Answer Book – જવાબવહી

મુખ્ય જવાબવહી	પુરવણી	કુલ
1		

H.S.C. વિજ્ઞાન પ્રવાહ 24-M-24

વિષય અને કોડ નંબર	ભૌતિકવિજ્ઞાન	054
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જવાબની ભાષા	English.	

પરીક્ષાર્થી માટે અગત્યની સૂચના

પરીક્ષાર્થીએ જવાબ લખવાનું શરૂ કરતાં પહેલાં પાન નં. 2 પરની સૂચનાઓ અવશ્ય વાંચવી.

મધ્યસ્થ મૂલ્યાંકન કેન્દ્રના ઉપયોગ માટે

302

વિભાગ	પરીક્ષકે આપેલ ગુણ	પરીક્ષકની સહી	પરીક્ષકની નિમણૂક નંબર	સમીક્ષકે આપેલ ગુણ	કો-ઓર્ડિનેટરે આપેલ ગુણ	બોર્ડની કચેરીના ઉપયોગ માટે
A						
B						
C						
કુલ ગુણ અપૂર્ણાંકમાં						
કુલ ગુણ પૂર્ણાંકમાં						
કુલ ગુણ શબ્દોમાં						

વેરીફાયરની સહી	સમીક્ષકની સહી	કો-ઓર્ડિનેટરની સહી
વેરીફાયરનો નિમણૂક નંબર	સમીક્ષકનો નિમણૂક નંબર	કો-ઓર્ડિનેટરનો નિમણૂક નંબર

ગુણાંકન

પ્રશ્ન ક્રમાંક

વિભાગ-A		વિભાગ-B		વિભાગ-C	
પ્રશ્ન ક્રમાંક	ગુણ	પ્રશ્ન ક્રમાંક	ગુણ	પ્રશ્ન ક્રમાંક	ગુણ
1		13		22	
2		14		23	
3		15		24	
4		16		25	
5		17		26	
6		18		27	
7		19		મેળવેલ કુલ ગુણ	16
8		20		પરીક્ષકની સહી	
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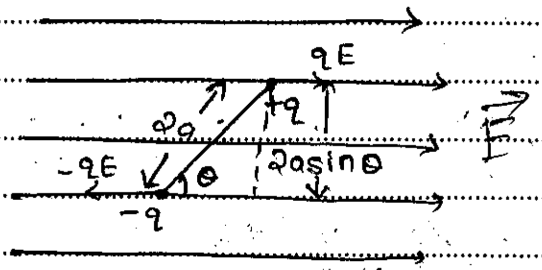
10		મેળવેલ કુલ ગુણ			
11		પરીક્ષકની સહી		વેરીફાયરની સહી	
12					
મેળવેલ કુલ ગુણ	16	વિભાગ : A + B + C =			50
પરીક્ષકની સહી		પેજ નં. 3 ઉપરના પ્રશ્નના ક્રમવાર મેળવેલ ગુણ મૂકીને મહત્તમ ગુણ ગણતરીમાં લઈ વિભાગવાર દર્શાવવાના રહેશે અને ઉત્તરવહીના મુખ્ય પેજ ઉપર વિભાગવાર ગુણ લખવાના રહેશે.			

SECTION – A

Q-1 When a dipole is placed in a uniform electric field, it experiences no net external force.



Here a dipole having charges +q and -q is placed in a uniform electric field. The dipole length is '2a' and it is at angle 'θ' with the uniform electric field.

∴ Perpendicular distance between two charges = $2a\sin\theta$

→ In uniform electric field, the dipole experiences torque ~~w.r.t~~ which is,

$$\vec{\tau} = \vec{r} \times \vec{F}$$

$$\therefore \tau = r_{\perp} \times F$$

$$= 2a\sin\theta \times qE$$

$$= 2aq\, E\sin\theta$$

$$= PE\sin\theta \quad \rightarrow (P = 2aq = \text{dipole moment})$$

$$\therefore \boxed{\vec{\tau} = \vec{P} \times \vec{E}}$$

Hence, this is the torque on the dipole in uniform external electric field.

