ISC Solved Paper 2018

Physics

Class-XII

(Maximum Marks : 80)

(Time allowed : Three hours)

Answers to this paper must be written on the paper provided separately.

*You will **not** be allowed to write during the first **15** minutes.*

This time is to be spent in reading the question paper.

The time given at the head of this paper is the time allowed for writing the answers.

***Section I** is compulsory. Attempt **any four** question from **Section II**.*

The intended marks for questions or parts of questions are given in brackets [ ].

SECTION-A

1. A. Choose the correct alternative (a), (b), (c) or (d) for each of the questions given below: [5×1]

***(i) The order of coloured rings in a carbon resistor is red, yellow, blue and silver. The resistance of the carbon resistor is:**

(a) $24 \times 10^{6}\,\Omega \pm 5\%$

(b) $24 \times 10^{6}\,\Omega \pm 10\%$

(c) $34 \times 10^{6}\,\Omega \pm 10\%$

(d) $26 \times 10^{6}\,\Omega \pm 5\%$

(ii) A circular coil carrying a current I has radius R and number of turns N. If all the three, i.e., the current I, radius R and number of turns N are doubled, then, magnetic field at its Centre becomes:

(a) Double **(b)** Half

(c) Four times **(d)** One fourth

(iii) An object is kept on the principal axis of a concave mirror of focal length 10cm, at a distance of 15 cm from its pole. The image formed by the mirror is:

(a) Virtual and magnified

(b) Virtual and diminished

(c) Real and magnified

(b) Real and diminished

(iv) Einstein's photoelectric equation is:

(a) $E_{max} = h\lambda - \varphi_0$ **(b)** $E_{max} = \frac{hc}{\lambda}\varphi_0$

(c) $E_{max} = h\lambda + \varphi_0$ **(d)** $E_{max} = \frac{hc}{\lambda} + \varphi_0$

(v) In Bohr's model of hydrogen atom, radius of the first orbit of an electron is r_0. Then, radius of the third orbit is:

(a) $\frac{r_0}{9}$ **(b)** r_0

(c) $3r_0$ **(d)** $9r_0$

(B) Answer the following questions briefly and to the point. [7×1]

(i) In a potentiometer experiment, balancing length is found to be 120 cm for a cell E_1 of emf 2V. What will be the balancing length for another cell E_2 of emf 1.5V? (No other changes are made in the experiment.)

(ii) How will you convert a moving coil galvanometer into a voltmeter?

(iii) A moving charged particle q travelling along the positive x-axis enters a uniform magnetic field $\vec{B}$. When will the force acting on 'q' be maximum?

(iv) Why is the core of a transformer laminated?

***(v) Ordinary (i.e., unpolarised) light is incident on the surface of a transparent material at the polarising angle. If it is partly reflected and partly refracted, what is the angle between the reflected and the refracted rays?**

(vi) Define coherent sources of light.

(vii) Name a material which is used in making control rods in a nuclear reactor.

***Out of Syllabus**

Ans.

A. **(ii)** **(a)** Double **1**

(iii) **(c)** Real and magnified **1**

(iv) **(b)** $E_{max} = \frac{hc}{\lambda} - \varphi_0$ **1**

(v) **(d)** $9r_0$ **1**

B. **(i)** Let l_1 be the balancing length for cell E_1 and l_2 for the cell E_2

$\frac{E_1}{E_2} = \frac{l_1}{l_2}$ (If no changes are made in the experiment)

$$\frac{2V}{1.5V} = \frac{120}{l_2} \Rightarrow l_2 = \frac{120 \times 1.5\,\text{cm}}{2} = 90\,\text{cm}$$ **1**

(ii) To convert a moving coil galvanometer into a voltmeter, a very high resistance known as 'series resistance' is connected in series with the galvanometer. **1**

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

$|\vec{F}| = qvB\sin\theta$

When $\theta = 90°$, F will be maximum. That is, when the particle moves perpendicular to the magnetic field, the force acting on it will be maximum. **1**

(iv) The core of the transformer is laminated to reduce the heating effect of the eddy currents. **1**

