# Unit-1

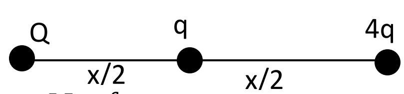
## LEVEL 1

1. $q = \pm ne$ charge on a body is always equal to integral multiple of electronic charge.
2. $\varepsilon_r = \varepsilon / \varepsilon_o$ $\varepsilon_r$ = force in free space/force in medium $\varepsilon_r$ = electric field in free space / electric field in medium $\varepsilon_r$ is unitless and dimensionless
3. It is electrostatic force felt by a unit charge.
   $E = F/q$
   $(E) = (M^1L^1T^{-3}A^{-1})$
   E due to a point charge in free space
   $E= 1/4\pi\varepsilon_0 (q_1 q_2 /r^2 )$
5. a. never intersect each other
   b. tangent along the electric field intensity
   c. continuous curve not having sudden breaks.
6. Product of either charge or separation between the two charges $P = 2aq$ unit of P = Cm
7. Derive $\tau = P \times E$ $U = - P . E$
8. External work required to shift unit positive charge from infinity to a point in electric field without acceleration. $V= 1/4 \pi\varepsilon_0 (q_1 q_2 /r )$
9. (1) equipotential surfaces never intersect.
   (2) Perpendicular to the electric field line.
   (3) Work done in shifting a point charge between any two points of an equipotential surface is zero.
10. Number of electric field lines passing through an area held normally. It is equal to the ratio of total charge enclosed to the permittivity of free space.
11. Gauss's theorem: The net outgoing flux through an enclosed surface is equal to the ratio of total charge enclosed to the permittivity of free space.
    (a) Out side the charged shell
    $E= 1/4 \pi\varepsilon_0 (q_1 q_2 /r^2 )$
    (b) On the shell
    $E= 1/4 \pi\varepsilon_0 (q_1 q_2 /R^2 )$
    (c) Inside the shell
    $E= 0$
12. Principle of capacitor : The capacitance of a conductor increases when an earthed conductor is brought near to it.
    $U = ½CV2$
13. Principle of Van de Graff generator
    Discharging action of sharp points (corona discharge)

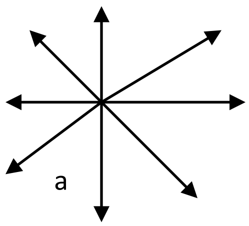
## Level 2

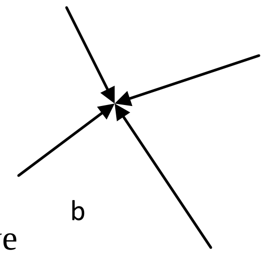
1. (1) distances between the charges should be greater the size of the nucleu
(2) applicable for point charges
2. SI unit of $\varepsilon_0 = C^2/Nm^2$
$(\varepsilon_0) = M^{-1}A^2 T^4L^{-3}$
3. $F= 9 \times 10^9 ( 2x1.6x10^{-19})2/(2x10^{-5})2$ N
4. At the point of intersection we get two tangents which means two directions of field which is not true.
5. refer to page no 27 of NCERT text book Part 1
6. No. As the torque felt by an electric dipole in uniform electric field is given by
$\tau = P E \sin\theta$
It will not experience any torque in the following two cases
(1) when $\theta = 0^0$ and (2) when $\theta = 180^0$
7. V = -dE/dr
8. Since $\Delta V=W/q$
For equipotential surface $\Delta V =0$, so W=0
9. Refer to NCERT text book to obtain
$U= -PE\cos\theta$
10. It is protecting any heavy appliance/conductor from external charges by keeping it inside a Faraday cage.
11. Refer to text book to obtain
$C = \varepsilon_o A/d$
Factors are plate area, plate separation and medium between the plates
12. Dielectric constant = the ratio of capacitance with and without dielectric medium between the plates.
13. Capacitance of a parallel plate capacitor $C = \varepsilon_o A/d$
(1) when d is doubled C will become half
(2) when A is halved C will also become half
14. Refer to NCERT text book to obtain
$U = ½CV^2$

# LEVEL 3

1.


Net force on q
$F_1 = F_2$
$kQq/(x/2)^2 = k\ 4qq/(x/2)^2$
It gives Q = 4q
2. first graph is for point charge i.e $E \propto 1/r^2$.
Secondgraph is for electric dipole i.e $e \propto 1/r^3$.
3. (i) charge is positive




(ii) charge is negative

4. $\tau = pE\sin\theta = qlE\sin\theta$

On putting the values

$E = 2\sqrt{3} \times 10^4 N/C$

$U = - pE\cos\theta$

On putting the values

$U = - 18J$

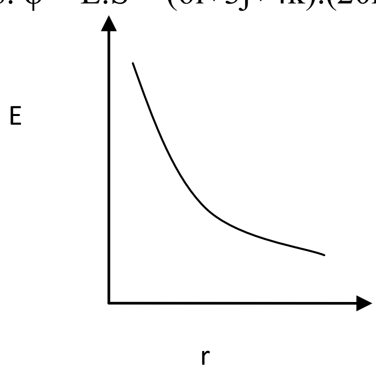
5. Zero, because a isolated charge particle does not experience electrostatic force.

6. $\varphi_1 / \varphi_2 = Q/3Q$ or 1:3

7. $\varphi = Q/\epsilon_0$

On putting the values $\varphi = 10^4 Wb$

8. $\varphi = E.S = (6i+3j+4k).(20k) = 120$units




9. As distance from the sphere increases electric field decreases

10. The electric field inside a conductor placed in an external electric field is zero because the net charge inside the conductor is zero in accordance with the Gauss's theorem.

11. $C_1 = 2\mu F$ , $C_2 = 2\mu F$

$C_s = 2\mu F + 2\mu F = 4\mu F$

$C_p = 1\mu F$

$$\frac{1}{C_s} = \frac{1}{2} + \frac{1}{2}$$

Cs/ Cp=1: 4

12. $C_1$, $C_2$ and $C_3$ are connected in series

Equivalent capacitance of the network will be

$$\frac{1}{C} = \frac{1}{C_1 + C_2 + C_3} + \frac{1}{C_4}$$

Putting the values we obtain c= 15µF

13. [ Ans: (i) no change in charge

(ii) E' = 1/k E

(iii) C' = kC]

14. The arrangements constitutes parallel combination of three capacitors of same plate separation 'd' and plate area 'A/3' having three types of dielectric medium of dielectric constant $k_1$ , $k_2$ and $k_3$ .

$C= C_1 + C_2 + C_3$

$C = k_1 \varepsilon_0 A/3d + k_2 \varepsilon_0 A/3d + k_3 \varepsilon_0 A/3d$

15. Initial capacitance

$C_0 = \epsilon_0 A/d$

Final capacitance

$$C = \frac{\epsilon_0 A}{d' - t(1- 1/k)}$$

according to the problem

$c_0 = c$

$$\varepsilon_0 A/d = \frac{\varepsilon_0 A}{d' - t(1- 1/k)}$$

putting the given values we obtain d' = 0.012m

# Unit 2
# Level 1

Ans1. Yellow, violet and orange.

Ans2. With increase in temperature, resistance increase and hence drift velocity decreases.

Ans3. Examples of Semi conducting dipole are Liquid electrolyte, transistor etc.

Ans4. R= ρ l/a R are constant. Since ρ is greater for maganin than for copper, hence maganin wire is thicker than that of copper wire.

Ans5. If temperature of a good conductor decreases, its resistance decreases. Since R $\alpha$ $1/\zeta$ or $\zeta$ $\alpha$ $1/R$. So, relaxation time increases.

Ans6. Because potentiometer measures emf of a cell without drawing any current from the cell.

Ans7. Wheat stone bridge is set to be balanced, when no current flows through galvanometer arm of wheat stone bridge

Ans8. Slide wire bridge & post office box.

Ans9. 60W; 220 because $R = V^2/P$ i.e., R $\alpha$ l/P (for given V).

Ans10. 200W bulb will show greater heat production because heat produced (H) is directly proportional to power of bulb

Ans: 11 Conservation of charge,energy

Ans: 12 $V = E - Ir$ Closed circuit and open circuit

Ans: 13 Nature of electrolyte

Separation between the electrode

Ans: 14 40 ohms , No Change

Ans: 15 Page 97 NCERT

Ans: 16 Page 118 NCERT and following answer

Kirchoff's first law – In an electrical circuit, the sum of input current is equal to output current.

