Marks distribution for +2 Physics (Theory)

UNIT	MAKRS
I	07
II	07
III	07
IV	07
V	03
VI	12
VII	03
VIII	04
IX	06
X	04
Total	60

Total Questions =28

1 Mark	$1\times10=10$
2 Marks	$2\times7=14$
3 Marks	$3\times8=24$
4 Marks	$4\times3=12$
Total 28	60

Internal Choice from chapter with marks
(UNIT)

S.No	Q.No.	Marks	Chapter from which choice is to be given.
1	12	02	5. (Electro Magnetic waves).
2.	21	03	02. (Current and Electricity).
3.	22	03	03. (Magnetism).
4.	27	04	04 (Wave optics).

Model Test
Paper +2 Physics

परीक्षार्थी यथासंभव अपने शब्दों में ही उत्तर दें।

Candidates are required to give their answers in their own words as far as practicable.

विशेष निर्देश :

Special Instructions:-

(i) अपनी उत्तर पुस्तिका के मुख्य पृष्ठ के ऊपर बायीं ओर दिए गए वृत में प्रश्न पत्र सीरीज अवश्य लिखें।

You must write Question Paper Series in the circle at the top left side of the title page of your answer book.

(ii) प्रश्नों के उत्तर देते समय जो प्रश्न संख्या प्रश्न पत्र पर दर्शाई गई है, उत्तर पुस्तिका पर वही प्रश्न–संख्या लिखना अनिवार्य है।

While answering your questions, you must indicate on your answer book the same question no. as appears in your question paper.

(iii) उत्तर–पुस्तिका के बीच में खाली पन्ना / पन्ने न छोड़ें।

Do not leave blank page/pages in your answer book.

(iv) सभी प्रश्न अनिवार्य हैं।

All questions are compulsory.

(v) कुछ प्रश्नों में आंतरिक विकल्प दिए गए हैं।

Internal choices are given in some questions.

(vi) आवश्यकता पड़ने पर लॉग टेबल प्रयोग कर सकते हैं।

Use log table, if necessary.

(vii) उत्तर संक्षिप्त एवं स्टीक होने चाहिए।

Answer should be brief and to the point.

(viii) प्रश्न संख्या 1–10 तक बहुविकल्पीय प्रश्न हैं, जिसके लिए 1 अंक निर्धारित है। प्रश्न संख्या 11–17 तक अति संक्षिप्त उत्तर वाले प्रश्न हैं, जिसके लिए 2 अंक निर्धारित हैं। प्रश्न संख्या 18–25 तक संक्षिप्त उत्तर वाले प्रश्न हैं, जिसके लिए 3 अंक निर्धारित हैं तथा प्रश्न संख्या 26–28 तक दीर्घ उत्तर वाले प्रश्न हैं, जिसके लिए 4 अंक निर्धारित हैं।

Question Nos 1-10 MCQ are (Multiple Choice Questions) carrying 1 mark each. Question Nos 11-17 are short answer type carrying 2 marks each. Question Nos 18-25 are short answer type carrying 3 marks each and Question Nos 26-28 are long answer type carrying 4 marks each.

Q.1 If the distance between two plates of a parallel plate capacitor is doubled, its capacitance.

(a) increases two times (b) decreases two times

(c) increases 4 times (d) decreases 4 times 1

Q.2 Dimensional formula of current density is :-

(a) $[ML^{-2}T^{0}A]$ (b) $[ML^{2}T^{-2}A]$

(c) $[M^{0}L^{-2}T^{0}A]$ (d) None of these 1

Q.3 What is the magnitude of the force experienced by a stationary charge when placed in uniform magnetic field?

(a) $F = q\vartheta\, BSin\theta$ (b) $F = q\vartheta\, B$

(c) $F = zero$ (d) None of these 1

Q.4 S.I. unit of Admittance is

(a) Ohm (b) Mho

(c) Henry (d) Tesla 1

Q.5 Who was the first to give a practical demonstration of the production of e.m. wave?

(a) J.C. Bose (b) Marconi

(c) Maxwell (d) Hertz 1

Q.6 Refractive index of glass and that of water w.r.t. air are 3/2 and 4/3 respectively. The refractive index of glass w.r.t. water is.

(a) $\frac{8}{9}$ (b) $\frac{9}{8}$

(c) $\frac{7}{6}$ (d) 2 1

Q.7 Which of the following illustrates the particle like nature of light.

(a) Interference (b) Diffraction

(c) Dispersion (d) Photoelectric effect 1

Q.8 Which ray contains positively charged particle?

(a) $\alpha - Rays$ (b) $\beta - Rays$

(c) $\gamma = Rays$ (d) $X - Rays$ 1

Q.9 The Boolean expression for NOR gate is :

(a) $A+B$ (b) $\overline{A+B}$

(c) $A.B$ (d) $\overline{A.B}$ 1

Q.10 Donor energy level in N-type Semiconductor lies :

(a) Between V.B. and C.B (b) Just below the conduction band

(c) Just above the V.B. (d) None of these

Q.11 What are eddy currents? How can they be reduced? 2

Q.12 Give two uses of each.