(vi) Two sources are said to be coherent when the waves emitted from them have same frequency and constant phase difference. **1**

(vii) Cadmium, boron → neutron absorbing material, **1**

SECTION-B

*Attempt **all** questions*

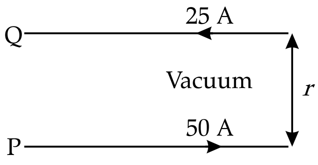
2. Define current density. Write an expression which connects current density with drift speed. [2]

Ans. Current density is defined as the amount of current flowing per unit cross-sectional area of a material.

$$\vec{J} = \frac{\vec{I}}{A} = ne\ \vec{n}_d$$

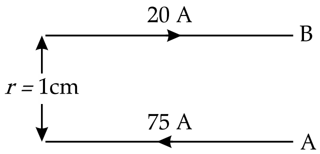
Where 'n' is the concentration of electrons and $\vec{n}_d$ is the drift velocity of the electrons. **2**

3. (a) A long horizontal wire P carries a current of 50A. It is rigidly fixed. Another wire Q is placed directly above and parallel to P, as shown in Figure given below. The weight per unit length of the wire Q is 0.025 Nm^{-1} and it carries a current of 25A. Find the distance '$\vec{r}$' of the wire Q from the wire P so that the wire Q remains at rest. [2]



OR

(b) Calculate force per unit length acting on the wire B due to the current flowing in the wire A. (See Figure given below)



Ans. (a) $$r = \frac{\mu_0 I_1 I_2}{2\pi\left(\frac{mg}{L}\right)}$$

given $\frac{mg}{L} = \frac{F}{L} = 0.025$ N/m

$I_1 = 50A, I_2 = 25A, \mu_0 = 4\pi \times 10^{-7}$ Hm^{-1}

$$r = \frac{4\pi \times 10^{-7} \times 50 \times 25}{2\pi \times 0.025}$$

$$= \frac{2 \times 10^{-7} \times 50 \times 25}{25} \times 1000$$

$= 100 \times 1000 \times 10^{-7} = 10^{-2}$ m

$r = 0.01$ m $= 1$ cm

$r = 10$ mm **2**

(b) $$\frac{F}{L} = \frac{\mu_0 I_1 I_2}{2\pi r}$$

$$\frac{F}{L} = \frac{4\pi \times 10^{-7} \times 20 \times 75}{2\pi \times 0.01m}$$

$= 3 \times 10^5 \times 10^{-7}$ N/m

$= 3 \times 10^{-2}$ N/m $= 0.03$ N/m **2**

4. (i) Explain Curie's law for a paramagnetic substance.

(ii) A rectangular coil having 60 turns and area of 0.4 m^2 is held at right angle to a uniform magnetic field of fl----------------------------------ux density 5×10^{-5}T. Calculate the magnetic flux passing through it. [2]

Ans. **(i)** Magnetisation of a paramagnetic material is inversely proportional to the absolute temperature.

$$M = C\frac{B_0}{T}$$

$B_o = \mu_0 nI$ and $M = \kappa H$, Also $B_o = \mu_0 H$

Where π is magnetic susceptibility

$$\kappa = \frac{M}{H} = \frac{CB_0}{TH} = \frac{C\mu_0}{T}$$

$$\kappa = \frac{C\mu_0}{T} \rightarrow \text{Curie's law}$$

$C \rightarrow$ Curie's constant

This tells us that the susceptibility is depended not only on the material but also on the sample temperature.

(ii) $\varphi = BA\cos\theta \qquad \theta = 90°$

$\varphi = 0.$

5. What is motional emf? State any two factors on which it depends. [2]

Ans. The induced emf due to the motion of electric conductor in the presence of magnetic field is called motional emf. **1**

The two factors on which it depends :

(i) Speed of electric conductor.

(ii) Magnetic field through which the conductor is moving. **1**

6. (i) What is the ratio of speed of gamma rays to that of radio waves in vacuum?

