Board of Secondary Education Rajasthan, Ajmer

Practice Question Paper-1 Sr. Secondary Examination-2022

SUBJECT: PHYSICS (SOLUTIONS)
CLASS-XII

Time: 2 Hours 45 Minutes **Marks: 56**

(SECTION-A)

Multiple Choice Questions

Q.1. Write the correct answer from multiple choice questions 1 (i to ix) and write in given answer book.

(i) (C) $C^2N^{-1}m^{-2}$

(ii) (B) Non conductors

(iii) (D) 240 ± 5%

(iv) (B) Zero

(v) (C) Faraday

(vi) (B) $h\upsilon = \frac{1}{2}mv_m^2 + \phi_0$

(vii) (C) 1 : 3

(viii) (B) Indium

(ix) (C) NOR

Q.2. Fill in the blanks -

(i) KC_0

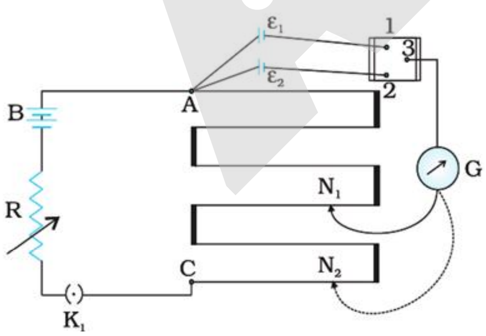
(ii) decreases

(iii) energy

(iv) zener

Q.3. Give the answer of the following question in one line.

(i)



(ii) To convert a galvanometer into voltmeter, we connect a large resistance in series with it.

(iii) When viewed from left side direction of current will look anticlockwise in coil AB.

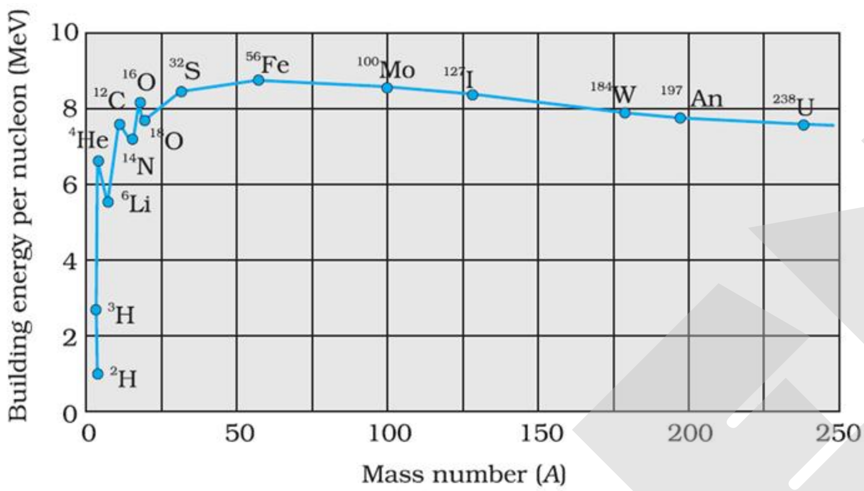
(iv) Davisson-Germer experiment.

(v) We know that de-Broglie wavelength is

$\lambda = \frac{h}{P} = \frac{h}{\sqrt{2mKE}}$ as mass of α-particle is more so, it's wavelength is lowest.

(vi) In nuclear fission a heavy nucleus breaks into lighter fragments while in fusion in nuclear fusion two or more lighter nuclei combine to form a heavy nucleus.