Q-2) for infinite line charge,

$\rightarrow E = 9\times10^4$ N/C,
$d = 2cm = 2\times10^{-2}$ m
$\lambda = ?$

$\therefore E = \frac{\lambda}{2\pi\varepsilon_0 d}$

$\therefore E = \frac{2K\lambda}{d}$ $\rightarrow \left(K = \frac{1}{4\pi\varepsilon_0}\right)$

$\therefore 9\times10^4 = \frac{\cancel{2}\times9\times10^9\times\lambda}{\cancel{2}\times10^{-2}}$

$\therefore \lambda = \frac{10^4\times10^{-2}}{10^9}$

$= 10^2\times10^{-9} = \boxed{10^{-7}\ Cm^{-1}}$

Hence the linear charge density is $\boxed{10^{-7}\ Cm^{-1}}$

Q-5

The magnetic energy stored in a solenoid $= \frac{1}{2}LI^2$

$\hookrightarrow P = VI$

$\therefore \frac{dw}{dt} = \frac{LdI}{dt}\times I$

$\therefore \int dw = \int_0^I LI\,dI$

$\therefore w = \frac{1}{2}LI^2$

$= \frac{1}{2}L\frac{B^2}{\mu_0^2 n^2}$ $\leftarrow$ (B = $\mu_0 nI$ = Magnetic field of solenoid)

$= \frac{1}{2}\cancel{\mu_0}\cancel{n^2}lA\times\frac{B^2}{\mu_0^{\cancel{2}}\cancel{n^2}}$ $\leftarrow$ $(L = \mu_0 NnA = \mu_0 n^2 lA)$

$$= \boxed{\frac{B^2}{2\mu_0} A l}$$

Hence, this is the magnetic energy stored in a solenoid.

→ Magnetic energy per unit volume $= \frac{B^2}{2\mu_0} \frac{Al}{V}$

$$= \frac{B^2}{2\mu_0} \frac{\cancel{Al}}{\cancel{Al}} \quad (V = Al)$$

$$= \boxed{\frac{B^2}{2\mu_0}}$$

Hence, this is the magnetic energy per unit volume.

6) $\boxed{Q-6}$ Given,

→ $R = 100\,\Omega$

→ $V_{rms} = 220V$

→ $f = 50Hz$

a) $V_{rms} = R \times I_{rms}$

$\therefore I_{rms} = \frac{220}{100} = \boxed{2.2 A}$

Hence, the Rms value of current is 2.2 A.

b) $P = VI\cos\phi$

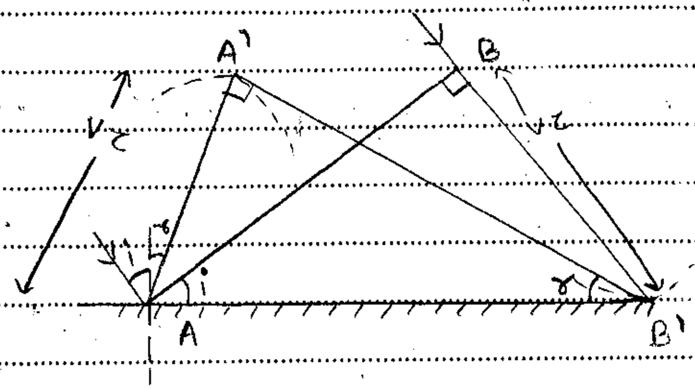
$P = V_{rms} \times I_{rms}$ → $(\cos\phi = 1)$

$= 220 \times 2.2$

$= \boxed{484 W}$

Hence, the net ~~rms~~ value of power consumed over full cycle is $\boxed{484 W}$.

$\boxed{Q-8}$ Reflection of plane wave by ~~the~~ a plane reflecting surface,



→ Here there is a plane wavefront AB incident at angle 'i' on plane reflecting surface. The angle of reflection is r. for reflected wavefront, we draw an arcs of radius $v\tau$ where v is speed of light in medium. The tangent to arcs gives new wavefront A'B' after ~~to~~ reflecting.