(1) Infrared rays (2) Microwaves

OR

Give four properties of E.M. waves. 2

Q.13 What is mirage? Explain its cause. 2

Q.14 The angle of prism is 30^0. The rays incident at 60^0 on one refracting surface suffers a deviation of 30^0. Calculate angle of emergence. 2

Q.15. Derive an expression for de- Broglie wavelength of an electron moving under a pot difference of V volts. 2

Q.16 Write three importance factors which justify the need of modulating a message signal. 2

Q.17 What is ground wave communication. On what factors does the maximum range of propagation in this mode depends? 2

Q.18 What is electric dipole. Find expression for electric field intensity at any point on the axial line of an electric dipole. 3

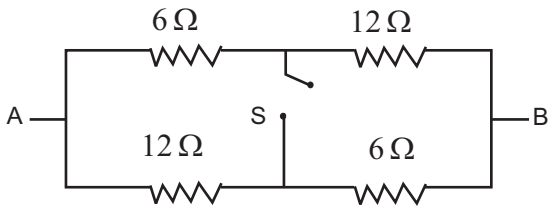
Q.19 What do you understand by polarisation of dielectric? Hence establish the relation K=1+y 3

Q.20 State principle of Potentiometer. How is it used to determine internal resistance of a cell? 3

Q.21 Find the equivalent resistance of the network shown in the figure between the points A and B when

(a) Switch is open

(b) Switch is closed



OR

State and verify Wheatstone bridge principle. 3

Q.22 State Biot-Savarts law. Derive an expression for magnetic field at the center of circular coil of n-turns carrying current I. 3

OR

State Ampere-circuital law and find expression for magnetic field due to a solenoid using this law.

Q.23 What are the parameters of earth's magnetic field. Explain them. 3

Q.24 Describe construction and working of astronomical telescope. Find expression for magnifying power when final image is formed at infinity. 3

Q.25 Stating Bohr's postulates obtain an expression for the radius of first orbit of Hydrogen atom. 3

Q.26 What is meant by Root square value of alternating current. Derive an expression for r.m.s. value of A.C. 1,3

Q.27 State Huygen's principle and prove laws of refraction on its basis. 2,2

OR

What is interference of light? Find an expression for fringe width in Young's double slit experiment. 1,3

Q.28 With the help of a labelled circuit diagram, explain how an n-p-n transistor can be used as amplifier in common emitter configuration. Explain how the input and output voltage are out of phase by 180^0 for a common emitter transistor amplifier. 4

SOLUTIONS +2 PHYSICS

Q.1 **If the distance between two plates of a parallel plate capacitor is doubled, its capacitance.**

(a)increases two times(b)decreases two times

(c) increases 4 times (d) decreases 4 times

Ans. (b)

Explanation : $C = \frac{E_o A}{d}$ $C' = \frac{E_o A}{2d}$

Q.2 **Dimensional formula of current density is :-**

(a) $[ML^{-2}T^0A]$ (b) $[ML^2T^{-2}A]$

(c) $[M^0L^{-2}T^0A]$ (d) None of these

Ans. (c)

Explanation : $J = \frac{I}{A} = \frac{A}{L} \Rightarrow [M^0L^{-2}T^0A]$

Q.3 **What is the magnitude of the force experienced by a stationary charge when placed in uniform magnetic field?**

(a) $F = q\vartheta B \sin\theta$ (b) $F = q\vartheta B$

(c) $F = zero$ (d) None of these

Ans (c).

Explanation : $F = q\vartheta B \sin\theta$

for stationary charges ϑ =O So F=O

Q.4 **S.I unit of Admittance is**

(a) Ohm (b) Mho

(c) Henry (d) Tesla

Ans. (b)

Explanation : Admittance $= \frac{1}{\text{impedance}} = \frac{1}{\text{Ohm}} = \text{mho}$

Q.5 **Who was the first to give a practical demonstration of the production of e.m. wave?**

(a) J.C. Bose (b) Marconi

(c) Maxwell (d) Hertz

Ans. (d)

Q.6 **Refractive index of glass and that of water w.r.t. aie 3/2 and 4/3 respectively. The refractive index of glass w.r.t. water is.**

(a) $\frac{8}{9}$ (b) $\frac{9}{8}$

(c) $\frac{7}{6}$ (d) 2

Ans. (b)

Explanation :- $^{a}n_{g} = \frac{n_g}{n_a} = \frac{3}{2} \Rightarrow {}^{w}n_{g} = \frac{n_g}{n_w} = \frac{\frac{3}{2}}{\frac{4}{3}} = \frac{9}{8}$

$^{a}n_{w} = \frac{n_w}{n_a} = \frac{4}{3}$

Q.7 **Which of the following illustrates the particle like nature of light.**

(a) Interference (b) Diffraction

(c) Dispersion (d) Photoelectric effect 1

Ans. (d)

Q.8 **Which ray contains positively charged particle?**

(a) $\alpha - Rays$ (b) $\beta - Rays$

(c) $\gamma - Rays$ (d) $X - Rays$

Ans. (a)

Q.9 **The Boolean expression for NOR gate is :**

(a) $A + B$ (b) $\overline{A + B}$

(c) $A.B$ (d) $\overline{A.B}$

Ans. (b)

Q.10 **Donor energy level in N-type Semiconductor lies :**

(a) Between V.B. and C.B (b) Just below the conduction band

(c) Just above the V.B. (d) None of these

Ans. (b)

Q.11 **What are eddy currents? How can they be reduced?**

Ans. **Eddy Currents :-** The induced circulating currents produced in a conductor itself when the amount of magnetic flux linked with the conductor changes are called eddy currents. Commonly metallic cores are used in electrical devices like transformer, dynamo, choke etc which are generally solid metallic cores. The eddy currents in these cores minimised by :-

(I) Replacing solid metallic cores into large no. of thin sheets.

(ii) By laminating these sheets.

Q.12 Give two uses of each.

Ans. **Infrared Rays :-**

(I) They are used in revealing the secret writing on ancient walls.

(ii) Infrared lamps are used to treat muscular strains.

Microwaves :-

(i) Microwaves are used in radar system for aircraft navigation.

(ii) Microwaves are used in weather radar.

OR

Give four properties of E.M. waves.

Ans. **Properties of E.M. Waves :-**

(i) E.M. waves do not require any material medium for their propagation.

