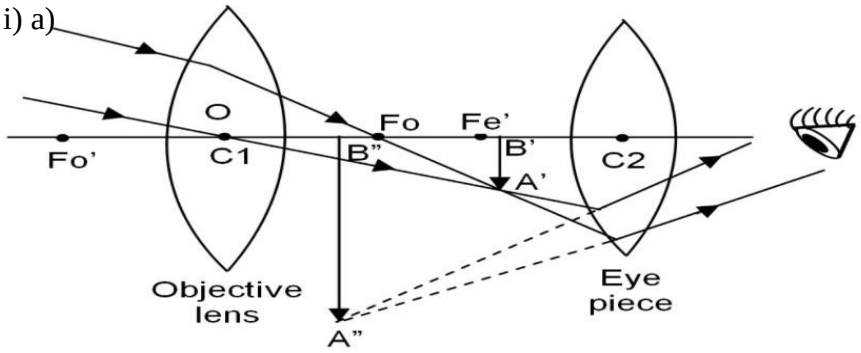
a) $S = I_g G/(I- I_g) = 30 \times 10^{-3} \times 80/(3- 30 \times 10^{-3})$ ----------1 mark

$= 0.81\ \Omega$ ----------1 mark

b) R (ammeter) = 80x0.81/(80+0.81)= 0.80 Ω ----------1 mark

Question 12

i) a)

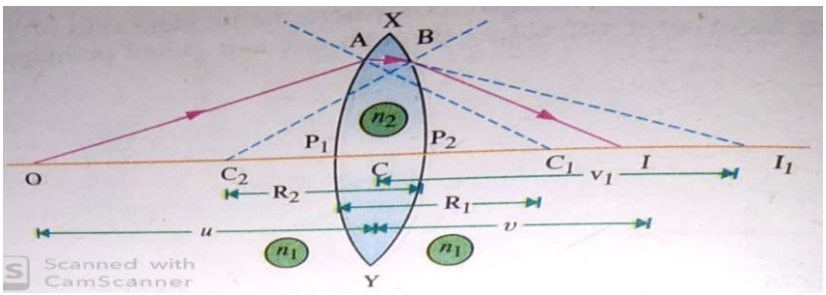


Correct diagram with any four labelling ----------2 mark

b) $M = -\frac{f_0}{f_e}\left(1 + \frac{D}{f_e}\right)$ ---------- 1 mark

OR

ii)



---------- 1 mark

Correct diagram

For first surface,

$$we\ get,\ \frac{n_2}{v'} - \frac{n_1}{u} = \frac{n_2 - n_1}{R_1} - - - - - Eqn\ (1)$$

For second surface,

$$we\ get, \frac{n_1}{v} - \frac{n_2}{v'} = \frac{n_1 - n_2}{R_2} - - - Eqn\ (2)$$

(Any one equation correct ---------- 1 mark)

Adding equations (1) and (2), we get

$$n_1\left(\frac{1}{v}-\frac{1}{u}\right) = (n_2 - n_1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$

When the object is at infinity, image is at focus. i.e., v=f and u= ∞

$$\frac{1}{f} = \left(\frac{n_2}{n_1} - 1\right)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$ ($n_2/n_1 = n$)

---------- 1 mark

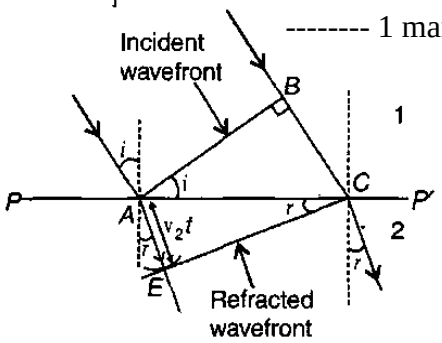
Question 13

Let v_1 be the speed of light in rarer medium and that in denser medium be v_2 .

Let BC = $v_1 t$ and AE = $v_2 t$.(distance travelled in two media at the same time.)

$BC = v_1 t$

To prove Snell's law:- -------- 1 mark



Consider two triangle's ABC and AEC :-

In triangle ABC sin i= (BC/AC) and ---------- 1 mark

sin r=(AE/AC)

$$\frac{\sin i}{\sin r} = \frac{v_1}{v_2}$$ ---------- 1 mark

Question 14

i) $W = h\nu_0 = \frac{hc}{\lambda_0} = \frac{6.6\times10^{-34}\times3\times10^{8}}{2900\times10^{-10}} = 6.83\times10^{-19}$ J ---------- 1 mark

ii) K max = $\frac{hc}{\lambda} - W = \frac{6.6\times10^{-34}\times3\times10^{8}}{200\times10^{-10}} - 6.83\times10^{-19} = 3.07 \times 10^{-19}$ J ---------- 1 mark

iii) eV_0 = K max

$V_0 = 3.07 \times 10^{-19} / 1.6 \times 10^{-19}$ J = 1.92V ---------- 1 mark

Question 15

$$\frac{1}{f} = (n-1)\left(\frac{1}{R_1}+\frac{1}{R_1}\right)$$

$R_1 = R_2 = R$ and n = 3/2

a) $\frac{1}{f} = \left(\frac{3}{2}-1\right)\left(\frac{2}{R}\right) \Rightarrow f = R$ ---------- 1 mark

b) $R_1 = \infty \Rightarrow f = 2R$ ---------- 1 mark

c) focal length increases ---------- 1 mark

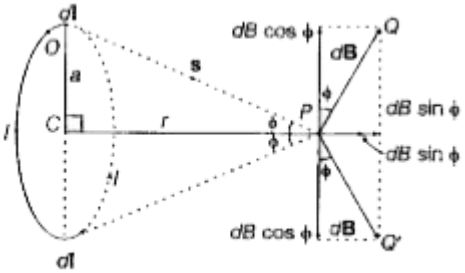
Question 16

B = $\int dB\, Sin\emptyset$ ---------- 1 mark

$= \frac{\mu_0}{4\pi}\frac{Idl}{r^2}\frac{a}{r}$

$$B = \frac{\mu_0 Ia}{4\pi(x^2+a^2)^{3/2}}2\pi a = \frac{\mu_0 Ia^2}{2(x^2+a^2)^{3/2}}$$