∴ In $\Delta ABB'$ and $\Delta B'A'A$,

→ $AB' = AB'$
→ $\angle ABB' = \angle B'A'A = 90°$
→ $AA' = BB' = v\tau$

∴ $\Delta ABB' \cong \Delta B'A'A$ → (By RHS Theorem)

∴ $\angle B'AB = \cancel{\angle AB'A'}$ $\angle AB'B$

∴ $\angle i = \angle r$

This is the law of reflection.

(Hence proved)

Q-9 $f = 7.21 \times 10^{14}$ Hz

$V_{max} = 6 \times 10^5$ m/s

$f_0 = ?$

∴ By Einstein's equation for photoelectric effect,

$hf = hf_0 + K_{max}$

$\therefore h(f - f_0) = \frac{1}{2} m v_{max}^2$ $\left(K = \frac{1}{2} m v^2\right)$

$\therefore 6.625 \times 10^{-34} (f - f_0) = \frac{1}{2} \times 9.1 \times 10^{-31} \times 6 \times 6 \times 10^{10}$

$f - f_0 = 24.724 \times 10^{13}$

$f - f_0 = 2.47 \times 10^{14}$

$\therefore f_0 = f - 2.47 \times 10^{14}$

$= (7.21 - 2.47) \, 10^{14}$

$= \boxed{4.74 \times 10^{14} \text{ Hz}}$

Hence, the thresold frequency is $\boxed{4.74 \times 10^{14} \text{ Hz}}$

Q-10 $n_1 = 1$

$n_2 = 4$

4 for wavelength,

$\frac{1}{\lambda} = R \left(\frac{1}{n_1^2} - \frac{1}{n_2^2} \right) z^2$ → (R = Rydberg constant)

$\therefore \frac{1}{\lambda} = 1.09677 \times 10^7 \left(\frac{1}{1} - \frac{1}{16} \right)$

$\frac{1}{\lambda} = 1.09677 \times 10^7 \left(\frac{15}{16} \right)$

$\therefore \lambda = 0.9725 \times 10^{-7}$

$= \boxed{972.5 \text{ A}^\circ}$

→ for frequency,

$\lambda . f = c$

$\therefore f = \frac{3 \times 10^8}{972.5 \times 10^{-10}}$

$= 0.003084 \times 10^{18}$

$= \boxed{3.08 \times 10^{15} Hz}$

$\boxed{Q-12}$ Given,

$n_i = 1.5 \times 10^{16} \cancel{^{28}}$ atom m^{-3}

→ 10^6 atoms has 1 pentavalent impurity

$\therefore$ for 5×10^{28} atoms,

$n_e = \boxed{5 \times 10^{22} m^{-3}}$ → (ne = no of electrons)

→ for nh,

$n_e \times n_h = n_i^2$

$\therefore n_h = \cancel{\frac{(5 \times 10^{28})^2}{}} \frac{(1.5 \times 10^{16})^2}{5 \times 10^{22}}$

$n_h = \frac{2.25 \times 10^{32}}{5 \times 10^{22}}$

$n_h = 0.45 \times 10^{10}$

$\boxed{n_h = 4.5 \times 10^9 m^{-3}}$

Hence, the no of electrons is $\boxed{5 \times 10^{22} m^{-3}}$ and holes is $\boxed{4.5 \times 10^9 m^{-3}}$.

$\boxed{Q-3}$ Mobility – Drift velocity per unit electric field is called mobility.

It is denoted by μ.

$\therefore \mu = \frac{v_d}{E} = \frac{eE\tau}{mE} = \frac{e\tau}{m}$

$\therefore \boxed{\mu = \frac{e\tau}{m}}$

Unit $= \frac{Cm}{Ns} = \frac{\cancel{Cm}}{\cancel{kg}}$ $kg^{-1} s^2 A$

Dimensional formula $= \frac{A^1 \cancel{T^1} \times \cancel{L^1}}{M^1 \cancel{L^1} T^{-2} \times \cancel{T^1}}$

$= \boxed{M^{-1} L^0 T^2 A^1}$

Hence, this is known as mobility.