(ii) E.M. waves are transverse in nature.

(iii) E.M. waves travel with the speed of light i.e. $3 \times 10^8 ms^{-1}$

(iv) An accelerated charge is the source of E.M. waves.

Q.13 What is mirage? Explain its cause.

Ans. **Mirage :-** Mirage is an optical illusion generally takes place in deserts during hot summer day. The density of air closer to the surface of earth reduces. Hence refractive index of air close to earth decreases. It means air close to earth behaves as rarer medium as compared to at high altitude. As the ray of light from distant object travel toward the observer on the hot surface of earth, it bend more and more away from the normal. When the angle of incidence becomes greater than he critical angle, the ray of light suffer total internal reflection and object appears to be inverted to the observer like object near the pond of water.

Q.14 The angle of prism is 30^0. The rays incident at 60^0 on one refracting surface suffers a deviation of 30^0. Calculate angle of emergence.

Ans :- We know for prism $A+\delta = i+e$

Here $A = 30^0 \Rightarrow e = A+\delta-i$

$i = 60^0$ $e = 30^0+30^0-60^0 = 0$

$\delta = 30^0$

$e = ?$

Q.15. Derive an expression for de- Broglie wavelength of an electron moving under a pot difference of V volts.

Ans :- We know de Broglie's wavelength for a particle of mass 'm' moving with the velocity 'ϑ'

is given by $\lambda = \frac{h}{m\vartheta} \rightarrow (1)$

when a beam of electrons travelling through a potential difference of 'V' volt, then electron acquires the kinetic energy

$\frac{1}{2}mv^2 = eV$

$mv^2 = 2eV$

multiplying both sides by m :-

$m^2v^2 = 2meV$

$mv = \sqrt{2meV}$

Substituting value of mv in equation (1)

$\lambda = \frac{h}{\sqrt{2meV}}$

Putting the values $h = 6.625\times10^{-34}JS \quad m = 9.1\times10^{-31}kg$

$e = 1.6\times10^{-19}C$

$$\lambda = \frac{6.625\times10^{-34}}{\sqrt{2\times9.1\times10^{-31}\times1.6\times10^{-19}V}} = \frac{12.27\times10^{-10}}{\sqrt{V}}m \quad or \quad \frac{12.27}{\sqrt{V}}A^0$$

Q.16 Write three importance factors which justify the need of modulating a message signal.

Ans. **Need For Modulation :-** Generally message signals are of very low frequencies. The very low frequencies are poor to radiate. They die out after covering small distances in air. So these low frequency signals need to be

superimposed on high frequency carrier waves called modulation. Following are the three important factors :-

(i) Height of the transmitting Antenna :-

For transmitting signals we need antenna. The height of antenna must be 1/4th of the wavelength of transmitting antenna. Suppose we wish to transmit audio frequency range i.e. 15 Khz

$$\lambda = \frac{c}{\vartheta} = \frac{3\times10^8}{15\times10^3} = 2\times10^4 m \quad or 20\ km$$

Hence minimum height $= \frac{1}{4}\times 20km = 5km$

and the antenna of virtual height 5km is practically impossible. So to decrease height frequency should be greater and that can be achieved by modulation.

(ii) Effective power radiated out by antenna :-

Power $\alpha \frac{1}{\lambda^2}$

For covering more area, power should be greater i.e. λ should be small or frequency should high.

(iii) Mixing up of Signals :- At low frequencies signals mixed up and we cannot differentiate the who is speaking and for what? Again solution is to increase frequency.

Q.17 What is ground wave communication. On what factors does the maximum range of propagation in this mode depends.

Ans:- **Ground Wave Propagation :-** In ground wave propagation radio waves travel along the surface of earth. Earth is itself a conductor. So due to induction effect a greater amount of energy get absorbed by earth, and signal gets weaken called the attenuation. That is why ground wave propagation is used to transmit the frequencies below than 1500 KHz. If h be the height of transmitting antenna R be the radius of earth, then coverage distance.

$$d = \sqrt{2Rh}$$

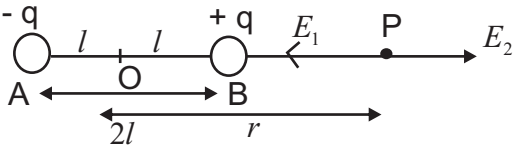
(I) $d \alpha \sqrt{R}$ (Radius should be greater)

(ii) $d \alpha \sqrt{h}$ (Height of antenna should be large)

Q.18 What is electric dipole? Find expression for electric field intensity at any point on the axial line of an electric dipole.

Ans:- **Electric dipole :-** Two equal and opposite charges separated by a certain distance between them form an electric dipole.

Expression :- Consider an electric dipole consisting of -q and +q charge separated by 2*l* distance between them.



Let P be the point where electric field intensity is to be determined so that OP=r
Let E_2 is the electric field intensity due to-q charge at point A.

$$\therefore \quad E_1 = \frac{q}{4\pi \in_0 AP^2} \qquad Along \ PA$$

$$PA = r + l$$

$$\therefore \quad E_1 = \frac{q}{4\pi \in_0 (r+l)^2} \longrightarrow (1) \qquad = \frac{q}{4\pi \in_0 (r+l)^2}$$