Second Law - $\Sigma\xi = \Sigma IR$

Applying kirchoff's law in

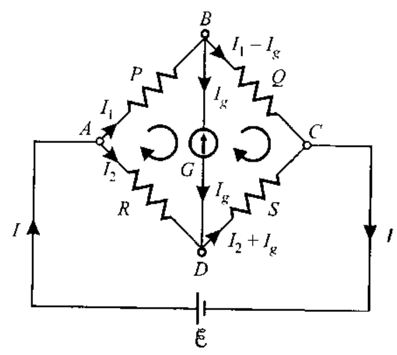
100P ABDA,

$$I_1P + IgG - I_2R = 0$$

In 100p BCDB,

$$(I_1 - I_g) - (I_2 + I_g)S - GI_g = 0$$

In balanced condition, Ig=0

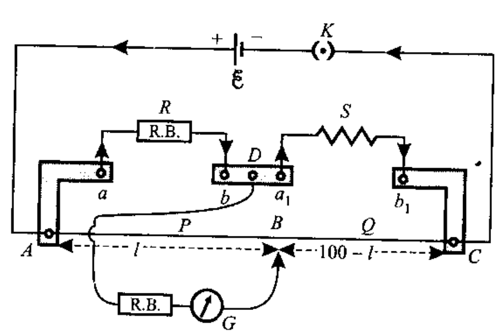



$$I_1P - I_2R = 0$$

$$I_1\theta - I_2S = 0$$

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

circuit diag. to determine the unknown resistance.



# LEVEL 2

Ans 1 It is average time between two successive collisions between electrons in conductor or semiconductor

Ans2 No Change in resistance

Ans3 Hint: using $H_1 = H_2$ and H= $V^2 t/R$, $R \propto l$

Ans4 Hint:- Charge = Area under graph. . Ans =37.5

Ans5 Use slope method, A represents. (Lower Resistance for parallel combination)

Ans6 Hint, use $V_d = Ee\tau/m$, $V_d = \frac{I}{neA}$

E = V/L, R = $\rho\frac{l}{A}$

Ans 7 Total emf = $\xi + \xi = 2\xi$

Total R = r+r=2r

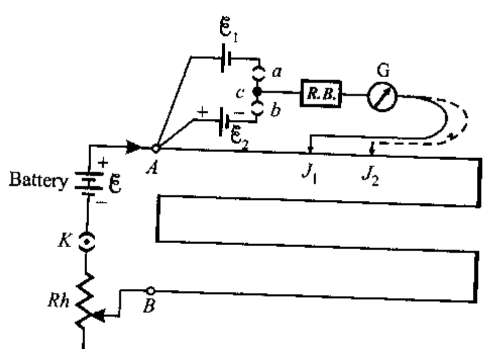
$\therefore$ I = $\frac{2\xi}{2r} = \frac{\xi}{r}$

$$V_A - V_B = \xi - Ir = \xi - \frac{\xi}{r} \times r = 0$$

Ans8 Potential gradient – The potential drop per unit of length of the potentiometer.

Method to compare emf of two cells –

$\xi_1 = kl$ when a is closed



$\xi_2 = kl_2$ when b is closed

$\therefore\ \xi_1 = kl_1$

$\xi_2 = kl_1$

$\xi_3 = \xi_1 \dfrac{l_2}{l}$

Causes for one sided deflection of potentionetari

(i) +ve terminals of all cells are not connected at one point.
(ii) emf of driving cell is less than emf of cell.

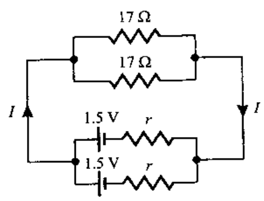
Ans9 Resistivity is the resistance of a conductor of that material having unit length and unit area of cross-section.

S.I. unit = ohm metre $(\Omega M)$

Resistivity = $\dfrac{M}{ne^2 \uparrow}$

With increase in temperature, the electrons suffer collisions more frequently and the relaxation time ($\tau$) decreases. hence, the resistivity of a conductor increases.

Ans 10




$\xi$ =1.5 V, V = 1.4 V

Resistance (R) $= \dfrac{R_1R_2}{R_1+R_2} = \dfrac{17\times17}{17+17} = 8.5\Omega$

Let $r'$ be the total internal resistance of the two cells

$$r' = R\left[\frac{\xi - V}{V}\right] = 8.5\left[\frac{1.5-1.4}{1.4}\right]\Omega = 0.6\Omega$$

As the two cells of internal resistance $r\Omega$ each have been connected in parallel

$$\frac{1}{r'} = \frac{1}{r} + \frac{1}{r} \Rightarrow \frac{1}{0.6} = \frac{2}{r}$$

$$r = 0.6 \times 2 = 1.2\Omega$$

Ans 11 : Length of the wire, $l$ =15 m

Area of cross-section of the wire, $a = 6.0 \times 10^{-7}\ \text{m}^2$

Resistance of the material of the wire, $R = 5.0\ \Omega$

Resistivity of the material of the wire = $\rho$

Resistance is related with the resistivity as

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

$$\rho = \frac{RA}{l}$$

$$= \frac{5 \times 6 \times 10^{-7}}{15} = 2 \times 10^{-7}\,\Omega\ \text{m}$$

Therefore, the resistivity of the material is $2 \times 10^{-7}\ \Omega\text{m}$

Ans 12 (a) Three resistors of resistances 1 Ω, 2 Ω, and 3 Ω are combined in series. Total resistance of the combination is given by the algebraic sum of individual resistances.

Total resistance = 1 + 2 + 3 = 6 Ω

(b) Current flowing through the circuit = $I$

Emf of the battery, $E$ = 12 V

Total resistance of the circuit, $R$ = 6 Ω

The relation for current using Ohm's law is,

$$I = \frac{E}{R}$$

$$= \frac{12}{6} = 2\ \text{A}$$

Potential drop across 1 Ω resistor = $V_1$

From Ohm's law, the value of $V_1$ can be obtained as

$V_1$ = 2 × 1= 2 V … (i)

Potential drop across 2 Ω resistor = $V_2$

Again, from Ohm's law, the value of $V_2$ can be obtained as

$V_2$ = 2 × 2= 4 V … (ii)

Potential drop across 3 Ω resistor = $V_3$

Again, from Ohm's law, the value of $V_3$ can be obtained as

$V_3$ = 2 × 3= 6 V … (iii)

Therefore, the potential drop across 1 Ω, 2 Ω, and 3 Ω resistors are 2 V, 4 V, and 6 V respectively.

Ans 13 B is preferred. Hint:- less potential gradient, more accuracy

# LEVEL 3

**Ans 1** Two possible faults for one-sided deflection are as follows.

(a) The +ve terminals of all the cells are not connected to the point A of the potentiometer.

(b) The emf of driving cell < emf. of cell to be balanced.

(i) deflection at B is more than at end A. as the two emf. support each other and the resultant emf becomes max. at B.

(ii) deflection at B is less than at A as the two emf oppose each other

**Ans 2**

(i) $K = \frac{IR_{AB}}{l_{AB}}$ when $R\uparrow$, potential gradiant decreases

As $V_{AX} = Kl_{AX}$

$$l_{AX} = \frac{V_{AX}}{K}$$

Due to increase in K $l_{AX}$ will increase i.e. balance point will shift towards the end B.

(ii) No effect because at null point no current is drawn from the cell Q.

(iii) Balance point is not found on AB because in this situation the potential drop across the wire is < the emf of cell Q.

Ans 3 Room temperature, $T = 27°C$

Resistance of the heating element at $T$, $R = 100\ \Omega$

Let $T_1$ is the increased temperature of the filament.

Resistance of the heating element at $T_1$, $R_1 = 117\ \Omega$

Temperature co-efficient of the material of the filament,

$$\alpha = 1.70 \times 10^{-4}\,°C^{-1}$$

$\alpha$ is given by the relation,

$$\alpha = \frac{R_1 - R}{R(T_1 - T)}$$

$$T_1 - T = \frac{R_1 - R}{R\alpha}$$

$$T_1 - 27 = \frac{117 - 100}{100(1.7 \times 10^{-4})}$$

$$T_1 - 27 = 1000$$

$$T_1 = 1027\,°C$$

Therefore, at 1027°C, the resistance of the element is 117Ω.

**Ans 4**

$$V = \frac{\xi R}{R + r} = \frac{\xi}{1 + r/R}$$

Hence, V decreases when R is reduced.