(vii)



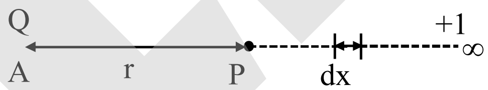
(viii) P → OR gate

Q → NAND gate

(SECTION-B)

Short Answer type question:–

4. According to question



Electric potential at a point P due to charge Q at point A is given as -

$$V_{PA} = W_{\infty \to r} = \int_{\infty}^{r} \vec{F}.d\vec{x} = -kQ\int_{\infty}^{r} \frac{1}{x^2}.dx$$

$$= \frac{kQ}{r}$$

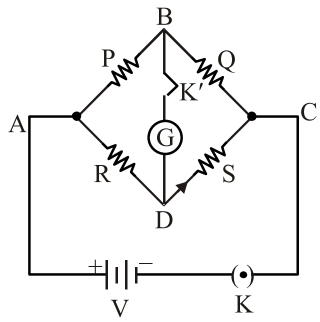
5. Here, two 5μF capacitors are connected in parallel and then 10μF is connected in series. So, equivalent capacity between A & B is

$C_{eq} = 5\mu F$

6. (a) Terminal voltage is the p.d. across the terminals of a cell when the cell is in close circuit, i.e. current is drawn from it but emf is the p.d. across the terminals of cell when the cell is in open circuit i.e. no current is drawn from it.

(b) Terminal voltage is the effect and emf is the cause.

7. In balanced state, $\frac{P}{Q}=\frac{R}{S}$



from figure given in question

$$\frac{40}{60}=\frac{4}{S}$$

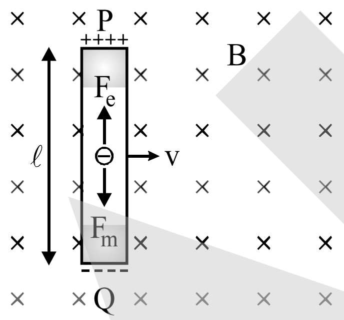
or $S=\frac{4\times 3}{2}=6\Omega$

8. **Expression of motional electromotive Force :-** Let according to diagram, a conducting rod PQ of length ℓ is moving with velocity (v) in plane of paper. A magnetic field B is perpendicular into the plane of paper. Free electrons present in conductor are also moving perpendicular to the magnetic field. Lorentz force acting on free electrons is given by -

$F_m = evB \sin 90°$

$\boxed{F_m = evB}$

The direction of this force is given by Fleming left hand rule and acts towards end 'Q'. Due to this force negatively charged free electrons move towards end 'Q' and leaving positive charged ions at 'P'. Due to which the end 'P' becomes positively charged and the end 'Q' becomes negatively charged, which develops a potential difference (ε) across the ends of the conductor. So, electric field gets induced in the conductor $\left(E=\frac{\varepsilon}{\ell}\right)$.



Now, this electric field exerts electric force on electrons

i.e. $F_e = eE$ (towards end P)

In equilibrium state

$F_e = F_m$

$eE = evB$

$$e\times\frac{\varepsilon}{\ell}=evB$$

Motional emf $\boxed{\varepsilon = vB\ell}$

9. Given $\Delta I = -5A$

$\Delta t = 0.1$ sec

$e = 100V$

Using $L = -\frac{e}{\frac{dI}{dt}} = \frac{100}{\frac{5}{0.1}}$

$= \frac{100}{50} = 2H$

10. **TIR :-** It is the phenomena in which, when a light ray moving from a denser to rarer medium get incident on separating surface at an angle greater than critical angle, then it got reflected back in the same medium.

Two phenomena based on TIR :-

(a) Brilliance of diamond

(b) Mirage

11. Three differences :-

(a) In primary rainbow the sequence of colors is from red to violet but in secondary rainbow the sequence is from violet to red.

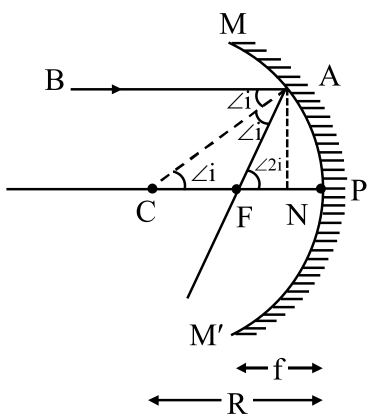
(b) Primary rainbow is formed because of two refraction one internal reflection and dispersion, but secondary rainbow is formed because of two refraction two internal reflection and dispersion.

(c) The colours got faded in secondary rainbow compared to primary.