Let E_2 is the electric field intensity due to +q charge at point B

$$\therefore \quad E_2 = \frac{q}{4\pi \in_0 BP^2} \qquad \text{Along BP Produced}$$

$$BP = r - l$$

$$\therefore \quad E_2 = \frac{q}{4\pi E_0 (r-l)^2} \longrightarrow (2)$$

Net electric fiel $\vec{E} = \vec{E}_2 - \vec{E}_1$

i.e. $$E = \frac{q}{4\pi \in_0 (r-l)^2} - \frac{q}{4\pi \in_0 (r+l)^2}$$

$$\therefore E = \frac{q}{4\Pi \in_0} \left[\frac{1}{(r-l)^2} - \frac{1}{(r+l)^2} \right]$$

$$E = \frac{q}{4\pi \in_0} \left[\frac{(r+l)^2 - (r-l)^2}{(r^2 - l^2)^2} \right]$$

$$E = \frac{q}{4\pi \in_0} \left[\frac{4rl}{(r^2 - l^2)^2} \right] \quad \Rightarrow \quad \frac{q \times 2l \times 2r}{4\pi E_0 (r^2 - l^2)^2}$$

$q \times 2l = \vec{P}$ (Electric dipole moment)

Hence $\vec{E} = \dfrac{\vec{P} \times 2r}{4\pi \in_0 (r^2 - l^2)^2}$

For short electric dipole $l << r$

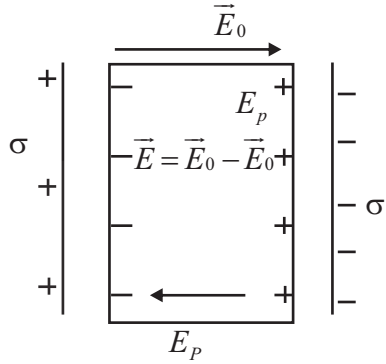
$$\therefore \vec{E} = \frac{\vec{P} \times 2r}{4\Pi \in_0 r^4} \quad or \quad \vec{E} = \frac{2\vec{P}}{4\Pi \in_0 r^3}$$

$$or \ \vec{E} \ \alpha \ \frac{1}{r^3}$$

Q.19 What do you understand by polarisation of dielectric? Hence establish the relation K=1+Y.

Ans:- **Polarisation of Dielectric :-** The process of inducing equal and opposite charges on two opposite faces of the dielectric on the application of electric field is known as polarisation of dielectric.

Relation :- Consider a dielectric is placed between two plates of external electric field having surface charge densities to $+\sigma \ and \ -\sigma$ Due to induction effect equal amount of opposite charges will be produced on the faces of dielectric. Hence reduced value of electric field.



$$\vec{E} = \vec{E}_o - \vec{E}_p$$

$$or \quad E_o = E + E_p \Rightarrow E_o = E\frac{+\sigma P}{E_o} \qquad \left[\because \ \sigma p = P \ Polarisation \ vector\right]$$

$$\therefore \ E_o = E + \frac{P}{E_o}$$

$$P = H_e E_o E \qquad \left[\because \frac{E_o}{E} = K \text{ Dielectric constant}\right]$$

$$\therefore E_o = E + \frac{H_e \cancel{E_o} E}{\cancel{E_o}}$$

$$E_o = E\left[1 + H_e\right]$$

$$\frac{E_o}{E} = 1 + H_e$$

Q.20 State principle of Potentiometer. How is it used to determine internal resistance of a cell?

Ans:- **Principle of Potentiometer :-** It works on the principle that potential difference across any part of the uniform wire is directly proportional to the length of that portion, provided constant current should flow through the wire.

Acc. to Ohm's Law V=1R

$$R = \delta \frac{l}{A}$$

$$\therefore V = I\delta \frac{l}{A} \Rightarrow V = \left(\frac{I\delta}{A}\right) l$$

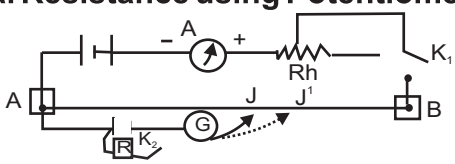
$$\frac{I\delta}{A} = \text{Constant } K$$

Hence $V = Kl$

$or \quad v \alpha l$

Determination of Internal Resistance using Potentiometer:-

Consider Auxillary Circuit diagram of Potentiometer



Step 1 :- Close the key K_1 keeping key K_2 open. Find the point on the length of wire by sliding jockey so that galvanometer shows no deflection. Let it will be J and $AJ = l_1$

$$\therefore E = Kl_1 \rightarrow (1)$$

Step 2 :- Now close the key K_2 , so that resistance (known) R connected across the cell. Now again move the Jockey over the length of wire and again find null point. Let this point is J^1 and $AJ^1 = l_2$

$$\therefore V = Kl_2 \rightarrow (2)$$

Dividing (1) by (2) :-

$$\frac{E}{V} = \frac{l_1}{l_2} \rightarrow (3)$$

We know that internal resistance of cell is given by

$$r = \left(\frac{E}{V} - 1\right) R$$

Using $\therefore \quad eqn$ (3)

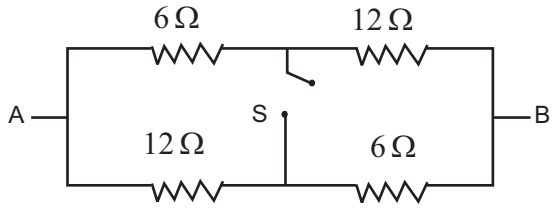
$$\boxed{r = \left(\frac{l_1}{l_2} - 1\right) R}$$

Q.21 Find the equivalent resistance of the network shown in the figure between the point A and B when

