SOLUTION

Section A

1. **(a)** Option C
Explanation: In p-type semiconductors, holes are the majority charge carriers.

2. **(a)** $V_A = V_C$
Explanation: The conducting sphere becomes an equipotential surface.

3. **(a)** concave mirror of focal length 10 cm
Explanation: $\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_m} + \frac{1}{f_1}$
$= \frac{2}{f_1} + \frac{1}{f_m} = \frac{2}{-20} + \frac{1}{\infty} = -\frac{1}{10}$
F = -10cm
This combination will behave like a convex mirror of a focal length of 10 cm.
4. **(b)** D, B, A, C
Explanation: D, B, A, C
5. **(a)** phosphorous
Explanation: As phosphorous is pentavalent, it produces n-type semiconductor when added to silicon.
6. **(b)** 2×10^{-7} m
Explanation: $\frac{hc}{\lambda_{max}} = 6$ eV
$\therefore \lambda_{max.} = \frac{hc}{6eV} = \frac{6.6 \times 10^{-34} \times 3 \times 10^8}{6 \times 1.6 \times 10^{-19}} = 2.06 \times 10^{-7}$ m
7. **(c)** 0.3541 Å
Explanation: Wavelength of K_α line is given by K_α
$\frac{1}{\lambda} = R(Z-1)^2 \left[\frac{1}{1^2} - \frac{1}{2^2}\right]$
$\therefore \frac{K_\alpha(Zn)}{K_\alpha(Mo)} = \frac{(30-1)^2}{(42-1)^2}$
$\Rightarrow K_\alpha(\text{Zn}) = \frac{29 \times 29}{41 \times 41} \times 0.7078\text{Å} = 0.3541$ Å
8. **(a)** $e_1 < e_2$
Explanation: When the switch is pressed, the current grows in the circuit. On account of the self-inductance of the inductor, the growth is slow. When the switch is opened, the current suddenly decreases to zero on account of the infinite resistance of the circuit. Thus, the rate of decay is higher as compared to the rate of growth of the current.
Therefore, $e_1 < e_2$

9. **(a)** -10^{-9} cm^{-2}

   Explanation: -10^{-9} cm^{-2}

10. **(d)** 4000 $\mathring{A}$

    Explanation: As we know that,

    $n_1\lambda_1 = n_2\lambda_2$

    $\lambda_2 = \frac{n_1}{n_2}\lambda_1$

    $= \frac{16 \times 6000}{24}$

    $= 4000\ \mathring{A}$

11. **(b)** has few holes but no free electrons

    Explanation: We know that at 0 K temperature, a pure semiconductor behaves as an insulator because it has a few holes in its valence band. But there is no free electron in this state.

12. **(a)** 10^4 V

    Explanation: The de-Broglie wavelength of an electron is given as:

    $\lambda = \frac{1.227}{\sqrt{V}}$nm

    Substitute the wavelength in the above expression:

    $V = \left(\frac{1.227}{1.227 \times 10^{-2}}\right)^2$

    $V = 10^4$ V

13. **(d)** $\vec{p} \times \vec{E}$

    Explanation: Torque on a dipole,

    $\vec{\tau} = \vec{p} \times \vec{E}$

14. **(d)** $\frac{\mu_0 \pi a^4}{2l^3}$

    Explanation: Magnetic field at the location of coil (2) produced due to coil (1),

    $B_1 = \frac{\mu_0}{4\pi} \cdot \frac{2m}{l^3}$

    where, m = magnetic dipole moment flux linked with coil (2),

    $\phi_2 = B_1A_2$

    $= \frac{\mu_0}{4\pi} \frac{2I(\pi a^2)}{l^3} \times (\pi a^2)$ ...($\because$ m = NIA)

    Also, ϕ_2 = MI

    $\Rightarrow M = \frac{\mu_0 \pi a^4}{2l^3}$

15. **(c)** A is true but R is false.

    Explanation: A is true but R is false.

16. **(a)** Assertion and reason both are correct statements and reason is correct explanation for assertion.

    Explanation: Assertion and reason both are correct statements and reason is correct explanation for assertion.

17. **(c)** both AC and DC

    Explanation: both AC and DC

18. **(c)** A is true but R is false.

    Explanation: Emf will always induces whenever, there is change in magnetic flux.