12. Considering reflection from a concave mirror as shown –

In ΔCNA

$i \sim \tan i = \frac{AN}{CN} \sim \frac{AN}{CP}$ ......(1)



&

In ΔFNA

$2i \sim \tan 2i = \frac{AN}{FN} \sim \frac{AN}{FP}$ ......(2)

(as aperture is small so N coincides with P)

Now, from eq. (1) & (2), we may write

$$2\times\frac{AN}{CP}=\frac{AN}{FP}$$

or $CP = 2FP$

but $CP = R$ & $FP = f$

thus $\boxed{f=\frac{R}{2}}$

13. Given $f_0 = 192cm$ & $f_e = 8$ cm

magnifying power, in normal adjustment,

$$m=-\frac{f_0}{f_e}=\frac{-192}{8}$$

$$= -24x$$

(–ve sign indicates that image is inverted with respect to the object)

The separation between the two lenses

$$= f_0 + f_e$$

$$= 192 + 8 = 200 \text{ cm}$$

for normal adjustment.

14. **Moderator :-** a moderator absorb energy from fast moving neutrons and thus make them suitable for fission.

Coolant :- It transfers the heat generated in reaction to make steam and maintain the temperature inside the reactor.

Control rods :- These are used to absorb the extra neutrons, to control the pace of reaction. The role of control rods is crucial during reactor shut down.

15. Given $\frac{N}{N_0}=6.25\%$, $t = 6$ hr

Let, the half-life is x hr then fraction of sample

after x hr is 50%

after 2x hr is 25%

after 3x hr is 12.5%

after 4x hr is 6.25%

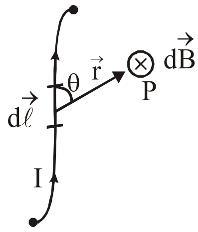
means $4x = 6$

so $x=\frac{6}{4}=\frac{3}{2}=1.5$ hr

(SECTION-C)

Long Answer type question:–

16. Bio-Savart law in vector form –



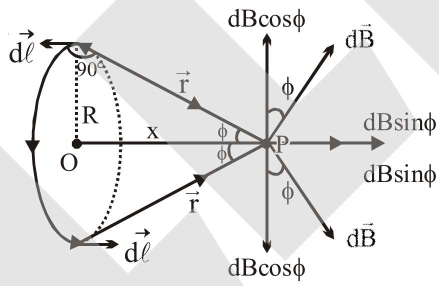
$$d\vec{B} = \frac{\mu_0 I}{4\pi r^2}\left(d\vec{\ell} \times \hat{r}\right)$$

or $$d\vec{B} = \frac{\mu_0 I}{4\pi r^3}\left(d\vec{\ell} \times \vec{r}\right)$$

Magnetic field on axis of a current carrying loop :-

Let current I is flowing through a loop of radius R.

We want to find magnetic field at an axial point P. The angle between each element $\overrightarrow{d\ell}$ and $\vec{r}$ is $\theta = 90°$.



Using Biot-savart's law -

$$d\vec{B} = \frac{\mu_0 I}{4\pi r^2}\left(d\vec{\ell} \times \hat{r}\right)$$

$$dB = \frac{\mu_0 I}{4\pi r^2} d\ell \sin 90°$$

$$\boxed{dB = \frac{\mu_0 I \, d\ell}{4\pi r^2}}$$

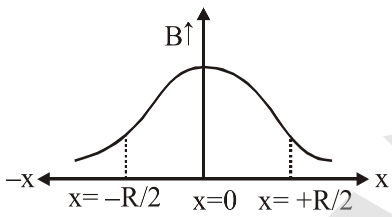
It is clear that the magnetic field developed at point 'P' due to symmetrical elements each of length $d\ell$ have equal magnitude. The equatorial components ($dB\cos\phi$) due to both elements get cancelled while axial components ($dB\sin\phi$) get added. In this way the net magnetic field is only because of axial component $dB\sin\phi$.