(a) Switch is open

(b) Switch is closed

Ans:-



(a) In open switch 6Ω and 12Ω are in series

so eq. resistance = $6+12=18\Omega$

$$\therefore \quad \frac{1}{R_p}=\frac{1}{18}+\frac{1}{18}=\frac{2}{18}=\frac{1}{9}$$

$$or \quad R_P=9\Omega$$

(b) In closed switch 6Ω and 12Ω are in parallel

$$\therefore \quad \frac{1}{R_p}=\frac{1}{6}+\frac{1}{12}=\frac{2+1}{12}=\frac{3}{12}=\frac{1}{4}$$

$$\therefore R_P=4\Omega$$

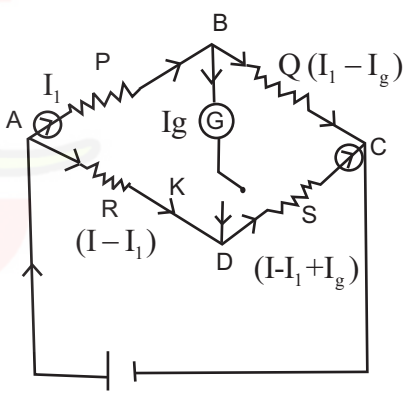
Now 4Ω and 4Ω are in series

$$\therefore \text{Req.}=4+4=8\Omega$$

OR

Wheatstone Bridge Principle :-

Wheatstone bridge principle is the arrangement of four resistors in the form of a bridge used for measuring one unknown resistor in terms of other three known resistors.



Let P, Q, R, and S be four resistors, Let P, Q, R are known and S is unknown. Adjust P, Q, R so that galvanometer shows no deflection by closing key K.

$$\therefore \quad \frac{P}{Q}=\frac{R}{S}\Rightarrow S=\left(\frac{Q}{P}\right)R$$

Applying Kirchoff's loop law in closed loop ABDA :-

$$I_1P+I_gG-(I-I_1)R=0 \qquad \because [I_g=0]$$

$$I_1P\text{-}(I-I_1)R=0$$

$$\therefore \quad I_1P=(I-I_1)R \longrightarrow \text{(i)}$$

Now applying Kirchoff's loop law in closed loop BCDB :-

$$(I_1\text{-}I_g)Q-(I\text{-}I_1+I_g)\delta-I_gG=0 \qquad \because [I_g=0]$$

$$I_1Q-(I-I_1)S=0$$

$$I_1Q=(I\text{-}I_1)S \longrightarrow (ii)$$

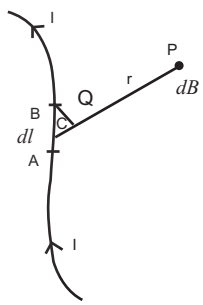
Dividing (I)by (ii) :-

$$\frac{P}{Q}=\frac{R}{\delta}$$

Q.22 State Biot-Starts law. Derive an expression for magnetic field at the center of circular coil of n-turns carrying current.

Ans :- **Biot-Savart's Law:-** Biot-Savart's law is used to determine the strength of magnetic field at any point due to a current carrying conductor.

Consider a very small element AB of length dl carrying current I. Then strength of magnetic field dB at P at a distance r from current element.



(i) $dB \alpha dl$

(ii) $dB \alpha l$

(iii) $dB \alpha \text{Sin}\theta$

(iv) $dB \alpha \frac{l}{r^2}$

$$\therefore dB \alpha \frac{Idl\text{Sin}\theta}{r^2} \Rightarrow dB=\frac{KIdl\text{Sin}\theta}{r^2}$$

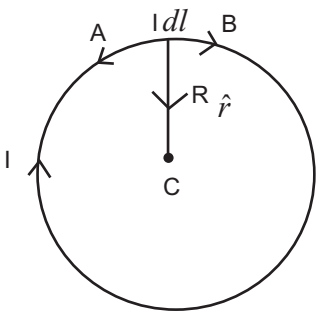
$$i.e\ dB=\frac{u_0}{4\Pi}\frac{Idl\text{Sin}\theta}{r^2} \qquad \left[\because K=\frac{u_0}{4\pi}\right]$$

Expression for magnetic field at the centre of circular coil carrying current I

Consider a circular coil of radius R carrying current I

As per Biot-Savart's law magnetic field.

at point C due to current element AB is given by :-



$$\overrightarrow{dB}=\frac{u_0}{4\pi}\frac{I\overrightarrow{dl}\times\hat{r}}{R^2}$$

Angle between $\overrightarrow{dl}$ and $\hat{r}$ is $90^0=dl\,\text{Sin}90^0=dl$

$$\therefore dB=\frac{u_0}{4\pi}\frac{Idl}{R^2}$$

Integrating both sides :-

$$B=\frac{u_0}{4\pi}\frac{I}{R^2}\int dl \Rightarrow \frac{u_0}{4\pi}\frac{I}{R^2}2\pi R$$

$$\therefore B=\frac{u_0}{4\pi}\frac{2\pi I}{R}\delta$$

Since coil has n-turns

$$\therefore B = \frac{u_0}{4\pi}\frac{2\pi\ nI}{R}$$

OR

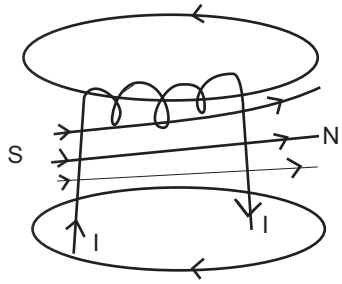
State Ampere-circuital law and a find expression for magnetic field due to a solenoid wing this law.

Ampere-Circuital Law :- Acc. to this law the line integral of the magnetic field around any closed path in free space is equal to absolute permeability (U_0) times the net current enclosed by that closed surface.

$$i.e \quad \int \vec{B}.\ \vec{dl} = \mathrm{u_0 I}$$

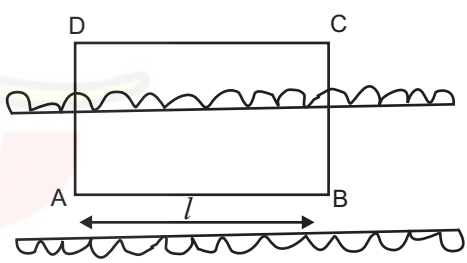
Magnetic field due to Current Carrying Solenoid :-

Consider a very long solenoid having n turns per unit length. Let current I be flowing through solenoid. The magnetic field inside the solenoid is uniform, strong and directed along the axis of the solenoid but outside the solenoid it is very weak and neglected.