The current will induced only in closed loop.

Section B

19. For a moving particle, the energy and momentum of an electron are related to the frequency and wavelength of the associated matter wave by the relations:
De-broglie wavelength is given by $\lambda = \frac{h}{p}$ or, $p = \frac{h}{\lambda}$
p is momentum.
The energy of photon is, E = h$\nu = h\frac{c}{\lambda}$
Therefore,
The energy of a moving particle $= \frac{p^2}{2m} = \frac{(h/\lambda)^2}{2m} = \frac{h^2}{2\lambda^2 m}$
From the above relation, we can see that, ν has no direct significance on the relation of E and p

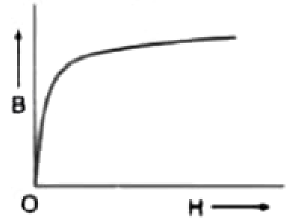
20. The total number of protons and neutrons present inside a nucleus is called its mass number (A).
The relation between the mass number (A) and radius (R) of the nucleus is
$R = R_0 A^{1/3}$ where $R_0 = 1.1 \times 10^{-15}$ m
Density of nuclear matter,
$\rho = \frac{\text{Mass of } {}_1^1\text{H}}{\text{Volume}} = \frac{1.66\times10^{-27}\text{ kg}}{\frac{4}{3}\pi(1.1\times10^{-15}\text{ m})^3}$
$= 3 \times 10^{17}$kgm^{-3}
$\frac{\text{Density of nuclear matter}}{\text{Density of ordinary matter}} = \frac{10^{17}}{10^3} = 10^{14}$

21. Imagine an electron being removed from the filled valence band to the bottom of the conduction band. This removal creates a vacancy or a hole in the valence band. Clearly, it requires more energy to remove an electron that is farther from the top of the valence band. Thus a valence hole state, farther from the top of the valence band, has higher energy just as a conduction electron farther from the bottom of the conduction band has higher energy.

22. i. Torque, $\tau = mB\sin\theta$ where m is the magnetic moment of the magnet, B is the external magnetic field and θ is the angle with which a short bar magnet placed with its axis.
Here, $\theta = 60^\circ$
$\tau = 0.063Nm$
$m = 0.9J/T$
$\Rightarrow B = \frac{\tau}{m\sin\theta} = \frac{0.063}{0.9\times\sin 60^\circ}$
$\Rightarrow B = 0.081\ T$
ii. The magnet will be in stable equilibrium in the magnetic field if torque, $\tau = 0$
$\Rightarrow mB\sin\theta = 0 \Rightarrow \theta = 0^\circ$
i.e when bar magnet aligns itself parallel to the field.

OR

No, the permeability of a ferromagnetic material depends upon the applied magnetic field. Its value is large for the small values of the applied field. The graph between B and H is of the shape as shown in Figure. It follows that the value of B is quite large for a comparitively small value of H.



23. The d.c. resistance is just equal to the voltage divided by current.

$\therefore r_{dc} = \frac{V_B}{I_B} = \frac{0.3\text{ V}}{4.5\times10^{-3}A} = 66.67\ \Omega$

Consider two points A and C around the point of operation B. Then,

$r_{ac} = \frac{\Delta V}{\Delta I} = \frac{V_C - V_A}{I_C - I_A} = \frac{0.35-0.25}{(6-3)\times10^{-3}} = 33.33\ \Omega$

24. i. For conversion into ammeter : $R_g = 100\ \Omega$, $I_g = 1\text{ mA} = 0.001\text{ A}$, $I = 1\text{ A}$

$R_s = \frac{I_g}{I - I_g} \times R_g = \frac{0.001\times100}{1-0.001} = \frac{0.001\times100}{0.999}$

$= 0.1\ \Omega$

ii. For conversion into voltmeter:

$R_g = 100\ \Omega$, $I_g = 0.001\text{ A}$, $V = 1\text{ V}$

$R = \frac{V}{I_g} - R_g = \frac{1}{0.001} - 100 = 900\Omega$

OR

Here $q = 1.5\ \mu C = 1.5 \times 10^{-6}\ C$,

$\vec{v} = 2\times10^6\hat{i}\ ms^{-1}$, $\vec{B} = (0.2\hat{j} + 0.4\hat{k})T$

Magnetic force on the positive charge is

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

$= 1.5\times10^{-6}\left[2\times10^6\hat{i}\times(0.2\hat{j}+0.4\hat{k})\right]$

$= 3.0[0.2\hat{i}\times\hat{j} + 0.4\hat{i}\times\hat{k}]$

$= (0.6\hat{k} - 1.2\hat{j})$ N ...$[\because i\times\hat{j} = \hat{k}, \hat{i}\times\hat{k} = -\hat{j}]$