Magnetic field developed at 'P' due to whole circular loop is given by -

$$B_{axis} = \int_0^{2\pi R} dB \sin\phi \quad \Rightarrow B_{axis} = \int_0^{2\pi R} \frac{\mu_0 I d\ell}{4\pi r^2}\sin\phi \quad \Rightarrow B_{axis} = \frac{\mu_0 IR}{4\pi r^3}\int_0^{2\pi R} d\ell \quad \begin{cases}\text{From figure} \\ \sin\phi = R/r \\ r = (R^2+x^2)^{1/2}\end{cases}$$

$$B_{axis} = \frac{\mu_0 IR}{4\pi r^3}\left(2\pi R - 0\right) \Rightarrow B_{axis} = \frac{\mu_0 IR^2}{2r^3}$$

$$B_{axis} = \frac{\mu_0 IR^2}{2\left(R^2+x^2\right)^{3/2}}$$



If the coil have N turns then

$$B_{axis} = \frac{\mu_0 NIR^2}{2\left(R^2+x^2\right)^{3/2}}$$

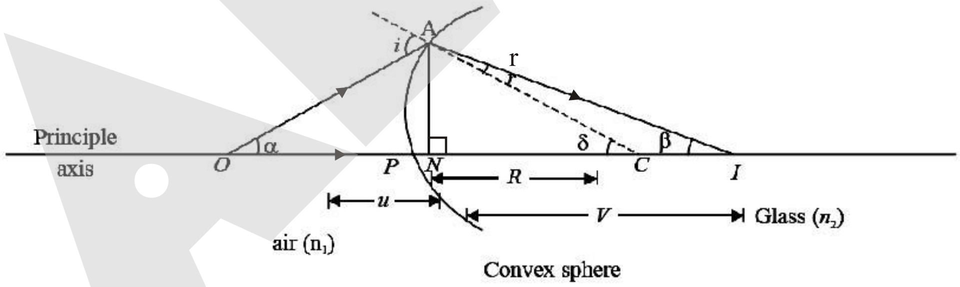
The direction of magnetic field can be obtained by right hand thumb rule.

17. Refraction through spherical surface

Convention

1. The spherical surface must be very thin.
2. The object must be a point object and should lie on principle axis.
3. The angle made by object, image and normal must be very-very small.

Convex surface – Real image



In ΔOAC,

$i = \alpha + \delta$ ....(i)

For smaller angle,

$\alpha = \tan\alpha$ ....(ii)

$\delta = \tan\delta$ ....(iii)

$\therefore\ i = \tan\alpha + \tan\delta$ ....(iv)

In ΔOAN

$$\tan\alpha = \frac{AN}{NO} = \frac{AN}{PO} \quad \text{........(v)}$$

Since $NO \simeq PO$ ....(vi)

In ΔANC,

$$\tan\delta = \frac{AN}{NC} \quad \text{........(vii)}$$

But, $NC \sim PC$ ....(viii)

$$\therefore \tan\delta = \frac{AN}{PC} \quad \text{.......(ix)}$$

Using in equation (iii)

$$\boxed{i = \left(\frac{AN}{PO} + \frac{AN}{PC}\right)} \quad \text{......(x)}$$

In ΔACI

$\delta = r + \beta$

$r = \delta - \beta$ ......(xi)

For smaller angle,

$\delta = \tan\delta$

$\beta = \tan\beta$ ......(xii)

$\therefore r = \tan\delta - \tan\beta$ ......(xiii)

In ΔANI,

$$\tan\beta = \frac{AN}{NI} \quad \text{......(xiv)}$$

But, $NI \sim PI$ ......(xv)

$$\boxed{\tan\beta} = \frac{AN}{PI} \quad \text{......(xvi)}$$

$$\therefore \boxed{r = \left(\frac{AN}{PC} - \frac{AN}{PI}\right)} \quad \text{.....(xvii)}$$

Using snell's law,

$$\frac{\sin i}{\sin r} = \frac{n_2}{n_1} \quad \text{....(xviii)}$$

For smaller angle,

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

$n_1 i = n_2 r$ .....(xix)