SECTION-B

Q-13 for spherical conductor,

$R = 12\ cm$

$Q = 1.6 \times 10^{-7} C$

a) $E = \frac{KQ}{r^2}$

In static situation, there is no charge inside the sphere.

$\therefore \boxed{E = 0\ N/C}$

b) $R = 12\ cm = 0.12\ m$

$Q = 1.6 \times 10^{-7} C$

$\therefore E = \frac{KQ}{r^2}$

$= \frac{9 \times 10^9 \times 1.6 \times 10^{-7}}{(0.12)^2}$

$= \frac{9 \times 1.6 \times 10^2}{144 \times 10^{-4}}$

$= 0.1 \times 10^6$

$= \boxed{10^5\ N/C}$

c) $r = 18\ cm = 0.18\ m$

$\therefore E = \frac{KQ}{r^2}$

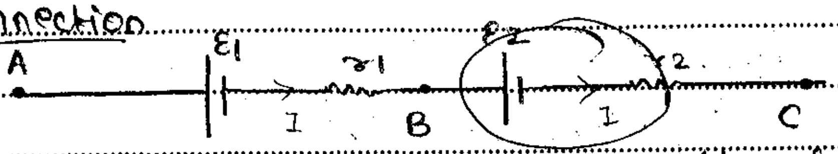
$= \frac{9 \times 10^9 \times 1.6 \times 10^{-7}}{(0.18)^2}$

$= 444.44 \times 10^2$

$= \boxed{4.44 \times 10^4\ N/C}$

Q-14 **Equivalent emf and internal Resistance of a series combination of two cells:**

↳ Proper connection



Direction of Current

Here there are two cells ~~et~~ ~~an~~ having emfs ε_1 and ε_2 and internal resistances r_1 and r_2 respectively. Let current I is flowing through them.

↳ Applying Kirchoff's loop rule betn points A & B,

$$V_A - V_B = \varepsilon_1 - I r_1 \quad — (1)$$

↳ Applying kirchoff's loop rule between points B & C,

$$V_B - V_C = \varepsilon_2 - I r_2 \quad — (2)$$

Add equation (1) + (2),

$$V_A - V_C = \varepsilon_1 + \varepsilon_2 - I r_1 - I r_2$$

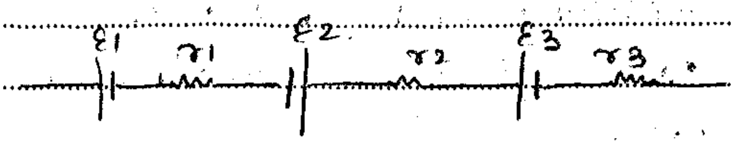
$$V_A - V_C = (\varepsilon_1 + \varepsilon_2) - I(r_1 + r_2)$$

∴ from above equation,

$$\boxed{\varepsilon_{eq} = \varepsilon_1 + \varepsilon_2}$$

$$\boxed{r_{eq} = r_1 + r_2}$$

↳ for improper connection,



→ Here,

$\varepsilon_{eq} = \varepsilon_1 - \varepsilon_2 + \varepsilon_3$

$r_{eq} = r_1 + r_2 + r_3$

Hence, in series connections of cells, emfs may be added or subtracted but internal resistance is always added.

Hence, this is the series combination of two cells.

$\boxed{\text{Q-16}}$ $l = 10\,m$

$v = 5\,m/s$

$B = 3 \times 10^{-5}\ Wb/m^2$

a) Instantaneous value of emf $= BVL$

$= 3 \times 10^{-5} \times 5 \times 10$

$= 15 \times 10^{-4}$

$= \boxed{1.5 \times 10^{-3}\,V}$.

b) As per right hand thumb Rule or fleming's left hand Rule,

direction of emf is $\boxed{\text{west to east}}$.

c) East end is at higher potential.