25. The fringe width is given by the expression

$\beta = \frac{D\lambda}{d}$

i. When D is increased, the fringes width increases.

ii. When d is increased, the fringe width increases.

iii. If the width w of the slits is changed, then interference occurs only, if $\frac{1}{w} > \frac{1}{d}$ remains satisfied, where d is the distance between the slits.

Section C

26. In a non-uniform magnetic field,

a. a diamagnetic substance tends to move very slowly from stronger to weaker parts of the field.

b. a paramagnetic substance tends to move slowly from weaker to stronger parts of the field.

c. a ferromagnetic substance tends to move quickly from weaker to stronger parts of the field.

Diamagnetic materials. Bismuth, copper.

Paramagnetic materials. Aluminium, sodium.

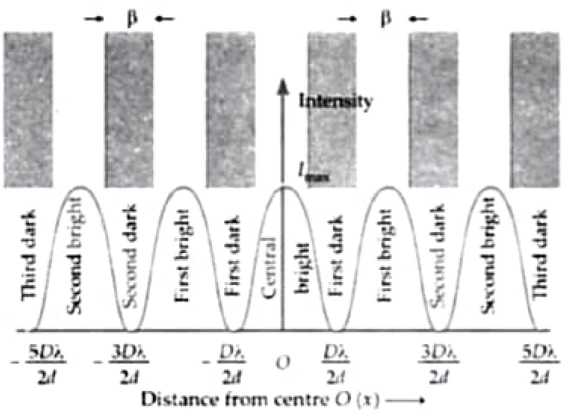
Ferromagnetic materials. Iron, cobalt.

i. For a permanent magnet, the ferromagnetic material should have high retentivity, high coercivity and high permeability.

ii. For an electromagnet, the material should have low retentivity and low coercivity.

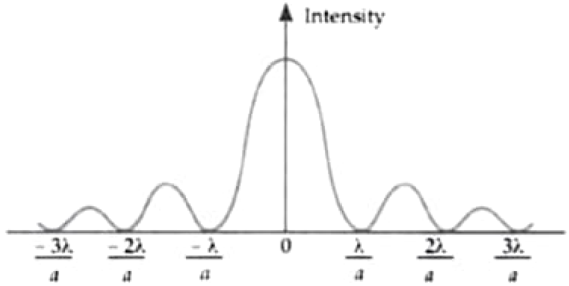
27. With two narrow slits, an interference pattern is obtained. When one slit is completely covered, the diffraction pattern is obtained.

For intensity distribution curve for interference, see Fig.



Intensity distribution curve.

For intensity distribution curve for diffraction, see Fig.

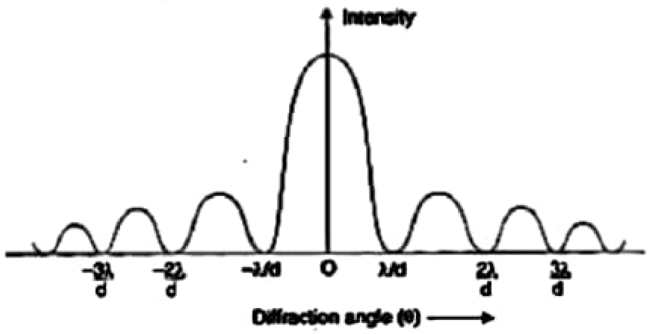


Interference	Diffraction
1. All the bright fringes are of same intensity.	Intensity of bright fringes decreases with the increasing order.
2. All the bright fringes are of equal width.	Central bright fringe is twice as wide as any secondary bright fringe.
3. Regions of dark fringes are perfectly dark.	Regions of dark fringes are not perfectly dark.
4. Maxima occur at $\theta = n\frac{\lambda}{d}$	Minima occur at $\theta = n\frac{\lambda}{a}$

OR

Diffraction of light: Phenomenon of bending of light around the corners of an obstacle or aperture is called diffraction.