**Ans 5** Total Resistance = $R_0 + \dfrac{RS}{R + S}$

$$I = \frac{E}{R_0 + \dfrac{RS}{R + S}}$$

$$V = IR_0 = \frac{ER_0}{R_0 + \dfrac{RS}{R + S}}$$

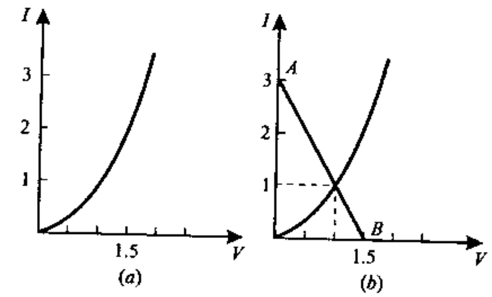
P.D. per unit length

$$K = \frac{V}{L} = \frac{ER_0}{L\left(R_0 + \frac{RS}{R+S}\right)}$$

**Ans6** $\xi = 1.5V \quad r = 0.5\Omega \quad V = \xi - Ir$

I=0 V=1.5-0=1.5V

I=1A V = 1.0 V




I=2A V= 0.5 V

I = 3A V = 0

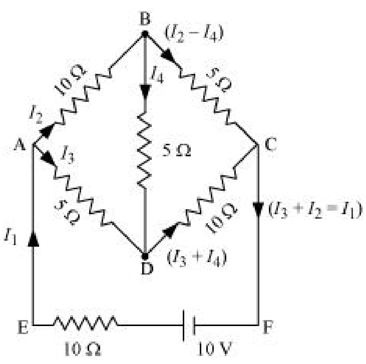
When I = 0 total emf = terminal V

$$\therefore\ 4\xi = 5.6\ V$$

$$\xi = 1.4\ V$$

When $I = 1.0\,A \quad V = \frac{2.8}{4} = 0.7V$

**Ans 7** Current flowing through various branches of the circuit is represented in the given figure.




$I_1$ = Current flowing through the outer circuit

$I_2$ = Current flowing through branch AB

$I_3$ = Current flowing through branch AD

$I_2 - I_4$ = Current flowing through branch BC

$I_3 + I_4$ = Current flowing through branch CD

$I_4$ = Current flowing through branch BD

For the closed circuit ABDA, potential is zero i.e.,

$10I_2 + 5I_4 - 5I_3 = 0$

$2I_2 + I_4 - I_3 = 0$

$I_3 = 2I_2 + I_4 \dots (1)$

For the closed circuit BCDB, potential is zero i.e.,

$5(I_2 - I_4) - 10(I_3 + I_4) - 5I_4 = 0$

$5I_2 + 5I_4 - 10I_3 - 10I_4 - 5I_4 = 0$

$5I_2 - 10I_3 - 20I_4 = 0$

$I_2 = 2I_3 + 4I_4 \dots (2)$

For the closed circuit ABCFEA, potential is zero i.e.,

$-10 + 10\,(I_1) + 10(I_2) + 5(I_2 - I_4) = 0$

$10 = 15I_2 + 10I_1 - 5I_4$

$3I_2 + 2I_1 - I_4 = 2 \dots (3)$

From equations (1) and (2), we obtain

$I_3 = 2(2I_3 + 4I_4) + I_4$

$I_3 = 4I_3 + 8I_4 + I_4$

$-3I_3 = 9I_4$

$-3I_4 = +I_3 \dots (4)$

Putting equation (4) in equation (1), we obtain

$I_3 = 2I_2 + I_4$

$-4I_4 = 2I_2$

$I_2 = -2I_4 \ldots (5)$

It is evident from the given figure that,

$I_1 = I_3 + I_2 \ldots (6)$

Putting equation (6) in equation (1), we obtain

$3I_2 + 2(I_3 + I_2) - I_4 = 2$

$5I_2 + 2I_3 - I_4 = 2 \ldots (7)$

Putting equations (4) and (5) in equation (7), we obtain

$5(-2\,I_4) + 2(-3\,I_4) - I_4 = 2$

$-10I_4 - 6I_4 - I_4 = 2$

$17I_4 = -2$

$$I_4 = \frac{-2}{17}\ \text{A}$$

Equation (4) reduces to

$I_3 = -3(I_4)$

$$= -3\left(\frac{-2}{17}\right) = \frac{6}{17}\ \text{A}$$

$$I_2 = -2(I_4)$$

$$= -2\left(\frac{-2}{17}\right) = \frac{4}{17}\ \text{A}$$

$$I_2 - I_4 = \frac{4}{17} - \left(\frac{-2}{17}\right) = \frac{6}{17}\ \text{A}$$

$$I_3 + I_4 = \frac{6}{17} + \left(\frac{-2}{17}\right) = \frac{4}{17}\ \text{A}$$

$$I_1 = I_3 + I_2$$

$$= \frac{6}{17} + \frac{4}{17} = \frac{10}{17}\ \text{A}$$

Therefore, current in branch $AB = \frac{4}{17}$ A

In branch BC = $\frac{6}{17}$ A

In branch CD = $\frac{-4}{17}$ A

In branch AD $= \frac{6}{17}$ A

In branch BD = $\left(\frac{-2}{17}\right)$ A

Total current = $\frac{4}{17} + \frac{6}{17} + \frac{-4}{17} + \frac{6}{17} + \frac{-2}{17} = \frac{10}{17}$ A

**Ans8** The equivalent internal resistance of each row of n cells in series = nr.

The net equivalent internal resistance of the combination = nr/m.

Net equivalent emf of the combination = n x E (E = emf of one cell)

Current drawn by R

$$= \frac{nE}{R + \frac{nr}{m}} = \frac{mnE}{mR + nr} = \frac{NE}{mR + nr}$$

$$= \frac{NE}{\left(\sqrt{mR} - \sqrt{nr}\right)^2 + \sqrt{2mnRr}} = \frac{NE}{\left(\sqrt{mR} - \sqrt{nr}\right)^2 + \sqrt{2NRr}}$$

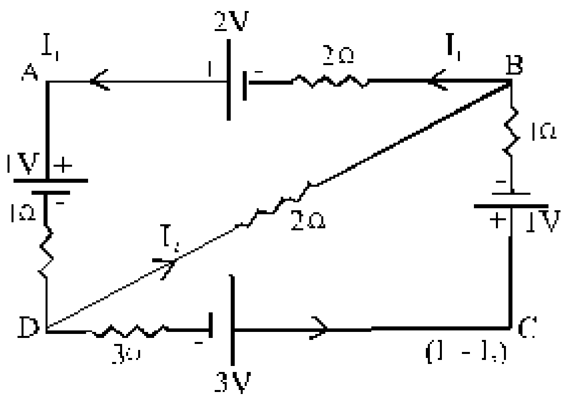
For maximum current, the denominator should be minimum.

This happens when,

$$\sqrt{mR} = \sqrt{nr} \text{ or } R = \frac{nr}{m}$$

$$\therefore \quad \frac{n \times 0.5}{m} = 1.5 \text{ or } \frac{n}{m} = 3$$
$$\text{Also } n \times m = 12 \text{ (given).}$$
$$\text{Solving, we get } \underline{n = 6} \text{ and } \underline{m = 2}$$

**Ans 9** We can draw the circuit explicitly as shown. The current distribution can be taken as shown. Applying Kirchoff's second law to loops BADB and DCBD, respectively, we get the equations:




- 2I1 + 2 - 1 - 1x I1 - 2I2 = 0 or 3 I1+ 2 I2 = 1

and, -3(I1- I2) + 3 - 1- 1 x (I1- I2) + 2 I2 = 0 or 4 I1- 6 I1 = 2

Solving, we get I1 = $\frac{5}{13}$ A and I2 = $\frac{1}{13}$ A

P.D. between B and D $= 2 \times \frac{1}{13} \text{V} = \frac{2}{13} \text{V} = \underline{\underline{0.154 \text{V}}}$

**Ans10** Total resistance in the five cases are : $\left| r, r + R_1; r + R_2; r + R_1 + R_2; r + \frac{R_1 R_2}{R_1 + R_2} \right.$

$$r, r + \frac{R_1 R_2}{R_1 + R_2}, r + R_1, r + R_2, r + R_1 + R_2$$ are in increasing order.

The correct order of values of I are : 4.2A, 1.4A, 1.05 A, 0.6 A and 0.42 A

Also

$$\frac{E}{r} = 4.2, \frac{E}{r + R_1} = 1.05, \frac{E}{r + R_2} = 0.6, \frac{E}{r + R_1 + R_2} = 0.42, \text{and } r + \frac{\frac{E}{R_1 R_2}}{R_1 + R_2} = 1.4$$

Solve first four to obtain, E = 4.2V, r = 1 Ω, R1 = 3 Ω, R2 = 6Ω

**Ans 11** Derivation for parallel combination

$$E = \frac{E_1 r_2 + E_2 r_1}{(r_1 + r_2)}$$

$$r = \frac{r_1 r_2}{r_1 + r_2}$$

(ii) Series combination formula

$$(E = E_1 + E_2), (r = r_1 + r_2)$$

(iii) Numerical

$$\left[\frac{2+1}{1+2+R} = \frac{(1x1+2x2)/(1+2)}{\frac{1x2}{1+2}} \Rightarrow R = \frac{9}{4}\,\Omega\,;\text{More in series}\right]$$

**Ans12**

$$\frac{x}{y} = \frac{60}{40} = \frac{3}{2}$$

$$\text{and} \quad \frac{x}{y+15} = \frac{60-10}{40+10} = 1$$

On solving

$$x = 45\Omega$$

$$y = 30\Omega$$

For the parallel connection

$$Y' = \frac{30y}{30+y} = \frac{30\times 30}{30+30}\,\Omega = 15\Omega$$

$$\therefore \quad \frac{x}{y'} = \frac{\ell}{100-\ell}$$

$$\frac{45}{15} = \frac{\ell}{100-\ell} \Rightarrow \quad \ell = 75.0\text{cm}$$

.