$\boxed{\text{Q-18}}$ $R_1 = 10\,cm$

$R_2 = 15\,cm$

$f = 12\,cm$

from len's makers formula;

$$\frac{1}{f} = (n_{21}-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\Rightarrow \frac{1}{12} = (n_{21}-1)\left(\frac{1}{10} + \frac{1}{15}\right)$$

$$\frac{1}{12} = (n_{21}-1)\left(\frac{3+2}{30}\right)$$

$$\frac{1}{12} = (n_{21}-1)\left(\frac{\cancel{5}}{\cancel{30}\,6}\right)$$

$$\therefore 0.5 = n_{21}-1$$

$$\boxed{n_{21} = 1.5}$$

Hence, the refractive index of material of lens is $\boxed{1.5}$

b). In air,

$$\frac{1}{20} = (n_{21}-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{20} = (0.5)\left(\frac{2}{R}\right) \quad -(1) \quad - (R_1 = R_2 = R)$$

In water,

$$\frac{1}{f_w} = (n_{21}-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

$$\frac{1}{f_w} = \left(\frac{1.5}{1.33} - 1\right)\left(\frac{2}{R}\right) = \frac{0.17}{1.33}\left(\frac{2}{R}\right) \quad -(2)$$

→ Divide equation (1) by (2),

$$\frac{f_w}{20} = \frac{0.5 \times 1.33}{0.17}$$

$$\therefore \boxed{f_w = 78.23 \text{ cm}}$$

Hence, the focal length of convex lens in water is $\boxed{78.23\text{ cm}}$.

Q-19

Let P_1 and P_3 be the crossed polaroids and P_2 is rotated between them.
Let angle between (pass axes of) P_1 & P_2 be θ.

$\therefore$ Angle between pass axis of P_2 and P_3 $= 90 - \theta$.

$\therefore$ Let I_0 be the intensity of light transmitted from P_1.

$\therefore$ By Malus law, the intensity of light tramitted from P_2 $= I_0 \cos^2\theta$ — (1)

$\therefore$ Intensity (I) of light emerging from P_3 $= I_0 \cos^2\theta \cos^2(90-\theta)$
$= I_0 \cos^2\theta \sin^2\theta$.

Multiplying and dividing by 4,

$$\therefore I = \frac{4 I_0 \cos^2\theta \sin^2\theta}{4}$$

$$= \boxed{\frac{I_0}{4}\sin^2(2\theta)} \rightarrow (\sin 2\theta = 2\sin\theta\cos\theta)$$

Hence, this is the intensity of light when a polaroid sheet is rotated between two crossed polaroids.

Q-21 ↳ for Radius of n^{th} orbit,

from Bohr's postulate,

$$mvr = \frac{nh}{2\pi}$$ → (angular momentum is quantised)

$$\therefore V = \frac{nh}{2\pi mr} \quad -(1)$$

↳ for electron revolving in circular orbit, centripetal force is equal to centrifugal force,

$$\therefore \frac{1}{4\pi\varepsilon_0}\frac{ze^2}{r^2} = \frac{mv^2}{r}$$

$$\therefore \frac{ze^2}{\cancel{4}\cancel{\pi}\varepsilon_0 \cancel{r}} = \cancel{m} \times \frac{n^2h^2}{\cancel{4}\pi^2 m^2 r^{\cancel{2}}} \quad -(\text{from equation } (1))$$

$$\therefore r = \frac{n^2h^2\varepsilon_0}{\pi ze^2 m}$$

for H, z = 1,

$$\therefore \boxed{r_n = \frac{n^2h^2\varepsilon_0}{\pi e^2 m}}$$

Hence, this is Radius of n^{th} orbit.