(ii) Name an electromagnetic wave which is used in the radar system used in aircraft navigation. [2]

Ans. **(i)** 1 : 1 **1**

(ii) Radio waves **1**

7. A biconvex lens made of glass (refractive index 1.5) has two spherical surfaces having radii 20 cm and 30 cm. Calculate its focal length. [2]

Ans. $R_1 = 20\text{ cm} \quad R_2 = -30\text{ cm}$

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

$$\frac{1}{f} = (0.5)\left(\frac{1}{20} - \left(\frac{-1}{30}\right)\right)$$

$$= 0.5\left(\frac{1}{20} + \frac{1}{30}\right) = 0.5\left(\frac{50}{600}\right)$$

$$\frac{1}{f} = \frac{5}{120} = \frac{1}{24}$$

$f = 24$ cm **2**

8. State any two differences between primary rainbow and secondary rainbow.

Ans.

	Primary Rainbow	Secondary rainbow
(i)	It is formed by rays that undergo one total internal reflection and two times refraction before emerging finally from water-droplets.	It is formed by rays that undergo two internal reflections and two times refraction before emerging finally from waterdroplets.
(ii)	Primary rainbow is very bright.	Secondary rainbow is less bright in comparison to primary rainbow.

1×2=2

9. (i) State de Broglie Hypothesis.

(ii) With reference to photoelectric effect, define threshold wavelength. [2]

Ans. **(i)** De Broglie proposed that moving particles of matter display wave-like properties under suitable conditions.

In other words matter posses dual nature - both particle like and wave-like. The wavelength λ associated with the particle is given as $\lambda = \frac{h}{mv}$, m is the mass of the particle, v its speed and λ is the de Broglie wavelength **1**

(ii) The maximum wavelength of incident light for a metal surface above which the incident light cannot reject electrons is called threshold wavelength for that metal. **1**

10. Calculate the minimum wavelength of the spectral line present in Balmer series of hydrogen.

Ans. **(i)** **Balmer Series**

$$\frac{1}{\lambda} = R\left[\frac{1}{2^2} - \frac{1}{n^2}\right] \qquad n = 3, 4...,$$

Minimum wavelength, n = 3

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

$R = 1.097 \times 10^7\,\text{m}^{-1}$

$$\frac{1}{\lambda} = 1.097 \times 10^7\left[\frac{1}{4} - \frac{1}{9}\right]\text{m}^{-1}$$

$$\frac{1}{\lambda} = 1.097 \times 10^7\left[\frac{5}{36}\right]\text{m}^{-1}$$

$= 1.522 \times 10^6\,\text{m}^{-1}$

$\Rightarrow \lambda = 657 \times 10^{-9}\,\text{m}$

$= 657$ nm. **2**

11. (a) What is meant by pair annihilation? Write a balanced equation for the same. [2]

***(b) What is meant by the terms half-life of a radioactive substance and binding energy of a nucleus?**

***Out of Syllabus**

Ans. **(a)** When a particle meets its antiparticle, the two annihilate each other to form 2 photons due to conservation of momentum, with sum total of energy equivalent to total mass-energy of the particle. **2**

For e.g., $e^- + e^+ \rightarrow \gamma + \gamma$

***12. In a communication system, what is meant by modulation? State any two types of modulation. [2]**

SECTION-C

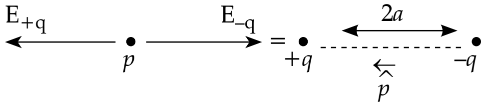
*Attempt **all** questions*

13. Obtain an expression for intensity of electric field at a point in end on position, i.e, axial position of an electric dipole. [3]

Ans. Let P be a point at a distance r from the center of the dipole on the side of the charge $\boldsymbol{q}$.

$$\vec{E}_{-q} = \frac{-q\,\hat{p}}{4\pi\in_0 (r+a)^2}$$

Where $\hat{p}$ is a unit vector along the dipole axis (from - q to q).



$$\vec{E}_q = \frac{q\,\hat{p}}{4\pi\in_0 (r-a)^2}$$

a is half the distance between the dipoles.