Using equation (x) and (xvii)

$$n_1\left[\frac{AN}{PO}+\frac{AN}{PC}\right]=n_2\left[\frac{AN}{PC}-\frac{AN}{PI}\right]$$

$$n_1AN\left[\frac{1}{PO}+\frac{1}{PC}\right]=n_2AN\left[\frac{1}{PC}-\frac{1}{PI}\right]$$

$$\frac{n_1}{PO}+\frac{n_1}{PC}=\frac{n_2}{PC}-\frac{n_2}{PI}$$

$$\frac{n_2}{PI}+\frac{n_1}{PO}=\frac{n_2-n_1}{PC} \qquad .....(xx)$$

Using proper sign – conversion,

PI = V

PO = –u

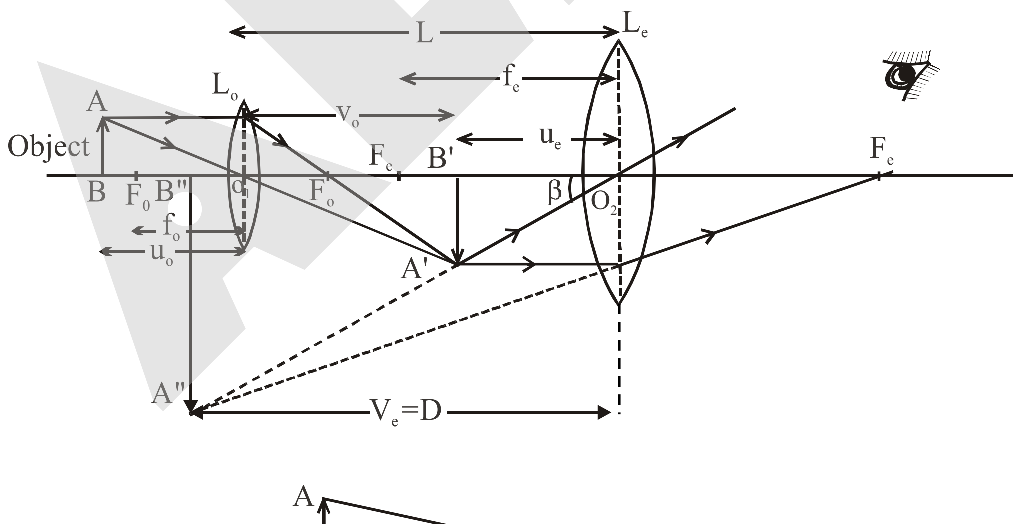
PC = R ....(xxi)

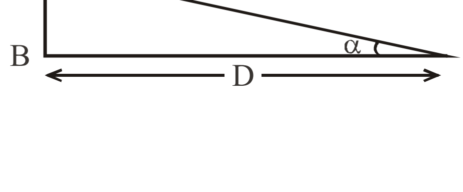
$$\therefore \boxed{\frac{n_2}{v}+\frac{n_1}{-u}=\frac{n_2-n_1}{R}} \qquad .....(xxii)$$

Equation (xxii) is the general equation for refraction through spherical surface.

OR

Compound microscope : Figure shows ray diagram of a compound microscope. It consists of two convex lenses one nearer to object is known as objective and other close the eye is eyepiece lens. Here objective lens is of small focal length (f_0) and small aperture whereas eyepiece is also a small focal length but larger than objective lens and relatively large aperture.





The image A' B' formed by the objective lens L_0 of object AB and Final image is A"B".

Magnification power (M)

$$= \frac{\text{Angle subtended by final image at eye}}{\text{Angle subtended by the object when it is placed at the least distance of distinct vision}}$$

$$M = \frac{\beta}{\alpha} \quad \begin{cases} \text{if } \alpha \text{ and } \beta \text{ are very small, then} \\ \alpha \approx \tan\alpha \text{ and } \beta \approx \tan\beta \end{cases}$$

$$M = \frac{\tan\beta}{\tan\alpha}$$

$$M = \frac{\left(\frac{A''B''}{D}\right)}{\left(\frac{AB}{D}\right)} \Rightarrow M = \frac{A''B''}{AB}$$