The intensity distribution wave for diffraction is shown in the diagram below:



In interference, by 2 slits all bright fringes are of same intensity. In diffraction, the intensity of bright fringes decreases with the increase in distance from the central bright fringe.

i. The diffraction pattern becomes narrower if the width of the slit is decreased.

ii. When the monochromatic source is replaced by a white light source, we get a coloured diffraction pattern. The central band is white, but the other bands are coloured. As bandwidth is proportional to λ, the red band of higher wavelength is wider than the violet band with smaller wavelength.

28. i. Microwaves: Wavelength 10^{-4}m - 10^{-1}m, frequency 10^{13} Hz - 10^{9} Hz

ii. Generation: Microwaves are produced by valves like magnetron, using a maser or Klystron valve. They are detected with crystal detectors, Point contact diodes or solid-state diodes.

iii. Uses:

a. Used in radar
b. Used in telemetry
c. Used in electron spin resonance studies
d. Used in microwave ovens for heating food

OR

i. The oscillating charge produces an oscillating or time-varying electric field and an oscillating electric field produces a time-varying magnetic field which then produces an oscillating emf. An oscillating voltage (emf) produces an oscillating magnetic field and so on. This, in turn, produces an oscillating electric field and so on. Thus oscillating electric and magnetic fields regenerate each other and as a result, an electromagnetic wave is produced and the wave propagates through space. In this way, the oscillating charges produce an electromagnetic wave. Vibrations of electric and magnetic fields are mutually perpendicular to each other and also perpendicular to the direction of propagation of the wave

ii. According to quantum theory, electromagnetic radiation is made up of massless particles called photons. The momentum of the photon is expressed as

$p = \frac{E}{c}$

Where p and E are momentum and energy carried by the electromagnetic radiation or photons respectively and c = speed of light.

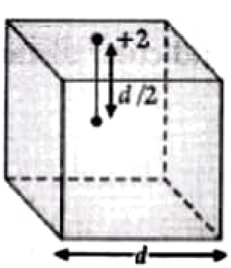
Thus, electromagnetic waves carry energy and momentum.

29. Electric flux: The electric flux may be defined as the number of electric lines of force crossing through a surface normal to the surface. It can be measured as the surface integral of the electric field over that surface, i.e.

$\phi = \int_s \overline{E} \cdot d\overline{s}$

Electric flux ϕ is a scalar quantity.

Now to calculate the electric flux passing through the square of side d, draw a cube of side d such that it completely encloses the charge q. Now by using Gauss's law.



Total flux through the all the six surfaces of a cube is given as

$\phi_{\text{total}} = 6 \times \phi_{\text{square face}} = \frac{\text{total charge enclosed}}{\epsilon_0}$

$\Rightarrow 6\phi_{\text{square}} = \frac{q}{\epsilon_0}$

$\Rightarrow \phi_{\text{square face}} = \frac{q}{6\epsilon_0}$

Hence the flux through the square of side d with charge q at a distance d/2 directly above the head is $q/6\epsilon_0$.

If a charge is now moved to the distance d from the center of square and side of the square is doubled, then electric flux remains unchanged because electric flux in a closed surface depends only on the amount of charge contained inside the closed surface and is independent of the distance of charge.

30. Principle : The current carrying coil placed in normal magnetic field experiences a torque when current passes through it, which is given by

$\tau = NI(\vec{A} \times \vec{B})$

where, N =number of turns of the coil, I = current in the coil, A = area of coil and B = magnetic field applied

The galvanometer cannot be used to measure the current because

i. all the currents to be measured has to be passed through coil which would get damaged due to heating effect of electric current or

ii. its coil has considerable resistance because of length and it may affect original current.

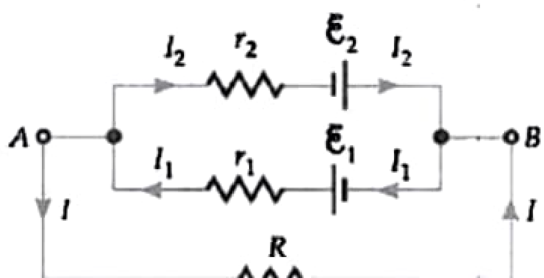
Current sensitivity is defined as the angular deflection of a moving coil galvanometer when unit current pass through it and expressed as $\frac{\theta}{I} = \frac{NAB}{K}$. It can be increased by

i. increasing the magnetic field intensity, B and

ii. decreasing the value of torsional constant, K.