The total field at P is

$$\vec{E} = \vec{E}_{+q} + \vec{E}_{-q} = \frac{q}{4\pi\in_0}\left[\frac{1}{(r-a)^2} - \frac{1}{(r+a)^2}\right]\hat{p}$$

$$= \frac{C}{4\pi\in_0} 4ar \frac{q}{\left(r^2-a^2\right)^2}\hat{p}$$

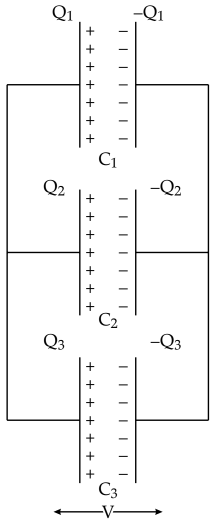
For $r \gg a$

$$\vec{E} = \frac{q4ar}{4\pi\in_0 r^4}\hat{p} = \frac{4aq\,\hat{p}}{4\pi\in_0 r^3}$$

$$\therefore \vec{E} = \frac{qa\,\hat{p}}{\pi\in_0 r^3}$$

14. Deduce an expression for equivalent capacitance C when three capacitors C_1, C_2 and C_3 are connected in parallel. [3]

Ans. Parallel combination of three capacitors.



Same potential difference is applied across all the three capacitors but the plate charges on the capacitors $\pm Q_1$, $\pm Q_2$, $\pm Q_3$ need not be same.

$Q_1 = C_1V$, $Q_2 = C_2V$, $Q_3 = C_3V$.

The charge stored in the equivalent capacitance

$Q = Q_1+Q_2+Q_3$

and potential difference

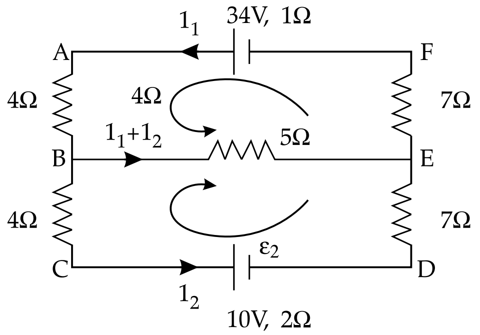
$CV = C_1V + C_2V + C_3V$

Thus, the effective capacitance will be

$CV = (C_1+C_2+C_3)\,V$

$C = C_1+C_2+C_3$ **3**

15. (a) ε_1 and ε_2 are two batteries having emf of 34V and 10V respectively and internal resistance of 1Ω and 2Ω respectively. They are connected as shown in Figure given below. Using Kirchhoffs' Laws of electrical networks, calculate the currents I_1 and I_2. [3]



[OR]

(b) An electric bulb is marked 200V, 100W. Calculate electrical resistance of its filament. If five such bulbs are connected in series to a 200V supply, how much current will flow through them?

Ans. **(a)** Loop equation, Loop AFEB

$$7I_1+4I_1 + 1I_1 + 5\,(I_1+I_2) = 34 \qquad ...(1)$$

Loop BCDE, $7I_2+2I_2 + 4I_2+5\,(I_1+I_2) = 10$ ...(2)

From (1) & (2),

$$17I_1 + 5I_2 = 34 \qquad ...(3)$$

$$5I_1+18I_2 = 10 \qquad ...(4)$$

*Out of Syllabus

From (4),

$$I_1 = \frac{10-18I_2}{5}$$

Substitute in (3),

$$\frac{17}{5}(10-18I_2)+5I_2=34$$

$$\frac{170}{5}-\frac{306}{5}I_2+5I_2=34$$

$$\frac{(-306+25)}{5}I_2=34-\frac{170}{5}$$

$$\frac{-281}{5}I_2=\frac{170-170}{5}=0$$

$$I_2=0$$

$$I_1=\frac{10-18I_2}{5}=\frac{10}{5}=2\text{A}$$

3

OR

(b) $P=\frac{V^2}{R} \Rightarrow \frac{(200)^2}{R}=100$

$$R=\frac{200\times200}{100}=400\Omega$$

Five of such bulbs when connected in series with a 200V supply, the voltage across each lamp is 40V (voltage is divided in series)