**Ans 13** The Emf of a cell equals the p.d. between its terminals when it is in an open circuit i.e. not supplying any current. A voltmeter measures p.d. (and not e. m. f.) as it draws a (small) current for its working. The potentiometer draws no (net) current (form the cell) at the balance point. So the cell can be treated as if it were in an open circuit

$$E_1 + E_2 = k(351)$$
$$\text{and} \quad E_1 - E_2 = k(70.2)$$

$$\therefore \quad \frac{E_1 + E_2}{E_1 - E_2} = \frac{351}{70.2} = \frac{5}{1}$$

$$\text{This gives } \frac{E_1}{E_2} = \frac{3}{2}$$

**Ans 14** When I = 0 total emf = terminal V

$$\therefore 4\xi = 5.6\ V$$

$$\xi = 1.4\ V$$

When $I = 1.0\ A \quad V = \frac{2.8}{4} = 0.7V$

Internal resistance

$$r = \frac{\xi - V}{I} = \frac{1.4 - 0.7}{1.0} = 0.7\Omega$$

$$I_{\max} = \frac{\text{total emf}}{\text{total resistance}} = \frac{4\xi}{4r + 4r}$$

$$\xi = \frac{\xi}{2r} = \frac{1.4}{2 \times 0.7} = 1A$$

# UNIT 3

## LEVEL 1

Ans1. $F = q(\vec{V} \times \vec{B})$

Ans2. Cyclotron frequency $f = qB/2\pi m$, which is independent of the radius of the circular path & velocity of the charged particle in the two Dees of cyclotron.

Ans3. Effective Resistance = GS/G+S

Ans4. $Wb/m^2$ is the S.I. unit of magnetic field intensity B. It is a vector quantity.

Ans5. P.E. = - MB, Work done = MB (cos 0°- cos 180°) = MB (1+1) = 2MB.

Ans6. $\tan\delta = B_v/B_H$ as $B_v = B_H$ So $\tan\delta = 1$ Or $\delta = 45°$.

Ans7. This is because permeability of soft iron is much greater than air.

Ans8. For making permanent magnet, a material having high coercivity is used, & steel has more coercivity. So, steel is preferred.

Ans9. Inside the solenoid.

Ans10. For making electromagnet, a material having low coercivity is used, & soft iron has low coercivity So, soft iron is preferred.

Ans11. Zero

Ans12.(i) coercivity of steel is greater than that of soft iron (ii) magnetization & demagnetization of soft iron is easier than that of steel(hard iron).

Ans13. It is used to strengthen the magnetic field so that maximum torque acts on the coil.

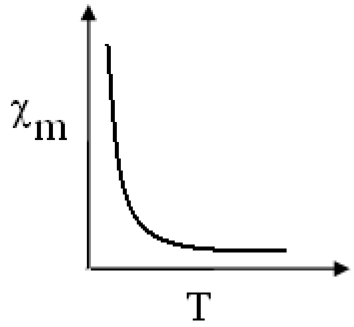
Ans14.No iron will not retain its magnetism if it is heated above the curie temperature(1000 K)

## LEVEL 2

Ans1. Along the +Z-axis.

Ans2. To make the galvanometer more sensitive the spring/suspension wire in a moving coil galvanometer should have low torsional constant.

Ans3.




Ans4. Rate of work done=F.v=q(vxB).v=0.so no work is done by the magnetic field & hence kinetic energy of the charge particle does not change while moving in the magnetic field.

Ans5. The magnetic field strength at the centre of the circular coil carrying current is $B=\mu_0 I/2r$ where r is the radius of the circular coil if the current through the coil is doubled and radius is halved the field will become four times.

Ans6. Moving coil galvanometer can not be used to detect an a.c. in a circuit as average value of a.c is zero over one complete cycle.

Ans7. Refer to page no 162 Part-1 of NCERT.

Ans8. Refer to page no 152 part-1 of NCERT.

Ans9. Refer to page no 186part-1 of NCERT.

Ans10. $G=30\Omega$

$I_g=2mA=2x10^{-3}A$

$I=0.3A$

$S=I_gG/(I-I_g)$

$= 2x10^{-3}x30/(0.3 - 2x10^{-3})$

$=0.2\Omega$

Ans11. Refer to page no 145 part-1 of NCERT.

Ans12. Refer to page no 157 part-1 of NCERT.

Ans13. Refer to page no 140 part-1 of NCERT.

Ans14. Refer to page no 154 part-1 of NCERT.

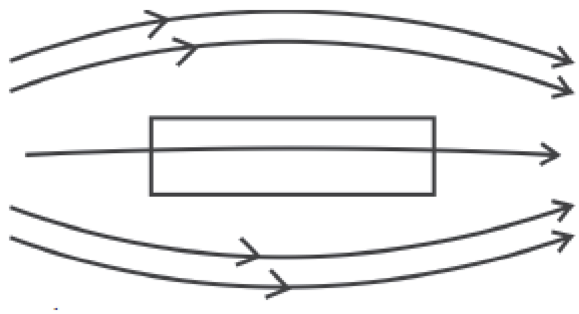
Ans15. Refer to page no 163 part-1 of NCERT.
Ans16. Refer to page no 151 part-1 of NCERT.

## LEVEL 3

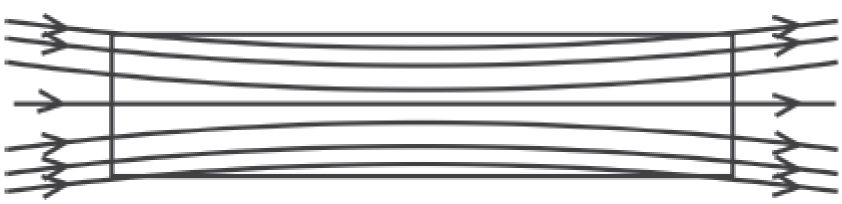
Ans1. When kinetic energy is halved, the radius is reduced to $1/\sqrt{2}$ times its initial value.

Ans2. The magnetic dipole moment induced in a diamagnetic substance is opposite to the magnetising field. This has nothing to do with the thermal motion of the atoms.

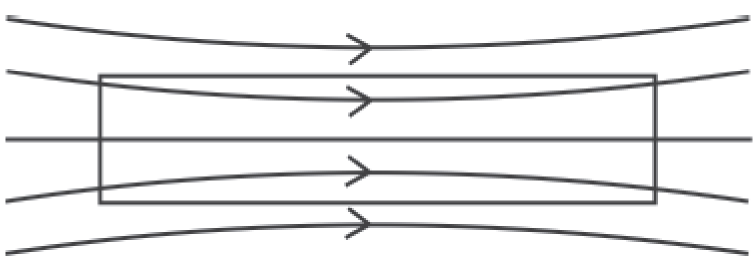
Ans3. For antimony



For nickel



For aluminium



Ans4. A moving coil galvanometer can be converted into an Ammeter by connecting a low value of shunt resistance in parallel with the galvanometer. When current sensitivity of moving coil galvanometer increases 50% due to increase in resistance, then voltage sensitivity remain unchanged.

Hint5. $B_1 = B_2 = \mu_0 i a^2/2(a^2+x^2)^{3/2}$ , Use $B = (B^2{}_1 + B^2{}_2)^{1/2}$

$\tan\theta = B_2/B_1$ since $B_1 = B_2$ $\tan\theta=1$ $\theta=45^0$

Hint6. Use $r = mv/qB$

Ans7. $F=qvB\sin\theta$

When $\Theta=90^0$

$F=qvB$

$qvB=mv^2/r$

$qB=mv/r=p/r$

$r=p/qB$

Both electron and a proton have equal momenta. Therefore ratio is 1:1

# Unit-4

## LEVEL-1

1. (i) $\theta=0^0$ , (ii)$\theta=90^0$

3. $\varepsilon = L(dI/dt) = 0.03 \times 150 = 4.5$ V

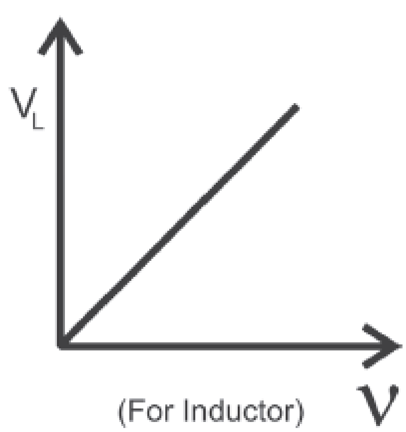
4. increases $\mu_r$ times

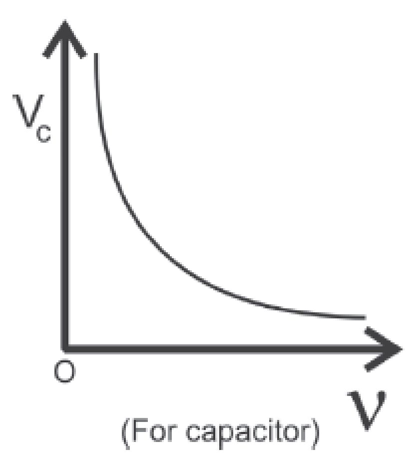
5. $\varphi = 0^0$

6. 0

8. in pure inductive circuit

10. (i) (ii)



## LEVEL-2

1. Clockwise

2. (i) Decreases ,(ii) Increases

3. Due to production of eddy current.

5. Using relation $\varepsilon = -(d\varphi/dt)$ , $\varepsilon = -370V$

6. (i) $E_{rms} = E_0/\sqrt{(2)} = 0.707\ E_0 = 0.707\times200 = 141.4\ V$

   (ii) $I_{rms} = E_{rms}/R = 14.14\ A$

   (iii) $P_{av} = E_{rms}\times I_{rms} = 2000\ W$

7. As the closed loops of the circular motions of free electrons are not formed.

8. $\nu = 1/(2\pi\sqrt{LC}) = 99.8\ \mu F$

9. $\mu_r = 1000$

10. because average current of one complete cycle is zero .