Section D

31. Suppose we connect a resistance R between points A and B. Then the circuit will be of the form as shown in the figure.



Applying Kirchhoff's first law at junction A,

$I = I_1 - I_2$ ...(i)

Applying Kirchhoff's second law,

$\varepsilon_1 = I_1r_1 + IR$

or $IR = \varepsilon_1 - I_1r_1$ ...(ii)

and $\varepsilon_2 = Ir_2 - IR$

or $IR = -\varepsilon_2 + I_2r_2$ ...(iii)

From (i) and (iii),

$IR = -\varepsilon_2 + (I_1 - I)I_2$

or $I(R + r_2) = -\varepsilon_2 + I_1 r_2$

Multiplying (ii) by r_2 and (iv) by r_1, and on adding, we get

$IRr_2 + I(R + r_2)r_1 = \varepsilon_1 r_2 - \varepsilon_2 r_1$

or $I = \frac{\varepsilon_1 r_2 - \varepsilon_2 r_1}{R(r_1 + r_2) + r_1 r_2}$

$= \frac{(\varepsilon_1 r_2 - \varepsilon_2 r_1)/(r_1 + r_2)}{R + \frac{r_1 r_2}{r_1 + r_2}} = \frac{\varepsilon_0}{R + r_0}$

Clearly,

$\varepsilon_0 = \frac{\varepsilon_1 r_2 - \varepsilon_2 r_1}{r_1 + r_2}$ = emf of the battery required and $r_0 = \frac{r_1 r_2}{r_1 + r_2}$

= internal resistance of the battery required.

OR

i. $H = \frac{V^2 t}{R}$ is the formula of the produced heat across the resistor R when applied potential difference is V.
New potential difference is V' and Heat Produced after change is H'.

Then , $H' = \frac{V'^2 t}{R}$

According to question,

H' = 9H

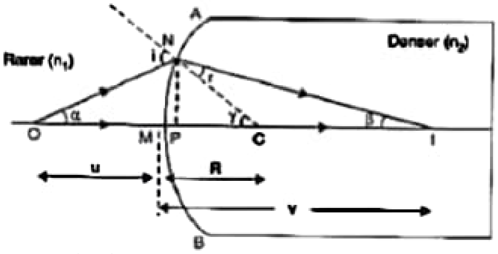
$\frac{V'^2 t}{R} = 9\frac{V^2 t}{R}$

$\Rightarrow V'^2 = 9V^2$

$\Rightarrow V' = 3V$

ii. Current is calculated by using Ammeter. Ammeter is connected in series with the resistor.
Current 'I' in the circuit is given by
$I = \frac{E}{R+r} = \frac{12}{4+2} = 2A$
Voltage is calculated by using voltmeter. Voltmeter is connected in parallel with the battery.
Also, terminal voltage across the cell is given by
V = E - Ir
12 2 2
= 8 V
So, ammeter reading = 2A
and voltmeter reading = 8 V

32. AMB is a convex surface separating two media of refractive indices n_1 and n_2 ($n_2 > n_1$). Consider a point object O placed on the principal axis. A ray ON is incident at N and refracts along NI. The ray along ON goes straight and meets the previous ray at I. Thus I is the real image of O.



From Snell's law,

$\frac{n_2}{n_1} = \frac{\sin i}{\sin r}$

$n_1 \sin i = n_2 \sin r$

or $n_1 i = n_2 r$ [$\because \sin\theta \cong \theta$ as θ is very small]

From $\Delta NOC, i = \alpha + \gamma$

From $\Delta NIC, \gamma = r - \beta$

or $r = \gamma - \beta$

$\therefore n_1(\alpha + \gamma) = n_2(\gamma - \beta)$

or $n_1\alpha + n_2\beta = (n_2 - n_1)\gamma$

But $\alpha \cong \tan\alpha = \frac{NP}{OP} = \frac{NP}{OM}$ [P is close to M]