So current through each bulb

$V= IR$

$40= I \times 400$

I = 1/10 A

I = 0.1 A **3**

16. (a) For any prism, prove that:

$$'n'\text{or}\,\mu=\frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

where the terms have their usual meaning. [3]

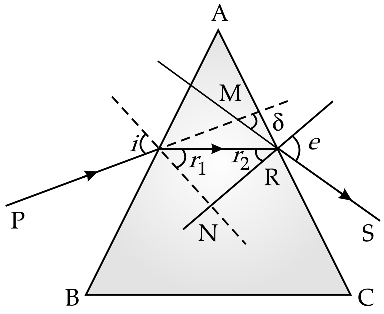
[OR]

(b) When two thin lenses are kept in contact prove that their combined or effective focal length F is given by

$$\frac{1}{F}=\frac{1}{f_1}+\frac{1}{f_2}$$

where the terms have their usual meaning. [3]

Ans. (a)



Consider passage of light through a triangular prism A B C. The angle of incidence and refraction at the face AB be i and r_1 respectively while the angle of incidence and refraction on emergence be i and δ respectively. The angle between emergent ray RS and the direction of incident ray PQ is called angle of deviation δ.

In quadrilateral AQNR, two of the angles at the vertices Q and R are at right angles.

$\therefore \angle A+\angle QNR = 180°$ (the other two angles) ...(1)

From Δ QNR

$r_1+r_2+\angle QNR=180^\circ$ ...(2)

Comparing (1) & (2),

$r_1+r_2+\angle A$ ...(3)

Now, $\delta=(e-r_1)+(e-r_2)$ (sum of deviations at the two faces)

$\delta = i + e^{-A}$ ...(4)

At the minimum deviation, the refracted ray inside the prism becomes parallel to its base.

i.e., at $\delta=\delta_m$, $i= e \Rightarrow r_1 = r_2$

therefore, equation (3) becomes

$2r = A$ or $r = A/2$. ...(5)

Similarly at δ = δm equation (4) becomes

$\delta_m = 2i - A$

or

$i=\left(\frac{A+\delta m}{2}\right)$ ...(6)

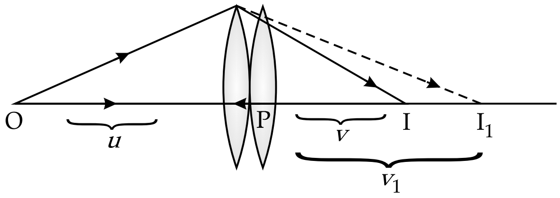
The refractive index of the prism.

$$\mu=\frac{n_2}{n_1}=\frac{\sin i}{\sin r}=\frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}.$$

A: being the angle of prism. **3**

OR

(b) Consider two lenses A and B having focal length f_1 and f_2 respectively, placed in contact with each other. Let the object be placed at a point O beyond the focus of the first lens A. The first lens produces the image at I, which is real. This act as a virtual object for the second lens B, producing final image at I. we assume that the optical center of the lens to be coincident as the lenses are very thin. Let this be represented by P.



For the image formed by the first lens A, we get

$$\frac{1}{v_1} - \frac{1}{u} = \frac{1}{f_1} \qquad ...(1)$$

For the image formed by the second lens

$$\frac{1}{v} = \frac{1}{v_1} + \frac{1}{f_2} \qquad ...(2)$$

Adding equation (1) & (2),

$$\frac{1}{v} - \frac{1}{u} = \left(\frac{1}{f_1} + \frac{1}{f_2}\right)$$

If two lens system is regarded as equivalent to a single lens of focal length f, we have

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

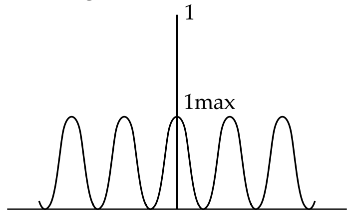
So, we get

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} \qquad 3$$

17. (i) In Young's double slit experiment, show graphically how intensity of light varies with distance.