Consider a rectangular Loop ABCD as shown in fig.

$\vec{B}$ is perpendicular to paths BC and AD and CD arm lies outside solenoid.



Step I :-

$$\therefore \quad \oint \vec{B}.\vec{dl} = \int_A^B \vec{B}.\vec{dl} + \int_B^C \vec{B}.\vec{dl} + \int_C^D \vec{B}.\vec{dl} + \int_D^A \vec{B}.\vec{dl} \qquad \rightarrow (i)$$

$$\therefore \int_B^C B\ dl\ \ \mathrm{Cos}\,90^0 = \int_D^A B\ dl\ \ \mathrm{Cos}\,90^0 = 0$$

Also $\int_C^D \vec{B}\,.\,\vec{dl} = 0$

$$\therefore \oint \vec{B}.\vec{dl} = \int_A^n B\ dl Cos0^0 = B\int dl = Bl \qquad \rightarrow (ii)$$

Step II :- Acc. to Ampere circuital law:-

$\oint \vec{B}.\vec{dl} = uo \times$net current in loop ABCD

$= u_0 nlI \longrightarrow (iii)$

from (ii) and (iii) :-

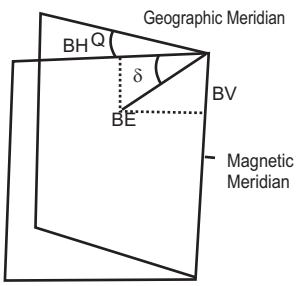
$Bl = U_0 nlI \quad or \quad B = U_0 nI \quad \text{Since } n = \frac{N}{l}$

$$\therefore B = \frac{u_0 NI}{l}$$

Q.23 What are the parameters of earth's magnetic field. Explain them.

Ans:- **Parameter's of Earth's Magnetic field :-**

The magnitude and direction of Earth's magnetic field at a place is given by three parameters.



(i) Magnetic Declination :- Magnetic declination at a place is the angle between Geographic meridian and at the place. Magnetic declination Q is lessnear the equator and more at higher altitudes. The declination in India is small.

(ii) Magnetic Inclination :- Magnetic Inclination is the angle between the direction of total strength of earth's magnetic field and horizontal line in magnetic meridian. It is shown by δ in diagram . δ is 90^0 at poles and 0^0 at equator. It can be measured with the help of instrument called Dip-circle.

(iii) Horizontal Component :- The component of total intensity of magnetic field of earth in the horizontal direction in magnetic meridian is called horizontal component.

$B_H = B_E \ \text{Cos}\delta \longrightarrow$ (i)

$B_V = B_E \ \text{Sin}\delta \longrightarrow$ (ii)

Squaring and adding (I)and (ii) :-

$B_{H^2} + B_{V^2} = B_{E^2} \ [\text{Sin}^2\delta \quad \text{Cos}^2\delta$

$\therefore \ B_E = \sqrt{B_{H^2} + B_{V^2}}$

Dividing (ii) by (I)

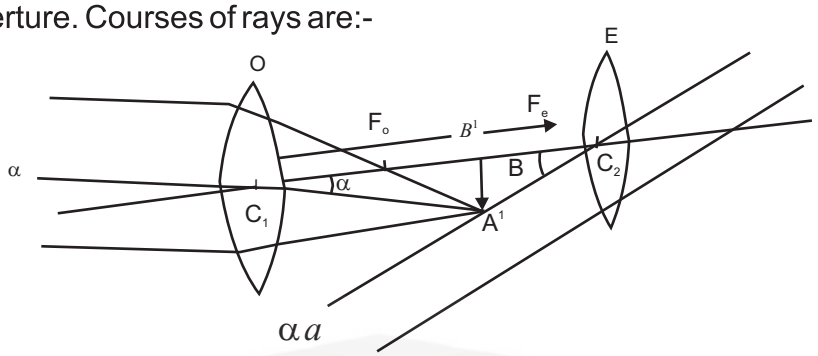
$\frac{B_V}{B_H} = \tan\delta$

B_H can be measured with magnetometer.

Q.24 Describe construction and working of astronomical telescope. Find expression for magnifying power when final image is formed at infinity.

Ans:- **Astronomical Telescope :-** Telescope is an optical instrument used for observing magnified images of distant objects.

Construction :- It consist of two convex lenses, an objective lens of larger focal length and large aperture, an eye piece of smaller focal length and small aperture. Courses of rays are:-



Magnifying Power :- It may be defined as the ratio of the angle subtended by the final image at an eye to the angle subtended by the object at an eye. $M.P = \frac{\beta}{\alpha}$

If α, β are small then $M.P = \frac{\tan\beta}{\tan\alpha}$

from diagram $\tan\beta = \frac{A'B'}{C_2B'}$

$$\tan\alpha = \frac{A'B'}{C_1B'}$$

$$M.P = \frac{A'B'}{C_2B'} \times \frac{C_1B'}{A'B'} = \frac{C_1B'}{C_2B'}$$

Since object lies at α image formed at focus so $C_1B' = fo$

Since image formed ϑ object lies at focus so $C_2B' = -fe$

$$\therefore \quad M.P = \frac{fo}{-fe}$$

$$or \quad M.P = \frac{fo}{|fe|}$$

Q.25 Stating Bohr's Postulates obtain an expression for the radius of first orbit of Hydrogen atom.