$\beta \cong \tan\beta = \frac{NP}{PI} = \frac{NP}{MI}$

$\gamma \cong \tan\gamma = \frac{NP}{PC} = \frac{NP}{MC}$

$\therefore n_1 \cdot \frac{NP}{OM} + n_2 \cdot \frac{NP}{MI} = (n_2 - n_1)\frac{NP}{MC}$

or $\frac{n_1}{OM} + \frac{n_2}{MI} = \frac{n_2 - n_1}{MC}$

Using Cartesian sign convention,

OM = -u, MI = +v, MC = +R

$\therefore \frac{n_1}{-u} + \frac{n_2}{v} = \frac{n_2 - n_1}{R}$

or $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$

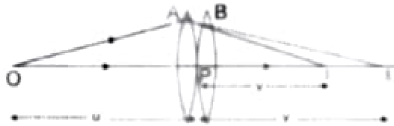
The lens maker formula gives us the relationship,

$\frac{1}{f} = (\mu - 1)(\frac{1}{R_1} - \frac{1}{R_2})$

i.e. focal length, f and refractive index, μ have inverse dependence.
Now, as refractive index of water is greater than the air, the focal length of the lens will reduce when immersed in water.

OR

i.



Two thin lenses, of focal length f_1 and f_2 are kept in contact. Let O be the position of the object and let u be the object distance. The distance of the image (which is at I_1), for the first lens is v_1

This image serves as object for the second lens. Let the final image be at I. We then have

$\frac{1}{f_1} = \frac{1}{v_1} - \frac{1}{u}$

$\frac{1}{f_2} = \frac{1}{v} - \frac{1}{v_1}$

Adding, we get

$\frac{1}{f_1} + \frac{1}{f_2} = \frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

$\therefore \frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$

$\therefore P = P_1 + P_2$

ii. A ray of light passing from the air through an equilateral glass prism undergoes minimum deviation. Thus, At a minimum deviation

$r = \frac{A}{2} = 30^\circ$

We are given that, $i = \frac{3}{4}A = 45^\circ$

$\therefore \mu = \frac{\sin 45^\circ}{\sin 30^\circ} = \sqrt{2}$

$\therefore$ Speed of light in the prism $v = \frac{c}{\mu} = \frac{c}{\sqrt{2}}$

$= (2.1 \times 10^8 \text{ ms}^{-1})$

33. Two postulates of Bohr's theory of hydrogen atom are
   i. Every atom consists of small and massive central core, known as nucleus around which electron revolve. The necessary centripetal force is provided by electrostatic

force of attraction between positively charged nucleus and negatively charged electrons.

ii. The electrons revolved around the nucleus in only those circular orbits which satisfy the quantum condition, that the angular momentum of electrons is equal to integral multiple of $\frac{h}{2\pi}$ where, h is Planck's constant. Thus, for any stationary orbit,

$mvr = \frac{nh}{2\pi}$

where, n = 1, 2, 3,...

In second excited state i.e., n = 3, two spectral lines namely Lyman series and Balmer series can be obtained corresponding to transition of electron from n = 3 to n = 1 and n = 3 to n = 2, respectively.

For Lyman series, n = 3 to n = 1, for minimum wavelength

$\frac{1}{\lambda_{min}} = R\left[\frac{1}{1^2} - \frac{1}{3^2}\right] = \frac{8R}{9}$...........(i)

For Balmer series (maximum wavelength),

$\frac{1}{\lambda_{max}} = R\left[\frac{1}{2^2} - \frac{1}{3^2}\right]$

$= \left(\frac{9-4}{36}\right) R = \frac{5R}{36}$..........(ii)

On dividing Eq. (i) by Eq. (ii), we get

$\frac{\lambda_{max}}{\lambda_{min}} = \frac{8R/9}{5R/36} = \frac{8R}{9} \times \frac{36}{5R} = \frac{32}{5}$