## LEVEL-3

1. Yes , according to the relation $\varepsilon = Blv$

3. $(E_s/E_p) = k$ , $E_s = 12.5 \times 220 = 2750\ V$

4. $\varepsilon = nBA/\Delta t = 240\ V$ , $I = 24\ A$

6. $\varepsilon = 0$ , As there is no change in magnetic flux at any arm.

8. Refer to NCERT Text Book. Page No. 216

9. Refer to NCERT Text Book. Exercise 7.18, Page No. 267

10. $\varepsilon = Bl^2\omega/2$

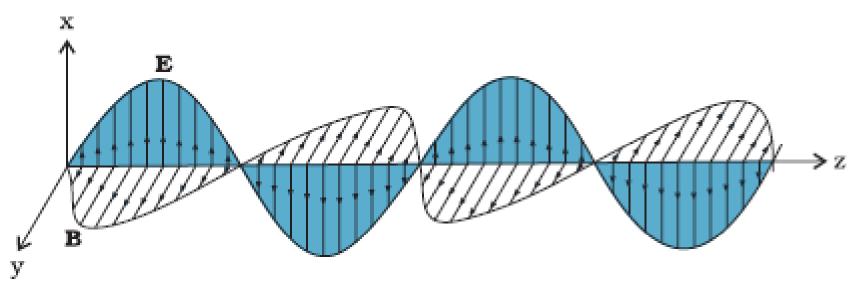
# Unit – 5

# LEVEL 1

1.

| | |
|---|---|
| 1. $\oint \mathbf{E} \cdot d\mathbf{A} = Q / \varepsilon_0$ | (Gauss's Law for electricity) |
| 2. $\oint \mathbf{B} \cdot d\mathbf{A} = 0$ | (Gauss's Law for magnetism) |
| 3. $\oint \mathbf{E} \cdot d\mathbf{l} = \frac{-d\Phi_B}{dt}$ | (Faraday's Law) |
| 4. $\oint \mathbf{B} \cdot d\mathbf{l} = \mu_0 i_c + \mu_0 \varepsilon_0 \frac{d\Phi_E}{dt}$ | (Ampere – Maxwell Law) |

1. Diagram of hertz expt. E.m. waves are produced due to ionization of the medium between the spheres.
2. (i)do not require any medium for propagation.
   (ii)transverse in nature.
   (iii)produced by accelerated charges.
   (iv)carry energy and momentum & hence exert pressure on the surface on which they fall.
3. $C = 1/\sqrt{(\mu_0 \varepsilon_0)}$
4. (i) Radio waves,(ii) gamma waves
5.




6. (i) $C = 1/\sqrt{(\mu_0 \varepsilon_0)}$

   (ii)$v = 1/\sqrt{(\mu\varepsilon)}$

7. Gauss's law in magnetism
8. Charge

# LEVEL 2

1. Electric and magnetic field,Transverse
2. 1:1 as all em waves propagate with the same speed in vacuum
3. Because light wavesare electromagnetic waves whereas sound waves are mechanical waves.
4. (i) radio waves, (ii)infrared waves, (iii)microwaves (iv) radio waves,( v)x-rays
5. (i)cooking,radar system for aircraft navigation
   (ii) for taking photographs during the conditions of fog & smoke,to treat muscular pain

   (iii)satellite communication & mobile telephony

6. Absorbs harmful ultraviolet rays

7. $\lambda = c/\nu$   25m to 40m
8. An oscillating charge produces the oscillating electric field of same frequency which then produces oscillating magnetic field of the same frequency
9. Only acceleratedcharge will produce e.m. waves
10. Because of change in optical density of the medium

# LEVEL 3

2. To save the retina of eye from high intensity of radiations
4. Use formulae $E_O = B_O.C$, $\omega = 2\Pi\nu$ , $\lambda = C/\nu$ , $K = 2\Pi/\lambda$
5. Compare with the general eqn. $E_x = E_O\cos(ky+\omega t)\hat{i}$ for a wave propagating along -ve y direction with the magnetic field along z- axis and electric field along x-axis

   Magnetic field, $B_z = B_o\cos(ky+\omega t)\hat{k}$

# <u>Unit 6</u>

# <u>LEVEL 1</u>

A.1 Shrinks.

A.2 The ray of light bends away from the normal.

A.3 When the refractive index of the liquid is same as that of lens material, no light is reflected by the lens and hence it will not be visible.

A.4 The sunlight will not be scattered in the absence of atmosphere. So the sky appears dark

A.5 Using Snell's Law for refraction from glass to air,

Sin i/sin r = ${}_g\mu_a = v / c$

Where c is the speed of light in air and v is the speed of light in glass, In the constitution of critical incidence, we have $i = i_c$ and $r = 90^0$

$\sin i_c / \sin 90^0 = v / c$ or $\sin i_c = v / c$

Or $i_c = \sin^{-1}(v / c)$

A.6 A hollow prism contains air which does not cause dispersion. The faces AB of the hollow prism behave like parallel sides of glass plates. The beam is laterally at each of the two refracting faces. However, the rays of different colours emerge parallel each other. So there is no dispersion.

A.7 A wavefront is a surface obtained by joining all points vibrating in the same phase. A ray is a line drawn perpendicular to the wavefront in the direction of propagation of light wave.

Hint – refer to diagram10.6 (TB)

A.8When the monochromatic source is replaced by a source of white light, the diffraction pattern shows following changes:

(i) In each diffraction order, the diffracted image of the slit gets dispersed into component colours of white light. As fringe width is proportional to the wavelength, so the red fringe with higher wavelength is wider than violet fringe with smaller wavelength,

(ii) In higher order spectra, the dispersion is more and it causes overlapping of different colours.

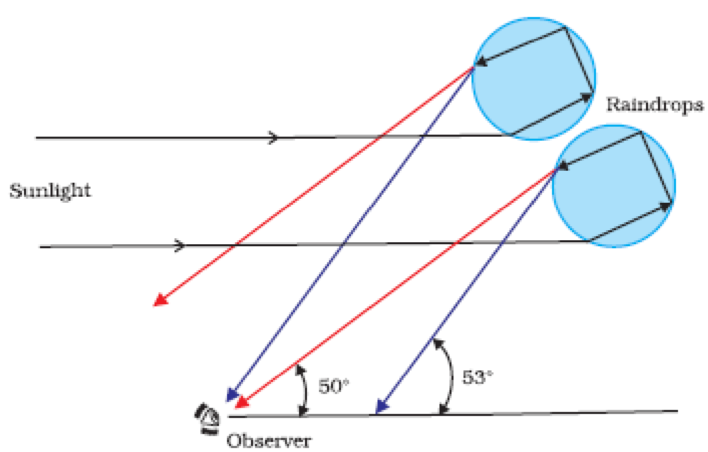
A.9 $90^0$

A.10 Real and inverted.

A.11 No change

A.12 Refer P-318 and figure 9.11 NCERT –TB

A.13



$50^0 - 53^0$

A.14 (1) Light gathering power

(2) Resolution

A.15 $\mu = \tan i_p$, $60^0$

A.16 2:1

A.17 443nm

A.18 5I

A.19 $\tan 53^0 = 1.3$

A.20 1.5

# <u>LEVEL 2</u>

A.1 Zero

A.2 According to the Brewster law, when a ray of light is incident on a transparent refracting medium at polarizing angle,

$\mu = \tan i_p$

but $i_p + r_p = 90° $ or $i_p = 90° - r_p$

$\mu = \tan(90° - r_p) = \text{Cot } r_p = 1/\tan r_p$

As $i_c$ is the critical angle for the transparent medium, so

$\mu = 1/\sin i_c$

on comparing (i) and (ii) we get

$\tan i_p = \sin i_c$ or $r_p = \tan^{-1}(\sin i_c)$

A.3 As the critical angle for diamond-oil interface is greater than that for the diamond –air interface, so the shining of diamond reduces when it is dipped in transparent oil.