Bohr's Postulates:-

Ans:- (i) An atom will consists of positively charged sphere in which entire mass and positive charge supposed to be concentrated called atomic nucleus.

(ii) The electrons revolve around the nucleus in certain permitted orbits and

centripetal force is provided to the electrons due to force (electrostatic) of attraction between nucleus and electrons.

i.e. $\frac{mv^2}{r} = \frac{1}{4\pi E_0}\frac{Ze.e}{r^2}$

or $\frac{mv^2}{r} = \frac{kze^2}{r^2} \rightarrow (i)$ $\qquad$ $Where\ k = \frac{1}{4\pi \in_0}$

(iii) Only those electrons can revolve around the nucleus for which angular momentum is equal to integral multiple of

$\frac{h}{2\pi}$ $\quad ie \quad mur\frac{nh}{2\pi} \rightarrow (ii)$

(iv) The radiation of energy will take place when electrons jumps from one permitted orbit to another.

ie $h\vartheta = E_2 - E_1$ or $E_f - E_i$

Expression for Radius of Ist orbit of H-atom :-

from eq^n (ii)

$$\vartheta = \frac{nh}{2\pi mr}$$

Putting value of ϑ in equation (i)

$$\frac{mv}{r}\ \frac{n^2h^2}{4\pi^2m^2r^2} = \frac{kZe^2}{r^2}$$

or $r = \frac{n^2h^2}{4\pi^2 m\ kZe^2}$ $\qquad$ or $\quad r\ \alpha\ n^2$

For H-atom in Ist orbit n=1 z=1

$$r = \frac{h^2}{4\pi^2 m\ ke^2} \qquad k = \frac{1}{4\pi E_0}$$

$$r = \frac{h^2 4\pi E_0}{4\pi^2 m\ e^2} \qquad \text{or} \quad \boxed{r = \frac{h^2 E_0}{\pi m\ e^2}}$$

Q.26 What is meant by Root square value of alternating current. Derive an expression for r.m.s. value of A.C.

Root Mean Square Value of A.C.

Ans:- It is that value of steady current which producers the same amount of heat in a conductor or in a resistor in a certain time as is produced by the source of e.m.f. through the same conductor over the same full cycle time.

Expression :- Let $I = I_o Sin\ wt$

Heat produced in a conductor is given by

$$dH = I^2 R dt = I_O^{\,2}\ \mathrm{Sin}^2 wt\ R dt$$

Integrating both sides :- $\int dH = \int_O^T I_o^{\,2} R \mathrm{Sin}^2 wt\ dt$

$$H = I_0^2 R \int_O^T \mathrm{Sin}^2\ wt\ dt \qquad \left[\because\ \mathrm{Sin}^2\ wt = \frac{1-\mathrm{Cos}2\ wt}{2}\right]$$

$$H = I_o^{\,2} R \int_O^T \left(\frac{1-\cos 2\ wt}{2}\right) dt$$

$$H = \frac{I_O^{\,2} R}{2}\left[\int_O^T dt - \int_O^T \mathrm{Cos}2\ wt\ dt\right]$$

$$H = \frac{I_o^2 R}{2}\left[T - \left\{\frac{\sin 2\ wt}{2w}\right\}_o^T\right]$$

I

$$H = \frac{I_O^{\,2} R}{2}\left[T - \frac{1}{2w}\left\{\mathrm{Sin}\,2.\frac{2\pi}{\cancel{T}}.\cancel{T} - \mathrm{Sin}\,o^0\right\}\right] \qquad \left[\because\ \mathrm{Sin}4\pi = \mathrm{Sino}^0 = 0\right]$$

$$H = \frac{I_O^{\,2} RT}{2}$$

If I r.m.s. be the root mean square value of A.C.

$$\therefore\ H = \mathrm{Ir.ms}^2.\ RT$$

$$\therefore\ \mathrm{Ir.m.s}^2.\cancel{R}T = \frac{I_O^{\,2}\mathrm{ms}.\cancel{R}T}{2}$$

$$\text{or}\ \boxed{\mathrm{Irm.s} = \frac{I_O}{\sqrt{2}} = 0.707\ I_O}$$

Q.27 State Huygen's principale and prove laws of refraction on its basis.

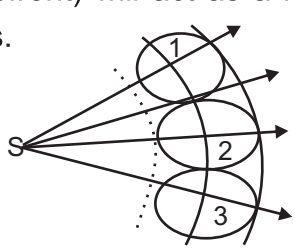
Ans:- **Huygen's Principle :-**

Huygen's principle gives the geometrical construction of wave front.

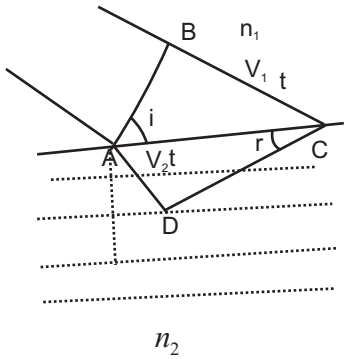
Acc. to Huygen's Principle :-

(i) Each point on the given wavefront (Primary wavefront) will act as a new source of disturbance called the secondary wavelets.

(ii) Only the forward envelop enclosing the tangents at the secondary wavelets gives the new position of the wavefront called secondary wavefront.



Laws of Refraction :-



(I) Let AB be the plane wave front incident on the interface separating between rarer and denser medium.
Let v_1 and v_2 be the speeds of light in two media.