(ii) In Fraunhofer diffraction, how is the angular width of the central bright fringe affected when slit separation is increased? [3]

Ans. (i) Width of the central bright fringe is inversely proportional to the width of the slit. So if we increase the width size, the angular width of the fringe decreases.



Path difference = $d\sin\theta$

If path difference $= n\lambda$ → Constructive interference

$= (n+1/2)\lambda$ → Destructive interference **1½**

(ii) Width of the central bright fringe is inversely proportional to the width of the slit. So if we increase the width size, the angular width of the fringe decreases. 1½

18. Write one balanced equation each to show: [3]

(i) Nuclear fission

(ii) Nuclear fusion

(iii) Emission of β^-(i.e., a negative beta particle)

Ans. (i)

$${}^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{236}_{92}U \rightarrow {}^{144}_{56}Ba + {}^{89}_{36}Kr + 3\,{}^{1}_{0}n + 200\,MeV \qquad \mathbf{1}$$

(ii) $4\,{}^{1}_{1}H \rightarrow {}^{4}_{2}He + 2\,{}^{0}_{+1}e(B^+)$ **1**

(iii) ${}^{32}_{15}p \rightarrow {}^{32}_{16}S + e^- + \bar{\nu}$ **1**

***19. With reference to semiconductor devices, define a *p*-type semiconductor and a Zener diode. What is the use of a Zener diode? [3]**

SECTION-D

*Attempt **all** question from this Section*

20. (a) An alternating emf of 220V is applied to a circuit containing a resistor R having resistance of 160Ω and a capacitor 'C' in series. The current is found to lead the supply voltage by an angle $\theta = \tan^{-1}(3/4)$.

(i) Calculate:

(1) The capacitive reactance

(2) Impedance of the circuit

(3) Current flowing in the circuit

(ii) If the frequency of the applied emf is 50 Hz, what is the value of the capacitance of the capacitor 'C'? [5]

OR

(b) An A.C. generator generating an emf of

$\varepsilon = 300 \sin (100\pi\, t)\; V$ is connected to a series combination of 16 μF capacitor, 1H inductor and 100 Ω resistor. Calculate:

(i) Impedance of the circuit at the given frequency.

(ii) Resonant frequency f_0.

***Out of Syllabus**

(iii) Power factor at resonance frequency f_0. **[5]**

Ans.

(a) (i) (1) $\theta = \tan^{-1}\left(\frac{3}{4}\right) = \tan^{-1}\left(\frac{X_c}{R}\right)$

$\Rightarrow \frac{X_c}{R} = \frac{3}{4}$

$\Rightarrow X_c = \frac{3}{4} \times R = \frac{3}{4} \times 160 = 120\Omega$

(2) $Z = \sqrt{R^2 + X_c^2} = \sqrt{(160)^2 + (120)^2}$

$= \sqrt{25600 + 14400}$

$= \sqrt{40,000}$

$= 200\ \Omega$

(3) $e = ZI$

$I = \frac{e}{Z}$

$I = \frac{220\text{V}}{200\Omega}$

$I = 1.1$ A

(ii) $X_c = \frac{1}{\omega C}$

or $C = \frac{1}{\omega X_c}$ ...(1)

$f = 50$ Hz

$X_c = 120\Omega$

$\omega = 2\pi f = 2\pi \times 50$ rad/s

using equation (1)

$C = \frac{1}{2 \times 3.14 \times 50 \times 120}$

$= 0.0000265$ F

$C = 26.5\ \mu$F

OR

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

$R = 100\Omega$

$\omega = 100\pi$ rad/s

$X_c = \frac{1}{\omega.c} = \frac{1}{100 \times 3.14 \times 16 \times 10^{-6}}$

$= \frac{1}{3.14 \times 16 \times 10^{-4}} = \frac{10^4}{50.24} = 199.04\,\Omega = 199\,\Omega$