A.4 No, the image will be formed at the same position. From lens maker's formula, $1/f = (\mu - 1)\,[1/R_1 - 1/R_2]$ , it is clear that when we interchange $R_1$ and $R_2$, the magnitude 'f' remains the same.

A.5 Focal length 'f' of a convex lens is related to its refractive index as $F \propto \frac{1}{(\mu - 1)}$ As ${}_w\mu_g < {}_a\mu_g$, so focal length of a convex lens will increase when it is immersed in water.

A.6 When the prism is held in water,

$$ {}^{w}\mu_{g} = \sin g \frac{(A+\delta m)}{2} \Big/ Sin\frac{A}{2} $$

As ${}_w\mu_g < {}_a\mu_g$, so the angle of minimum deviation decreases in water.

A.7 (i) We should take $f_0$ =1 cm and $f_e$ = 3cm for a microscope.

(ii) We should take $f_0$ = 100 cm and $f_e$ = 1 cm for a telescope.

A.8 Light from the stars near the horizon reaches the earth obliquely through the atmosphere. Its path changes due to refraction. Frequent atmospheric disturbances change the path of light and cause twinkling of stars. Light from the stars overhead reaches the earth normally. It does not suffer refraction. There is no change in its path. Hence there is no Twinkling effect.

A.9 Fringe width, $\beta = \frac{\lambda D}{d}$

When d is very very small

fringe width is very large. Even a single fringe may occupy the entire screen. The interference pattern cannot be observed.

A.10 For diffraction to take place the wave length should be of the order of the size of the obstacle. The radio waves (particularly short radio waves) have wave length of the order of the size of the building and other obstacles coming in their way and hence they easily get diffracted. Since wavelength of the light waves is very small. They are not diffracted by the buildings.

A.11 $D=37.2^0$ and $i=48.6^0$

A.12 Minimum distance $x = 1.25 \times 10^{-4}$m

A.13 Size same, Intensity reduced

A.14 Hint: put $R_1=R_2$ in lens makers formula

A.15 f decreases

A.16 f = – 60cm p = = – 1.67D

A.17 ic = $17.46^0$

A.18 f = +78.2cm It remains as a convex lens of longer focal length

A.19 The total apparent shift in the position of the image due to all the three media given by

$$d = t_1[1-1/(\mu_1)+ t_2[1-1/(\mu_2)+ t_3[1-1/(\mu_3)$$

Given $t_1$ = 4.0 cm, $t_2$=6.0 cm, $t_3$ =8.0 cm

$\mu_1$ = 1.5, $\mu_2$=1.4 , $\mu_3$ =1.3 cm

d = 4.0(1-1/1.5) + 6.0(1-1/1.4)+8.0(1-1/1.3)

= 1.33 + 1.71 + 1.85 = 4.89 cm

A.20 (i) Moon has no atmosphere. There is no scattering of light. Sunlight reaches straight covering shortest distance. Hence sunrise and sunset are abrupt. (ii) Moon has no atmosphere. So there is nothing to scatter sunlight towards the moon. skylight reaches moon surface. Sky appears black in the day time as it does at night.

(iii) No water vapours are present at moon surface. No clouds are formed. There are on the moon. So rainbow is never observed.

# LEVEL 3

A.1 Violet.

A.2 As $\mu = \frac{\sin i}{\sin r}$ = c/v or v = $\frac{\sin r}{\sin i}$ × C For a given angle of incidence, $v \propto \sin r$, $v_A \propto \sin 15°$, $v_B \propto \sin 25°$, $v_C \propto \sin 35°$

But sin15° < sin25° < sin35° . $\therefore v_A < v_B < v_C$ .i.e. the velocity of light is minimum in medium A.

A.3 For glass-air interface, sin $i_c = \frac{1}{{}^a u_g}$

The critical angle $i'_c$ for glass water interface is given by

$$\text{Sin } i'_c = \frac{1}{{}^w u_g}$$

Now ${}_w\mu_g < {}_a\mu_g$,

Sin $i'_c >$ Sin $i_c$

or $i'_c > i_c$

A.4 For relaxed eye,

$L = f_0 + f_e$ (normal adjustment)

For least distance of distinct vision,

$L' = f_0 + u_e$ , $u_e < f_e$

Therefore, L' < L. so that distance between the two lenses should be decreased.

A.5 (i) Angle of refraction ($i$ /2) in medium 2 is less than the angle of incidence ($i$) in medium 1 i.e. the ray bends towards the normal in medium 2. so medium 2 is optically denser than medium 1.

(ii) From Snell's law,

$\mu$ = sin i/sin r = sin $i$ / sin $i$ /2 = 2sin $i$ /2 cos $i$ /2 /sin $i$ /2 = 2 cos $i$ /2

Also $\mu = c_1 / c_2$

hence 2 cos $i$ /2 = $c_1 / c_2$ or $i = 2\cos^{-1}(c_1 / 2c_2)$ .

A.6 The positions of bright and dark fringes will change rapidly. Such rapid changes cannot be detected by our eyes. A uniform illumination is seen on the screen i.e. interference pattern disappears.

A.7 $I = I_1 + I_2 + 2\sqrt{I_1 I_2}\ Cos\phi$

At and point, phase difference $\phi$ can have any value between O and $2\pi$, the average value of intensity will be $I_{av} = \frac{1}{2\pi}\left[\int_0^{2\pi} I d\phi\right]$

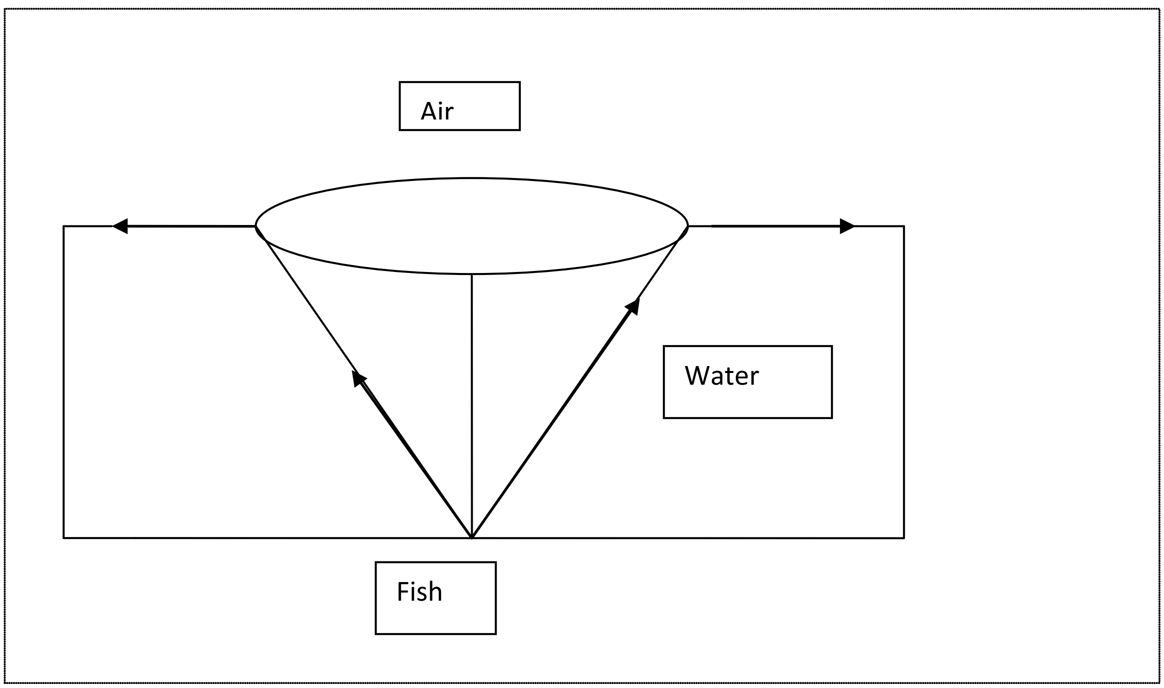
$I_{av} = I_1 + I_2$

As average value of intensity is equal to the sum of individual intensities.