↳ for total energy,

from $\frac{1}{4\pi\varepsilon_0}\frac{ze^2}{r^2} = \frac{mv^2}{r}$

∴ Dividing and multiplying RHS by 2,

$$\therefore \frac{kze^2}{r} = \frac{1}{2}mv^2 \times 2$$

$$\therefore \frac{1}{2}mv^2 = KE = \frac{2kze^2}{r} \quad -(1)$$

Potential energy of electron $= -\frac{kze^2}{r}$
(PE)

$\therefore$ Total energy $= PE + KE$

$$= -\frac{kze^2}{r} + \frac{kze^2}{2r}$$

$$= -\frac{kze^2}{2r}$$

$$= -\frac{1}{4\pi\varepsilon_0} \frac{ze^2}{2} \frac{\pi z e^2 m}{n^2 h^2 \varepsilon_0} \rightarrow \text{(from eqn of radius)}$$

$$= -\frac{z^2 e^4 m}{8\varepsilon_0^2 n^2 h^2}$$

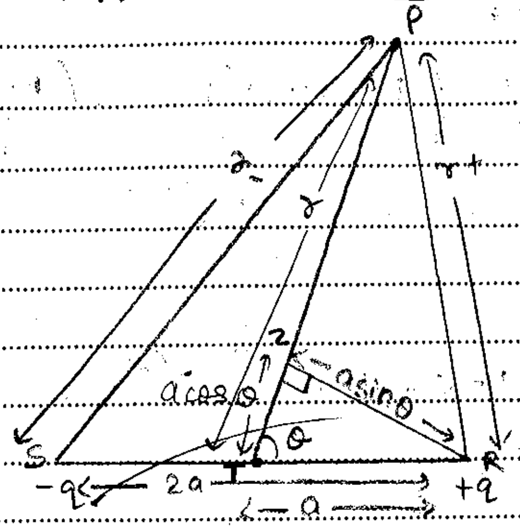
for H, $z=1$

$\therefore$ $\boxed{TE = -\frac{e^4 m}{8\varepsilon_0^2 n^2 h^2}}$

Hence, this is the stable orbit for hydrogen atom.

SECTION – C

Q-22



As shown in the figure, there is a dipole with +q and -q charges separated by 2a distance. P is the point at distance d and angle θ with respect to centre of dipole.

→ Draw a perpendicular from +q charge on line TP as shown.

∴ By trigonometry,

$$RZ = a\sin\theta$$

$$RT = a\cos\theta$$

$$\therefore \quad PZ = r - a\cos\theta$$

∴ In ΔPZR;

$$r_+^2 = (r - a\cos\theta)^2 + (a\sin\theta)^2 \rightarrow \text{(By pythagorus theorem)}$$

$$\therefore \quad r_+^2 = r^2 + a^2\cos^2\theta + a^2\sin^2\theta - 2ar\cos\theta$$

$$r_+^2 = r^2 + a^2(\cos^2\theta + \sin^2\theta) - 2ar\cos\theta$$

$$r_+^2 = r^2 + a^2 - 2ar\cos\theta$$

$$\therefore r_+^2 = r^2\left(1 + \frac{a^2}{r^2} - \frac{2a\cos\theta}{r}\right]$$

as $a << r$,

$$\therefore \frac{a^2}{r^2} \approx 0$$

$$\therefore \quad r_+^2 = r^2\left(1 - \frac{2a\cos\theta}{r}\right)$$

$$\therefore \frac{1}{r_+} = \frac{1}{r}\left(1 - \frac{2a\cos\theta}{r}\right)^{-1/2}$$

$$\therefore \frac{1}{r_+} = \frac{1}{r}\left(1 + \frac{a\cos\theta}{r}\right) \quad - \text{(By binomial expansion)} \quad -(1)$$

Similarly,

$$\frac{1}{r_-} = \frac{1}{r}\left(1 - \frac{a\cos\theta}{r}\right) \quad -(2)$$

$\therefore$ for potential due to dipole,
By superposition principal,

$$V_{total} = V_{+q} + V_{-q}$$

$$= \frac{Kq}{r_+} - \frac{Kq}{r_-}$$

$$\therefore V = \frac{Kq}{r}\left[1 + \frac{a\cos\theta}{r} - \left(1 - \frac{a\cos\theta}{r}\right)\right] - \text{(from eq}^n\text{ (1) \& (2))}$$

$$\therefore V = \frac{Kq}{r}\left(\frac{2a\cos\theta}{r}\right)$$

$$= \frac{K(2aq)\cos\theta}{r^2}$$

$$\boxed{V = \frac{KP\cos\theta}{r^2}} \rightarrow (P = 2aq = \text{dipole moment of dipole})$$