$$M = \frac{A''B''}{A'B'} \times \frac{A'B'}{AB} \Rightarrow M = m_e \times m_o \quad \begin{cases} m_0 = \frac{-v_0}{u_0} \\ m_e = \frac{v_e}{u_e} \end{cases}$$

$$\boxed{M = \frac{-v_o}{u_o} \times \frac{v_e}{u_e}} \qquad ...(1)$$

Applying lens formula for eyepiece -

$$\frac{1}{f_e} = \frac{1}{v_e} - \frac{1}{u_e} \quad \begin{cases} v_e \Rightarrow -D \\ u_e \Rightarrow -u_e \end{cases}$$

$$\frac{1}{f_e} = -\frac{1}{D} + \frac{1}{u_e}$$

$$\frac{D}{f_e} = -1 + \frac{D}{u_e}$$

$$\boxed{\frac{D}{u_e} = 1 + \frac{D}{f_e}} \qquad ....(2)$$

(i) When final image is formed at least distance of distinct vision (v_e=D)

$$M = \frac{-v_o}{u_o} \times \frac{D}{u_e}$$

$$\boxed{M = \frac{-v_o}{u_o}\left(1 + \frac{D}{f_e}\right)} \qquad ....(3)$$

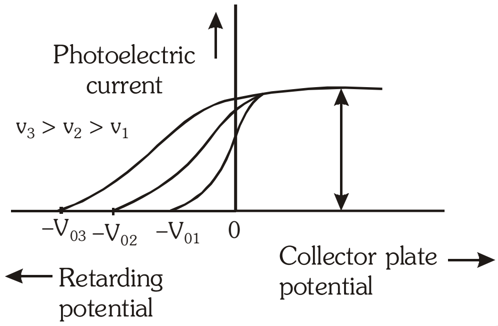
(ii) When final image is formed at infinity (u_e=f_e)

$$\boxed{M = \frac{-v_o}{u_o} \times \frac{D}{f_e}} \qquad ....(4)$$

18. (i) PHOTO ELECTRIC EFFECT (PEE)

The phenomenon of the emission of electrons, when metals are exposed to light (of a suitable frequency) is called photo electric effect.

(ii) **Effect of frequency of incident light on stopping potential**



(iii) Given $\phi = 3.31 \times 1.6 \times 10^{-19}$ J

as $\phi = h\nu_0$

so $\nu_0 = \dfrac{3.31 \times 1.6 \times 10^{-19}\text{ J}}{6.62 \times 10^{-34}}$ Hz

$= 0.8 \times 10^{15}$ Hz

$= 8 \times 10^{14}$ Hz

OR

(i) **Stopping potential / cut-off potential (V_0) :** The minimum negative (retrading) potential (given to collector) for which the photo electric current becomes zero, is called stopping potential.

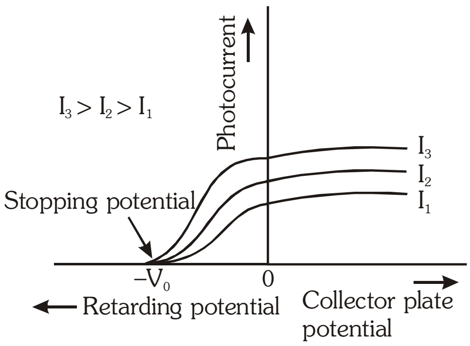
$$\frac{1}{2}mV_{max}^2 = eV_0$$

$$\Rightarrow \quad K_{max} = eV_0$$

(ii) **Effect of potential (anode) on photo electric current**

By keeping the intensity & frequency of incident light constant, variation of photo electric current with the potential difference between cathode & anode studied.

It is found that photo current is found increased up to the level of saturation current by increasing the anode potential. Also at a given frequency of incident radiation the stoping potential is independent of its intensity.