$\Rightarrow \lambda_{max} : \lambda_{min} = 32 : 5$

OR

i. $mvr = \frac{nh}{2\pi}$

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

$r = \frac{4\pi\varepsilon_0 mv^2}{e^2}$

$r = \frac{4\pi\varepsilon_0 m\left(\frac{nh}{2\pi mr}\right)^2}{e^2}$

$\Rightarrow \quad r = \frac{\varepsilon_0 n^2 h^2}{\pi me^2}$

Potential energy, $U = -\frac{1}{4\pi\varepsilon_0} \cdot \frac{e^2}{r}$

$= -\frac{me^4}{4\varepsilon_0 n^2 h^2}$

$K.E. = \frac{1}{2}mv^2 = \frac{1}{2}m\left(\frac{nh}{2\pi mr}\right)^2$

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

$K.E. = \frac{me^4}{8\varepsilon_0^2 n^2 h^2}$

total energy = Kinetic energy + Potential energy

$= -\frac{me^4}{8\varepsilon_0^2 n^2 h^2}$

ii. **Rydberg formula:** For first member of Lyman series

$\frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{2^2}\right)$

$\lambda = \frac{4}{3R} = \frac{4}{3} \times 912\overset{o}{A}$

$= 1216\ \overset{o}{A}$

For first member of Balmer Series

$\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$

$\lambda = \frac{36}{5R}$

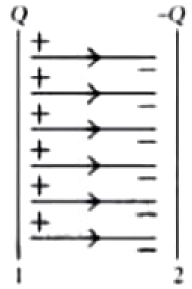
$= \frac{36}{5} \times 912\overset{o}{A}$

$= 6566.4\ \overset{o}{A}$

Section E

34. **Read the text carefully and answer the questions:**

A capacitor is a device to store energy. The process of charging up a capacitor involves the transferring of electric charges from its one place to another. This work done in charging the capacitor is stored as its electrical potential energy.



If q is the charge and V is the potential difference across a capacitor at any instant during its charging, then small work done in storing an additional small charge dq against the repulsion of charge q already stored on it is dW = $V \cdot dq = (\frac{q}{C})dq$

(i) As, $C_1 = 2\ \mu F$, $C_2 = 4\ \mu F$

In series combination, the equivalent capacitance will be, C =

$\frac{C_1C_2}{C_1+C_2} = \left(\frac{2\times4}{2+4}\right)\mu F = \frac{4}{3}\mu F$

Potential difference applied, V = 6V

Energy stored in the system, U = $\frac{1}{2}CV^2$

$= \frac{1}{2} \times \frac{4}{3} \times 10^{-6} \times (6)^2\ J = 24\mu J$

(ii) The energy stored in a capacitor is U = $\frac{1}{2}CV^2 = \frac{1}{2} \times \left(10 \times 10^{-6}\right)(10)^2 = 500\mu J$

(iii)The potential difference and electric field both decrease.

When the gap between the plates is completely filled with dielectric of dielectric constant K, then potential is V = $\frac{Qd}{A\varepsilon_0 K}$ ...(i)

and electric field is

E = $\frac{Q}{A\varepsilon_0 K}$ ...(ii)

From equations (i) and (ii), both electric field and potential decrease.

OR

Work done = $U_f - U_i = \frac{1}{2}\frac{q^2}{C_f} - \frac{1}{2}\frac{q^2}{C_i}$

$= \frac{q^2}{2}\left[\frac{1}{C_f} - \frac{1}{C_i}\right] = \frac{(5\times10^{-6})^2}{2}\left[\frac{1}{2\times10^{-6}} - \frac{1}{5\times10^{-6}}\right]$

$= 3.75 \times 10^{-6}$ J

35. **Read the text carefully and answer the questions:**

A transformer is essentially an a.c. device. It cannot work on d.c. It changes alternating voltages or currents. It does not affect the frequency of a.c. It is based on the phenomenon of mutual induction. A transformer essentially consists of two coils of insulated copper wire having a different number of turns and wound on the same soft iron core.

The number of turns in the primary and secondary coils of an ideal transformer are 2000 and 50 respectively. The primary coil is connected to the main supply of 120 V and secondary coil is connected to a bulb of resistance 0.6 Ω.

(i) As $\frac{E_s}{E_p} = \frac{n_s}{n_p} \Rightarrow E_S = E_P \cdot \frac{n_s}{n_p}$

$= \frac{120 \times 50}{2000} = 3V$

(ii) $I_S = \frac{E_s}{R} \Rightarrow I_S = \frac{3}{0.6} = 5A$

(iii) As $\frac{I_p}{I_s} = \frac{E_s}{E_p}$

$\Rightarrow I_p = \frac{E_s}{E_p} \times I_s = \frac{3}{120} \times 5 = 0.125\text{ A}$

OR

Power in primary, $P_P = E_P \times I_P = 120 \times 0.125 = 15W$