A.8 P-336 NCERT (TB)

A.9 20cm

A.10

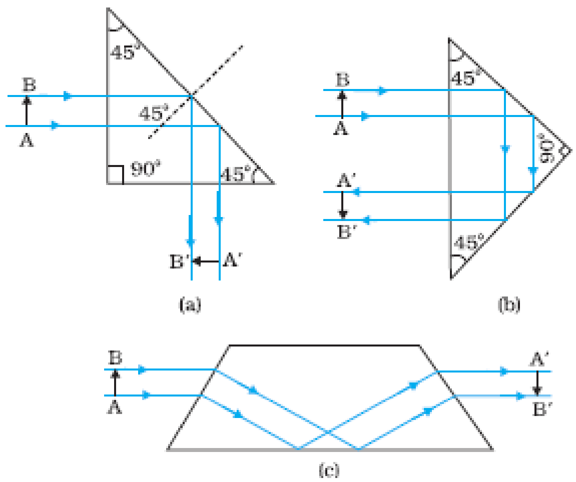



Clearly, the fish can see the outside view of the cone with semi vertical angle, But $\mu = \frac{1}{\sin i_c}$ Or

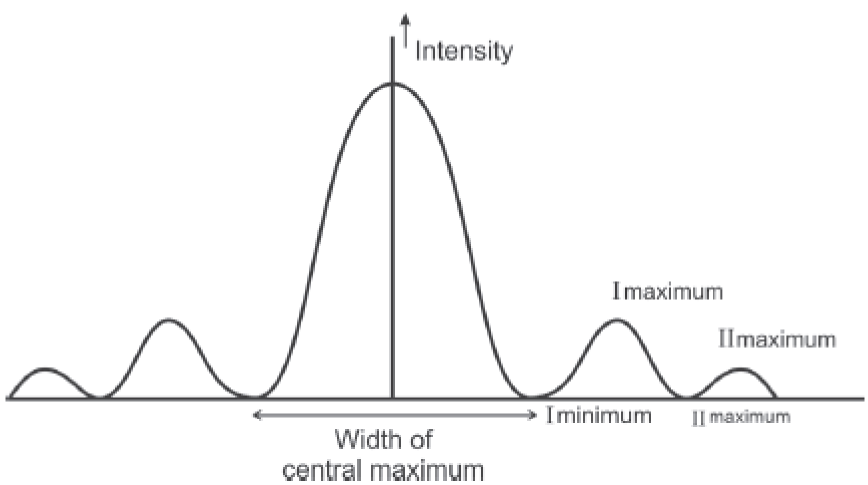
$\frac{4}{3} = \frac{1}{\sin i_c}$ Or $\sin i_c = ¾ = 0.75$

$i_c = \sin^{-1}(0.75) = 48.6°$

.A.11




A.12 The intensity distribution of light in diffraction at a signal slit is as follows




Width of central maximum is given by $w = 2D\frac{\lambda}{d}$

(i) When wavelength of light used is increased, the width of central maximum increases.

(ii) When width of the slit is increased, the width of central maximum decreases.

Wavelength of light in water decreases, so width of central maximum also decreases.

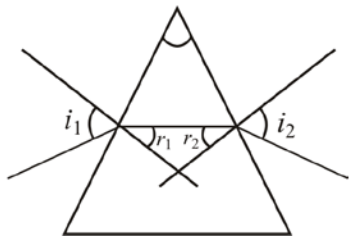
A.13

$$A = \sqrt{A_1^{\ 2} + A_2^{\ 2} + 2A_1A_2\cos\Phi} = 5$$

$$\tan\theta = \frac{A_2\sin\Phi}{A_1 + A_2\cos\Phi} = \frac{3}{4} \Rightarrow \theta = 0.2\pi\, radian$$

A.14 As A = $r_1 + r_2$, ray will not pass through the prism if $r_2$ is at least equal to critical angle $(r_1)_{max}$ = A – $(r_2)_{mini}$

$(r_1)_{max}$ at $i_2 = \frac{\pi}{2}$ and equals $i_c$ $(\angle A)_{least} = i_c + i_c = 2i_c$




A.15 (i) The upper part of the mirror is convex.

(ii) The middle part of the mirror is concave.

(iv) The lower part of the mirror is plane.

## Unit-7

1. Mass less charge less particle carrying packet of light energy.

2. Emission of electrons with photons of light.

3. Minimum energy needed to set an electron free from the surface of a metal.

4. Maximum wavelength upto which photoelectric emission can take place.

5. $h\nu = h\nu_o + ½ mv^2_{max}$

6. Waves associated with moving matter.

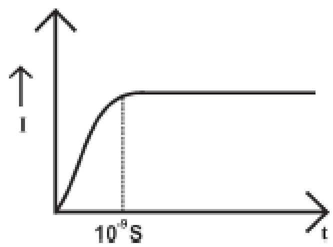
7. NCERT Page no. 392

8. Both particle as well as wave.

9. NCERT Page no. 398

10. Energy acquired by an electron under potential difference of 1volt.

11.




12 (Energy of photon=3.546eV , metal-B)

13 Energy of incident photon = $hc/\lambda = 3.97 \times 10^{-19}$ J =2.48eV

Max K.E of electron=2.48-1.2=1.28eV hence Vo = 1.28 V

14 Metal B

15 Because the work function of alkali metals is small

16 No effect

17 NCERT text book page no 392 fig 11.5 &page 395

19 Davisson and Germer experiment NCERT text book page no 403

22 Photoelectric effect and Compton Effect

23. 2:1 use, $\omega = hc/\lambda$

24. $10^{-10}$
25. Max KE = 4eV hence stopping potential is 4V
26. using formula $\lambda = h/\sqrt{2mE}$ , hence $\lambda$ is inversely propotional to square root of mass hence alpha particle has shortest wavelength
27. photon
28. using $E = hc/\lambda$, $E = 3\times10^{-15}$J
29. using $\text{Ø} = h\nu_o$ threshold frequency $=1.4\times10^{15}$Hz ,
30. (1) K.E becomes more than double, (2) Photocurrent remains unchanged ,
    (3) Stopping potential becomes more than double.
31. $v_1 / v_2 = ½$
33. electron in both cases as velocity is inversely proportional to mass and KE inversely proportional to square root of mass
34. 1.264 A□
35. Refer to NCERT text book Page 431

36. a) $KE_{max}$ = 2.5 eV , b) W = 3.75 eV c) $\gamma_0 = 9.1 \times 10^{14}$ Hz

37. 1.45$A^0$ using relation $\lambda = h/\sqrt{3mKT}$

38. 75%

# Unit-8

# Level 1

A2. 1:1(since density is independent of mass no.)

A7. **(1:3)** since $r_1/r_2 = (A_1/A_2)^{1/3}$

**A10. Dis. Int. constt. =0.693/$T_{1/2}$**

# Level 2

**Ans1. (62.6%)**

# Level 3

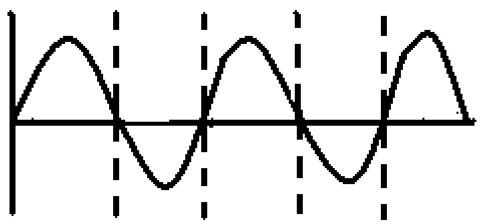
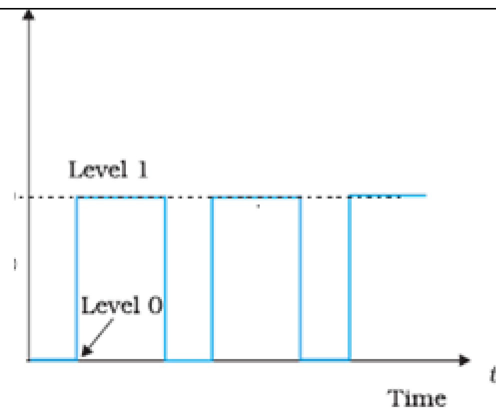
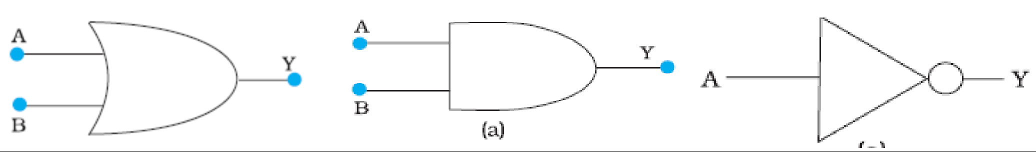
**Ans1. (1:48)**

Ans.4. fqer =**2.5x10**$_{15}$ **Hz,** $E2-E_1=h\nu$

Ans.**5. n = $10^{49}$**

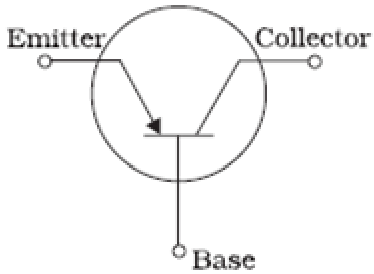
# Unit-9

# Level-1

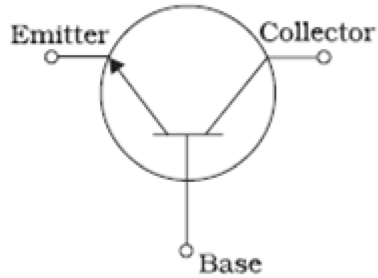
| | |
|---|---|
| **4.** | Electrons |
| **7.** | Converts solar energy into electric energy |
| **8.** | Light Emitting Diode |
| **9.** | Building blocks of digital circuits |
| **10.** |   <br>ANALOG DIGITAL |
| **11.** | As it is transformer of resistance,which can be achieved by interchanging the biasing across the junction of junction transistor. |
| **12.** | Zener diode has sharp breakdown voltage, used in reverse bias. |
| **13.** | Electrons have greater mobility. $e^-$ moves in CB, holes move in VB. |
| **14.** | Conductor –> O, Insulator–> 5eV, semiconductor1eV |
| **15.** | The number of charge carriers and their direction of flow can be controlled by proper doping and biasing |
| **16.** |   |
| **17.** | Pentavalnt:_ Antimony,bismuth Trivalent:- Gallium, Indium |

**18.** In the energy band diagram of Ge and Si the energy gap is .72eV and 1.1 eV between conduction band and valence band.