---------- 1 mark



Magnetic field on the axis of a circular current loop

B at the centre of the loop

At the centre, x= 0

$B = \frac{\mu_0 I}{2a}$ ---------- 1 mark

Question 17

a) fringe width doubles ---------- 1 mark

b) fringe width decreases ---------- 1 mark

c) interference pattern doesn't form ---------- 1 mark

SECTION D – 15 MARKS

Question 18

i) a) direction of induced emf or current is such that it opposes the cause that produces it. ---------- 1 mark

b) using laminated soft iron core ---------- 1 mark

c) n = 20 turns/cm = 2000 turns/m

A = 2cm ^{2} = 2 x 10 $^{-4}$ m^2

e = $\frac{\mu_0 nAdI}{dt}$ = $\frac{4\pi\times10^{-7}\times2000\times2\times10^{-4}\times2}{10^{-3}}$ = 5.024 x10^{-12}V

{ substitution with conversion 2 mark & final answer with unit 1 mark}

OR

ii)a) $X_c = 1/\omega C = \frac{1}{314\times30\times10^{-6}} = 106.16\ \Omega$, $X_L = \omega L = 314 \times 0.8 = 251.2\ \Omega$

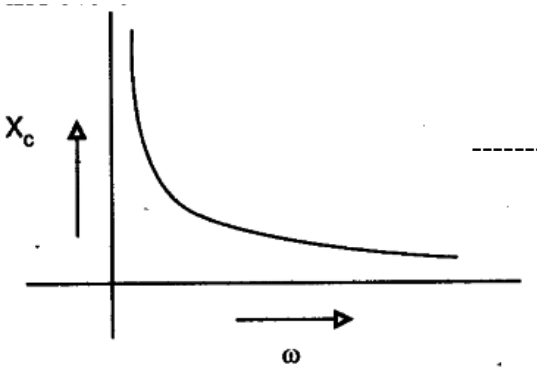
1. $Z = \sqrt{R^2 + (X_L - X_c)^2} = \sqrt{80^2 + (251.2 - 106.16)^2} = 165.64\Omega$

{ substitution 1 mark & final answer with unit 1 mark}

2. $f_0 = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{0.8\times30\times10^{-6}}} = 32.26$ Hz ---------- 1 mark

3. $I_{rms} = \frac{220}{\sqrt{2}\times80} = 1.94A$ ---------- 1 mark

b)



---------- 1 mark

Question 19

i) a) $r \propto \frac{1}{n^2}$ ---------- 1 mark

b) $_0n^1 + {}_{92}U^{235} \rightarrow {}_{92}U^{236} \rightarrow {}_{56}Ba^{141} + {}_{36}Kr^{92} + 3\,{}_0n^1$

or $_{92}U^{233} + {}_0n^1 \rightarrow {}_{54}Xe^{137} + {}_{38}Sr^{94} + 3\,{}_0n^1$

or any other correct reaction ---------1 mark

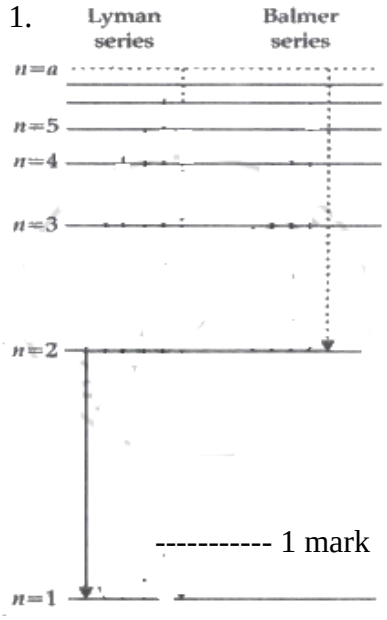
c) slows down the fast moving neutrons ---------- 1 mark

d) mass defect = (10 x 1.007825 + 10 x1.008665) -19.992397

= 0.172503 u ---------- 1 mark

BE / nucleon= 0.172503 x 931.5/20 = 8.03 MeV ---------- 1 mark

OR

ii) a) 1. 

2. ---------- 1 mark

3. -13.6 – (-13.6/4)

= 10.2eV ---------- 1 mark

---------- 1 mark

b) 1u x c^2 = 1.66 x 10^{-27} x 3x 10^8 / 1.6x 10^{-13} = 933.6 MeV ----------1 mark

c) IR region ---------- 1 mark

Question 20

i) forward bias characteristics ---------- 1 mark

ii) 0.5 V ---------- 1 mark

iii) a) 55Ω ---------- 1 mark

b) 80 Ω ---------- 1 mark

iv) reverse bias ---------- 1 mark

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