(iii) We know that

$$\lambda = \frac{12.27}{\sqrt{V}} Å$$

$$= \frac{12.27}{\sqrt{100}} = 1.227 Å$$

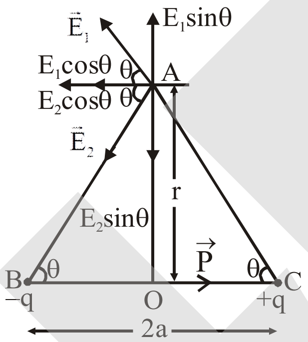
(SECTION-D)

Essayistic question:–

19. **Electric dipole :-** It is an arrangement of two equal and opposite charges arranged at a very small distance.

Derivation :-

(a) Electric field at an equatorial point due to an electric dipole :-



Electric field at point A due to +q Charge $E_1 = \frac{kq}{r^2 + a^2}$

Electric field at point A due to –q charge $E_2 = \frac{kq}{r^2 + a^2}$

resultant electric field intensity at point 'A'

$E_{eq.} = E_1\cos\theta + E_2\cos\theta \quad \{E_1 = E_2$

$E_{eq.} = 2E_1\cos\theta$

$$E_{eq.} = 2 \times \frac{kq}{r^2 + a^2} \times \frac{a}{\sqrt{r^2 + a^2}}$$

$$E_{eq.} = \frac{kp}{(r^2 + a^2)^{3/2}}$$ if r >>> a, then

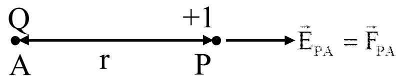
$$\boxed{E_{eq.} = \frac{kp}{r^3}}$$

In vector form $\boxed{\vec{E}_{eq.} = \frac{-k\vec{p}}{r^3}}$

OR

Electric field intensity :-

At a point P situated at distance r from source charge Q, the electric field is defined as force experienced by a test charge placed at that point.



$$\vec{E}_{PA} = \frac{kQ}{r^2}\hat{r}$$

Expression for electric field at a point due to uniformly charged straight conductor of infinite length :-

At a point P, electric field intensity due to infinite charged straight wire is perpendicular to it.

Let linear charge density on wire is λ. Now, considering a cylindrical Gaussian surface of radius r and length ℓ.

Using Gauss's law,

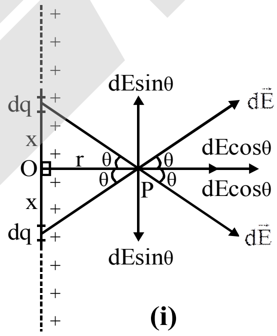
$$\oint E dA \cos\theta = \frac{q_{enclosed}}{\varepsilon_0}$$

$$\int_{S_1} E dA \cos 0° + \int_{S_2} E dA \cos 90° + \int_{S_3} E dA \cos 90° = \frac{\lambda\ell}{\varepsilon_0}$$

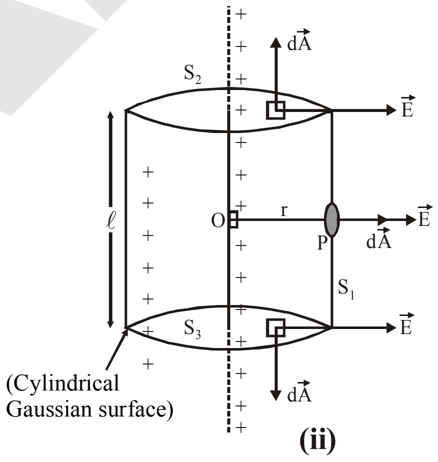
$$E\int_{S_1} dA + 0 + 0 = \frac{\lambda\ell}{\varepsilon_0} \quad \{E \Rightarrow \text{constant}$$

$$E \times 2\pi r\ell = \frac{\lambda\ell}{\varepsilon_0}$$

$$E = \frac{\lambda}{2\pi\varepsilon_0 r} \Rightarrow \boxed{E = \frac{2k\lambda}{r}}$$

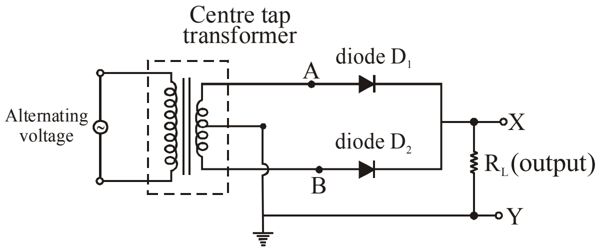


(i)



(ii)

20. **Rectification :** The process in which alternating current is changed into direct current by p-n junction diode is called rectification.