So that $n = \frac{v_1}{v_2} \quad \rightarrow (i)$

In rarer median distance travelled by light $BC = v_1 t$
Draw an arc of radius $v_2 t$ and draw tangent BC
So that $AD = v_2 t$
In rt $\angle ed\ \Delta ABC :-$

$$\text{Sin } i = \frac{BC}{AC} = \frac{v_1 t}{AC} \quad \rightarrow (ii)$$

In rt $\angle ed\ \Delta ADC :-$

$$\text{Sin } r = \frac{AD}{AC} = \frac{v_2 t}{AC} \quad \rightarrow (iii)$$

Dividing (ii) by (iii)

$$\frac{\text{Sin } i}{\text{Sin } r} = \frac{v_1 t}{AC} \times \frac{AC}{v_2 t} = \frac{v_1}{v_2}$$

From eq^n (i) :-

$$n = \frac{v_1}{v_2} \quad \text{or} \quad \boxed{n = \frac{\text{Sin } i}{\text{Sin } r}}$$

Which is Snell's Ist law

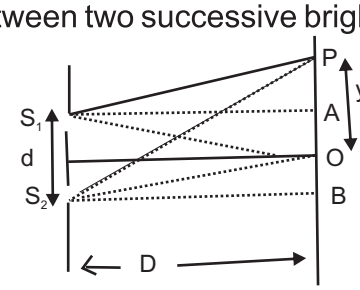
(ii) Incident ray, refracted ray and thenormal lie in the same plane.

OR

What is interference of light? Find an expression for fringe width in Young's double slit experiment.

Ans:- **Interference of Light :-** The phenomenon of redistribution of light energy due to superimposition of light waves coming from two coherent sources is known as interference of light.

Expression for Fringe Width :- The distance between two successive bright and dark fringes is known as fringe width.
Consider two choerent sources S_1 and S_2 separated by distance d.
Light waves emitted from S_1 and S_2 meets



at O in the same phase. So O is bright fringe. Let waves coming from S_1 and S_2 meets at screen at point P at a distance y from central fringe.

The path difference between these waves is given by :-

$$\Delta x = S_2P - S_1P$$

In rt. ∠ed ΔS_2BP:-

$$S_2P = \left[S_2B^2 + PB^2\right]^{1/2}$$

$$S_2P = \left[D^2 + \left(y + \frac{d}{2}\right)^2\right]^{1/2}$$

$$S_2P = D\left[1 + \frac{\left(y + \frac{d}{2}\right)^2}{D^2}\right]^{1/2}$$

Using Binomial expression :-

$$S_2P = D\left[1 + \frac{\left(y + \frac{d}{2}\right)^2}{2D^2}\right] \rightarrow (1)$$

Similarly

$$S_1P = D\left[\frac{1 + \left(y - \frac{d}{2}\right)^2}{2D^2}\right] \rightarrow (2)$$

$$\Delta x - S_2P - S_1 = D\left[\frac{1 + \left(y + \frac{d}{2}\right)^2}{2D^2} - 1 - \frac{\left(y - \frac{d}{2}\right)^2}{2D^2}\right]$$

$$\Delta x = \frac{D}{2D^2}\left[\left(y + \frac{d}{2}\right)^2 - \left(y - \frac{d}{2}\right)^2\right]$$

$$\Delta x = \frac{yd}{2} \cdot \frac{2}{D} = \frac{dy}{D}$$

For constructive interference :-

$$\frac{yd}{D} = m\lambda$$

$$y = \frac{Dm\lambda}{d}$$

$m = 0 \;\; y_0 = 0$

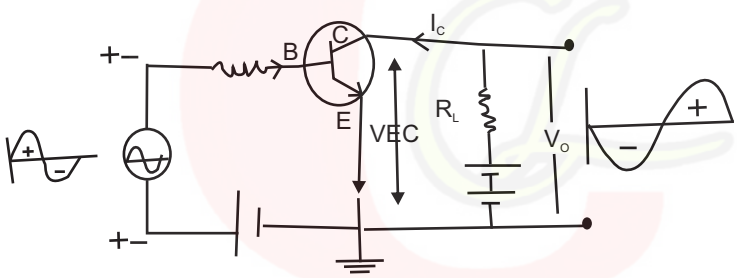
$m = 1 \;\; y_1 = \frac{D\lambda}{d}$

Fringe width $\beta = y_1 - y_0 = \frac{D\lambda}{d}$

$\boxed{\beta = \frac{D\lambda}{d}}$ is the required relation for fringe width.

Q.28 With the help of a labelled circuit diagram, explain how an n-p-n transistor can be used as amplifier in common emitter configuration. Explain how the input and output voltage are out of phase by 180^0 for a common emitter transistor amplifier.

Ans:- Common emitter $n-p-n$ transistor as an Amplifier :-



Amplifier is a device used to obtain enlarged version of the input signal.

Working :- Since input circuit is always forward biased. The majority charge carriers i.e. electrons in emitter gets repelled by -ve terminal of battery since base is lightly dooped. Only five percent of in neutralised with holes at base resulting 5% I_e at base and remaining 95% of electrons are collected by collector due to +ve terminal of battery resulting 95% I_e at collector, thereby satisfying the condition

$I_e = I_b + I_c \qquad \rightarrow (i)$

Also $V_o = VEC - I_C R_L \qquad \rightarrow (ii)$

Phase Relation between Input And Output Voltage:-

During +ve half of input signal, input signal is forward biased so emitter current increases, collector current also increases. From equation (ii) output voltage decreases. Since it is connected to the +ve terminal of battery it will become less positive which corresponds to the -ve half cycle of output signal.

During -ve half cycle of input signal, it opposes the forward biasing of input signal, so emitter current decreases, collector current also decreases. From equation (ii) output voltage increases. Since it is connected to +ve terminal of battery, it becomes more positive, which corresponds to +ve half cycle of output signal.

That is why input and output signals i.e. voltages are out of phase by 180^0 for common emitter transistor amplifier.