In vector form,

$$\boxed{V = \frac{K\vec{P}\cdot\hat{r}}{r^2}} \quad - \text{here } \hat{r} \text{ is a unit vector}$$

$$\therefore \boxed{V = \frac{K\vec{P}\cdot\vec{r}}{r^3}}$$

a) On Equator :

$$V = \frac{Kp\cos\theta}{r^2}$$

$\theta = 90^\circ$

$\therefore \cos\theta = 0$

$\therefore V = \frac{Kp\cos 90^\circ}{r^2}$

$V_{total} = \boxed{0}\ V$

b) On axis,

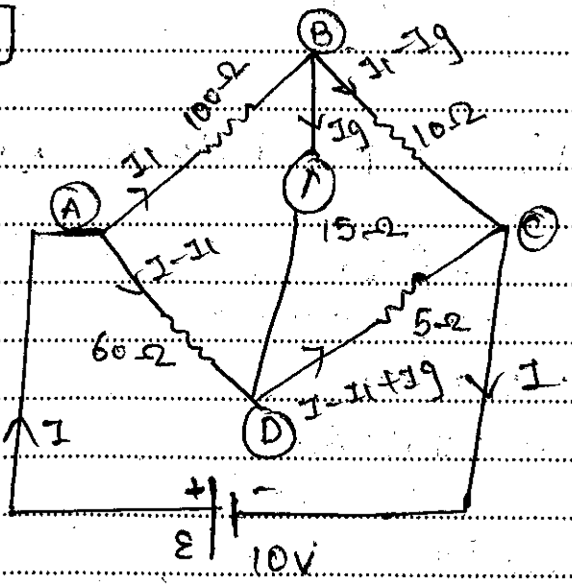
$\theta = 0^\circ$

$\therefore \cos\theta = 1$

$\therefore V = \frac{Kp\cos 0^\circ}{r^2} = \boxed{\frac{Kp}{r^2}}$

Hence, on equator the potential due to dipole is zero ~~to~~ and on axis it is $\boxed{\frac{Kp}{r^2}}$.

Q-23



↳ Applying Kirchoff's loop Rule in ABDA,

$-100 I_1 - 15 I_g + 60(I - I_1) = 0$

$\therefore -100 I_1 - 15 I_g + 60 I - 60 I_1 = 0$

$\therefore -160 I_1 - 15 I_g + 60 I = 0$

$\therefore -32 I_1 - 3 I_g + 12 I = 0 \quad -(1)$

↳ Applying Kirchoff's loop Rule in CBDC,

$$10(I_1 - I_g) - 15I_g - 5(I - I_1 + I_g) = 0$$
$$\therefore\ 10I_1 - 10I_g - 15I_g - 5I + 5I_1 - 5I_g = 0$$
$$\therefore\ 15I_1 - 30I_g - 5I = 0$$
$$\therefore\ 3I_1 - 6I_g - I = 0 \quad -(2)$$

↳ Multiply equation (2) by 12 and add to eqn (1),

$$36I_1 - 72I_g - \cancel{12I} = 0$$
$$-32I_1 - 3I_g + \cancel{12I} = 0$$
$$4I_1 - 75I_g = 0$$

$$\therefore\ 4I_1 = 75I_g$$
$$\therefore\ \boxed{I_1 = \frac{75}{4} I_g} \quad -(3)$$

↳ Applying Kirchoff's loop - Rule in ABCEA,

$$-100I_1 - 10(I_1 - I_g) + 10 = 0$$
$$-100I_1 - 10I_1 + 10I_g + 10 = 0$$
$$-110I_1 + 10I_g + 10 = 0$$
$$-22I_1 + 2I_g + 2 = 0$$

$$\therefore\ 22I_1 - 2I_g = 2$$
$$\therefore\ \left[22\left(\frac{75}{4}\right) - 2\right] I_g = 2 \rightarrow \left(\text{from equation } 3\right)$$
$$\Rightarrow\ 410.5\, I_g = 2$$
$$\therefore\ \boxed{I_g = 4.872\ mA}$$

Hence, the current through the galvanometer is $\boxed{4.87\,mA}$.