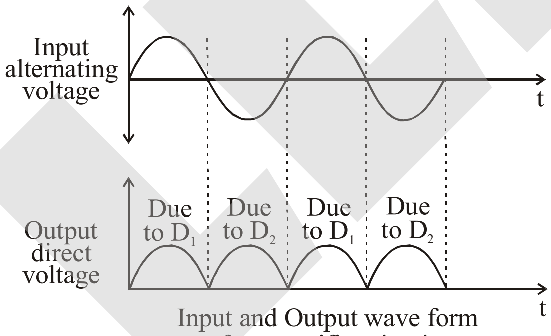


Full-wave rectifier circuit

Working : When positive half cycle of input a.c. signal flows through the primary coil, induced emf is set up in the secondary coil due to mutual induction. The direction of induced emf is such that the upper end of the secondary coil becomes positive while the lower end becomes negative. Thus, diode D_1 is forward biased and diode D_2 is reverse biased, so the current due to diode D_1 flows through the circuit. The output voltage which varies in accordance with the input half cycle is obtained across the load resistance (R_L).

During negative half cycle of input a.c. signal, diode D_1 is reverse biased and diode D_2 is forward biased. The current due to diode D_2 flows through the circuit. The output voltage is obtained across the load resistance (R_L). The input and corresponding output voltage are shown in figure.

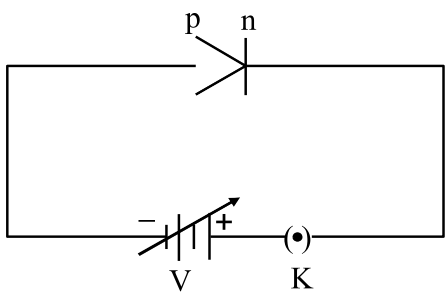
Since both the halves of input a.c. (wave) are rectified, so the junction diode is called a full wave rectifier.

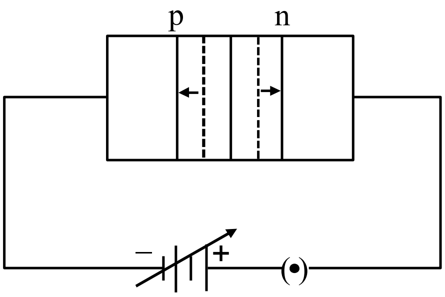


Input and Output wave form from rectifier circuit

OR

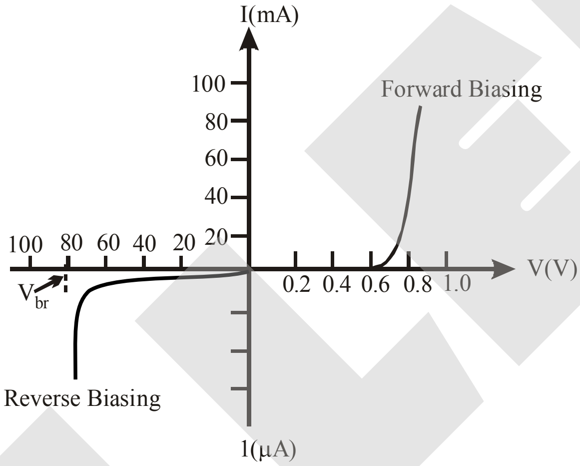
Reverse biasing :- When we connect a p-n junction diode in a circuit such that it's p type is connected to –ve terminal while n-type is connected to +ve terminal of the battery then it is called reverse biasing.





In reverse biasing the width of depletion layer and the height of potential barrier both increases. Very small current flows through the junction due to drift of minority charge carriers before breakdown.

If reverse bias is increased beyond a certain critical value then breakdown take place and current increases rapidly.



IMPORTANT NOTES