$X_L = \omega L = 100 \times \pi \times 1 = 314\Omega$

$Z = \sqrt{(100)^2 + (314 - 199)^2}$

$= \sqrt{(100)^2 + (115)^2}$

$= \sqrt{3225}$

$= 57\ \Omega$

(ii) $f_0 = \frac{1}{2\pi\sqrt{LC}}$

$= \frac{1}{2 \times 3.14\sqrt{1 \times 16 \times 10^{-6}}}$

$= \frac{1}{2 \times 3.14 \times 4 \times 10^{-3}}$ Hz

$= \frac{10^3}{25.12} = 39.18$ Hz

(iii) $\cos\theta$ is the power factor

$\theta = \tan^{-1}\frac{(X_L - X_c)}{R}$

at resonance $X_L - X_C = 0$

$\Rightarrow \theta = 0^o$

$\Rightarrow \cos\theta = 1$

21. (a) Draw a labelled ray diagram of an image formed by a refracting telescope with final image formed at infinity. Derive an expression for its magnifying power with the final image at infinity. **[5]**

(b) (i) Using Huygen's wave theory, derive Snell's law of refraction.

***(ii) With the help of an experiment, state how will you identify whether a given beam of light is polarised or unpolarised.** **[5]**

Ans. (a) The magnifying power m is the ratio of the angle p substended at the eye by the final usage to the angle α which the object subtends at the lens of the eye. Hence,

***Out of Syllabus**

$$m = \frac{\beta}{\alpha} \approx \frac{\tan\beta}{\tan\alpha}$$

$$= \left(\frac{h}{f_e}\right) / \frac{h}{f_0} = \frac{h}{f_e} \times \frac{f_0}{h}$$

$$= \frac{f_0}{f_e}$$

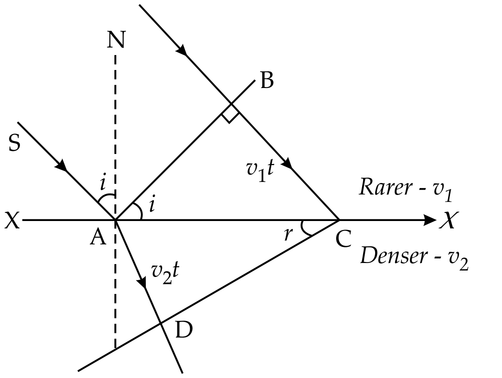
f_e = focal length of eye piece

f_o = focal length of objective

In this case, length of the tube = $f_o + f_e$

Magnification will be length as $f_o >> f_e$

(b) (i) Consider a plane wavefront AB incident on a plane surface XY, separating two media 1 and 2. Medium 1 ∞ rarer & 2 is denser medium. v_1 & v_2 be the velocity of light in medium 1 and medium 2 respectively. $v_2 > v_1$



The wave front first strikes at A and then the successive points towards C. according to Huygen's principle from each point of AC, the secondary wavelets will start growing in the second medium with speed v_2. Let the disturbance take time t to travel from B to C, then $BC = v_1$t. During the time, the disturbance from B reaches the point C, the secondary wavelets from point A must have spread over a hemi-sphere of radius $AD = v_2t$ in the second medium.

The tangent plane CD drawn from point C over this hemisphere of radius v_2t will be the new refracted wavefront

Let the angles of incidence and refraction be i and r respectively,

From right angle triangle, ΔABC, we get

$$\sin\angle BAC = \sin i = \frac{BC}{AC}$$

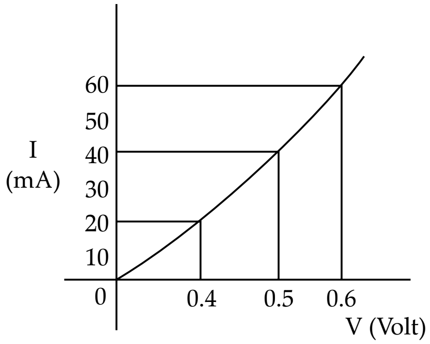
From right angle triangle, ΔADC,

$$\sin\angle DCA = \sin r = \frac{AD}{AC}$$

$$\therefore \frac{\sin i}{\sin r} = \frac{BC}{AD} = \frac{v_1 t}{v_2 t} = \frac{v_1}{v_2} = {}_1\mu_2 (\text{or } {}_1n_2)$$

This constant is called the refractive index of the second medium with respect to I.