Q-24

↳ For series LCR circuit,

$V_{peak} = 283\,V$

$f = 50\,Hz$

$R = 3\,\Omega$

$L = 25.48\,mH$

$C = 796\,\mu F$

a) $X_L = \omega L$

$= 2\pi f L$

$= 2 \times 3.14 \times 50 \times 25.48 \times 10^{-3}$

$= 8\,\Omega$

→ $X_C = \frac{1}{\omega C} = \frac{10^6}{2 \times 3.14 \times 50 \times 796}$

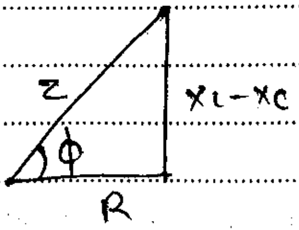
$= 4\,\Omega$

∴ Impedance $Z = \sqrt{R^2 + (X_L - X_C)^2}$

$= \sqrt{(3)^2 + (4)^2} = \sqrt{25}$

$= \boxed{5\,\Omega}$ ↳ Hence, the impedance is $5\,\Omega$.

b).



Phase difference between voltage and current $= \tan\phi = \frac{4}{3}$

∴ $\boxed{\phi = 53^\circ}$

Hence, the phase difference between current and voltage is 53°.

c). $I_{rms} = \frac{V_{rms}}{Z} = \frac{283}{\sqrt{2} \times 5} = \boxed{40\,A}$

∴ Power $= (I_{rms})^2 \times R$

$= \boxed{4800\,W}$

Hence, the power dissipited in the circuit is $\boxed{4800\,W}$

d) for power ~~face~~ factor,

$P = V_{rms} I_{rms} \cos\phi$

$\therefore 4800 = \frac{283}{\sqrt{2}} \times 40 \times \cos\phi$

$\therefore \boxed{\cos\phi = 0.6}$

Hence, the power factor is 0.6.

$\boxed{Q-26}$ $P = 100 W$

mass of Deuterium $= 2 kg$

$\therefore$ mole of deuterium $= \frac{2 \times 1000}{2}$

$\therefore$ No of deuterium atom $= \frac{\cancel{2} \times 1000}{\cancel{2}} \times 6.023 \times 10^{23}$

$= 6.023 \times 10^{26}$ atoms.

↳ from equation,

$${}^{2}_{1}H + {}^{2}_{1}H \longrightarrow {}^{3}_{2}He + n + 3.27\ MeV.$$

↳ Energy released from two atoms of deuterium $= 3.27\ MeV$

$= 3.27 \times 10^{6} \times 1.6 \times 10^{-19}$

$= 5.232 \times 10^{-13} J$

$\therefore$ Energy released from 6.023×10^{23} atoms $=$

$\frac{5.232 \times 10^{-13} \times 6.023 \times 10^{26}}{2}$

$= 15.756 \times 10^{13} J$

$= 15.756 \times 10^{13} J$

Supplementary/પુરવણી

04(S) - M - 24

વિષય	Physics.
તારીખ	11/03/2024.

★ અહીંથી જ લખવાનું શરૂ કરવું. ★

વિભાગ..................

પ્રશ્ન ક્રમાંક

1

$\therefore$ Power $= \dfrac{\text{Energy}}{\text{time}}$

$\therefore$ time $= \dfrac{\text{Energy}}{\text{Power}}$

$= \dfrac{15.756 \times 10^{10} \times 10^{3}}{100}$

$= \cancel{\boxed{49.96 \text{ years}}}$ 15.756×10^{11}

$= \boxed{4.9 \times 10^{4} \text{ years}}$

Hence, the electric lamp can be kept glowing for 4.9×10^{4} years.