22. (a) (i) The forward characteristics curve of a junction diode is shown in Figure given below:



Calculate the resistance of the diode at:

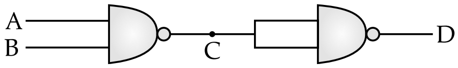
(1) V **= 0.5 Volts**

(2) I **= 60 mA**

(ii) Draw Separate energy band diagrams for conductors, semi-conductors and insulators and label each of them.

OR

***(b) (i) The arrangement given below represents a logic gate:**



Copy the following truth table in your answer booklet and complete it showing outputs at C and D.

A	B	C	D
0	0		
1	0		
0	1		
1	1		

***(ii) Draw a labelled diagram of a Common emitter amplifier, showing waveforms of signal voltage and output voltage.**

Useful Constants and Relations:

1.	Permeability of vacuum	(μ_0)	$= 4\pi \times 10^{-7}$ H m^{-1}
2.	Rydberg's constant	(R)	$= 1.097 \times 10^{7}$ m^{-1}

Ans. (a) (i)

(1) V = 0.5 volts

I corresponding to 0.5 volts is 40 mA.

***Out of Syllabus**

$$R = \frac{V}{I} = \frac{0.5}{40 \times 10^{-3}}$$
$$= \frac{0.5 \times 10^{3}}{40}$$
$$= 0.0125 \times 10^{3}\,\Omega$$
$$= 12.5\,\Omega$$

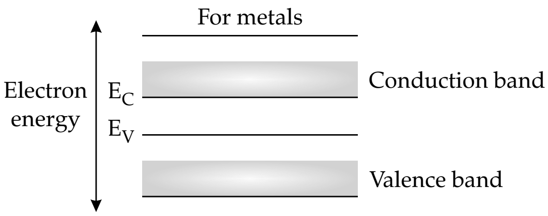
(2) At $I = 60$ mA.

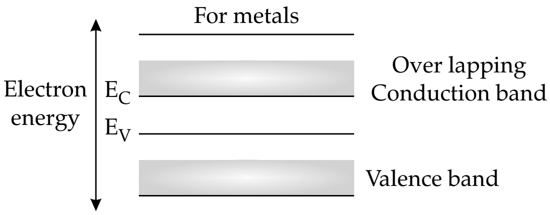
Voltage corresponding to $I = 60$ mA is 0.6 V.

$$R = \frac{V}{I} = \frac{0.6}{60 \times 10^{-3}}$$
$$= \frac{0.6 \times 10^{3}}{60}$$
$$= 0.01 \times 10^{3}\,\Omega$$
$$= 10\,\Omega$$

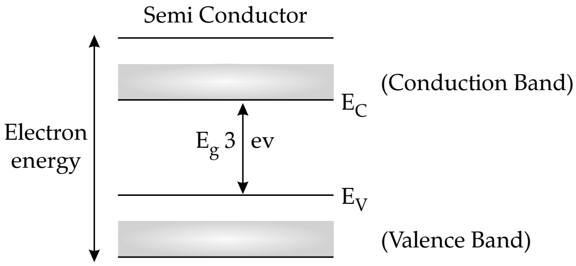
(a) (ii)

(i) For conductors :

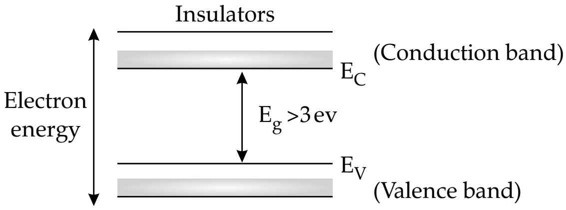




(ii) For Semiconductor



(iii) For Insulators



OR

■■