**19.**




**PNP Transistor**




**NPN Transistor**

**20.**

**OR GATE**

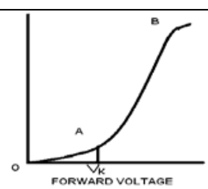
| Input | | Output |
|---|---|---|
| A | B | Y |
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

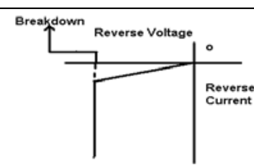
**AND GATE**

| Input | | Output |
|---|---|---|
| A | B | Y |
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

# Level 2

**2.**




**3.**

**4.**

**5.** By giving the output of OR gate as input to NOT gate formed from OR gate.

**6.** By giving the output of AND gate as input to NOT gate formed from AND gate.

| | |
|---|---|
| **7.** | Output resistance $= \frac{\Delta V_{CE}}{\Delta I_{CE}} = \frac{0.2}{0.004 \times 10^{-3}} =$ 50kilo ohms |
| **8.** | No current flow through transistor as there is no conduction due to majority carriers across the emitter-base junction or collector-base junction. |
| **9.** | NO, by joining two p-n junction diode back to back ,the n-region which form the base will become thick and will not serve the purpose of base in a transistor |
| **13.** | $E = h\upsilon = \frac{hc}{\lambda}$<br>$\lambda_{max} = \frac{hc}{E}$ |
| **14.** | A B Y / O O I / O I I / I O O / I I O |
| **15.** | A = 0 B = 0<br>Write the truth table of the expression and find |
| **16.** | $I_e = I_b + I_c$<br>$\alpha = \frac{I_c}{I_e}$ $\beta = \frac{I_c}{I_b}$<br>$\beta_{ac} = \frac{\Delta I_c}{\Delta I_b}$ |

Truth table for 14:

| A | B | Y |
|---|---|---|
| O | O | I |
| O | I | I |
| I | O | O |
| I | I | O |

# Level 3

<table>
<tr><td>1.</td><td>AND gate,
<table>
<tr><td>A</td><td>B</td><td>Y</td></tr>
<tr><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td>1</td><td>0</td></tr>
<tr><td>1</td><td>1</td><td>1</td></tr>
</table></td></tr>
<tr><td>2.</td><td>Current gain= $\frac{\Delta I_C}{\Delta I_b}$ =200 Voltage gain= $\frac{Ro}{Ri}$ X current gain= 1000</td></tr>
<tr><td>4.</td><td>Lamp will glow brighter, reading of voltmeter will increase.</td></tr>
<tr><td>5.</td><td>AND Gate</td></tr>
<tr><td>6.</td><td>
<table>
<tr><td>A</td><td>B</td><td>Y</td></tr>
<tr><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1</td><td>0</td><td>1</td></tr>
<tr><td>0</td><td>1</td><td>1</td></tr>
<tr><td>1</td><td>1</td><td>1</td></tr>
</table></td></tr>
<tr><td>8.</td><td>Inside transistor current carrier are electrons and holes while outside the transistor current carrier are electron.</td></tr>
<tr><td>9.</td><td>Decreases.</td></tr>
<tr><td>11.</td><td>Zener diode as voltage regulator.</td></tr>
</table>

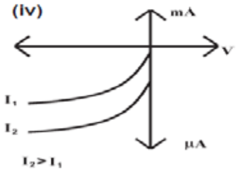
**12.**

(i) Photodiode

(ii) –ve

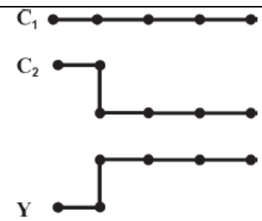
(ii) μA

(iv)




**13.**

| Interval | A | B | $B_1 = \overline{A}$ | $B_2 = \overline{B}$ | $C_1 = B_1.B$ | $C_2 = A.B_2$ | $Y = C_1 + C_2$ |
|---|---|---|---|---|---|---|---|
| 0 – 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 |
| 1 – 2 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| 2 – 3 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| 3 – 4 | 0 | 0 | 1 | 1 | 0 | 0 | 1 |




**14.**

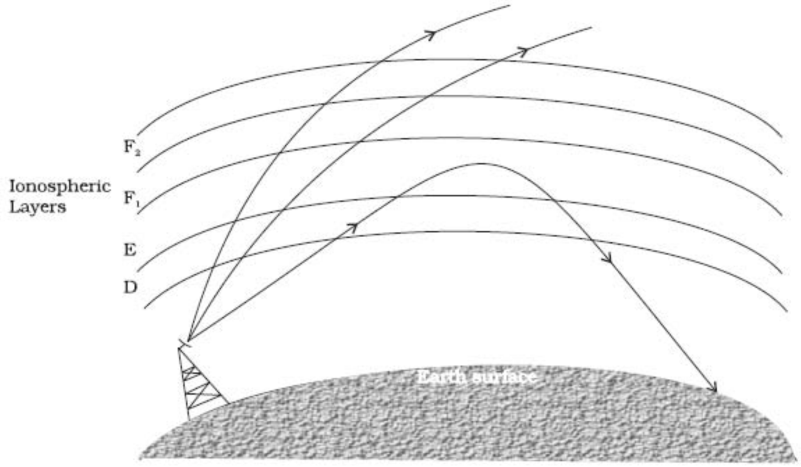
As temperature increases, resistance of semiconductor decreases. ∴ R must be increased to keep current constant

# Unit-10

# LEVEL I

1. The part of the em wave spectrum having frequency range $10^3$ to $10^9$ Hz and which is used in radio communication.
2 Device that transmits and receives signals.
3 The frequency range required to transmit a particular signal. (ref. P No 518 NCERT)
4 The medium through the radio waves can be transmitted. The commonly used transmission media are wire, free space and fiber optic cable.
5 Uplinking is sending out signals to a satellite and down-linking is receiving signals from the satellite by a earth station.
6 Exchange of information.
7 Time period = 24 hr, Orbit coplanar with equator and the sense of revolution should be same as that of earth.

8



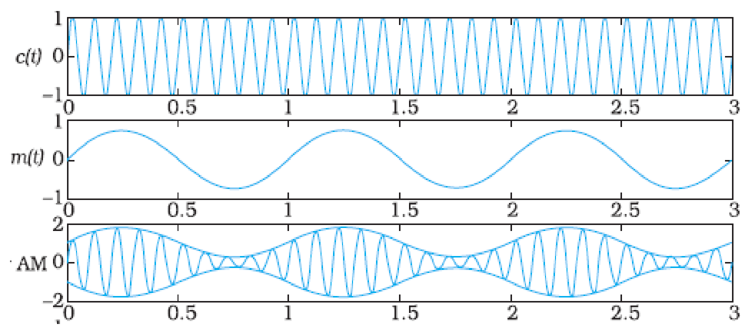

9 The process of modifying a parameter(amplitude, frequency or phase) of high frequency carrier wave in accordance with low frequency message signal.

10 power radiated is proportional to (*l*/λ□□□

# LEVEL 2

1. Height = λ/2 and λ = c/ν. *Hence required height is 150m*

2




3 Guided transmission is the transmission of radio waves through wires etc so that they propagate in a particular direction.

Unguided propagation is transmitted in all directions. ( Through space )

4 Maximum line-of-sight distance $d_M$ between the two antennas is the distance up to which the radio waves can be intercepted directly

$$d_M = \sqrt{2Rh_T} + \sqrt{2Rh_R}$$

5 It is at large distance, it is not coplanar with the equator of earth.

6 Population covered = population density × area covered = Pop.density $\times \pi\left(\sqrt{2dh}\right)^2$

7 Higher frequencies get heavily absorbed by ground.

8 It gives the extent of modulation. $m = \frac{E_m}{E_c} = \frac{1}{2}$

9 AM and FM

10 Above 20 MHz radiation losses becomes prominent.

11 Because short waves can be reflected by the ionosphere

12 Ground wave. ( as frequency is less than 1500 KHz and range required is quiet less)

13 FM is less susceptible to noise signals.

14 To increase the range of the signals, overcome the antenna length problem, overcome the problem of intermixing of the signals.

15 By increasing the height of the tower, by increasing the height of the receiving antenna and can also by increasing the power of transmitted signals.

16 Depends on the frequency of the signals to be transmitted and the distance to be travelled by the signal.

17 Four Times. $d = \sqrt{2hR}$

18 10 MHz

19 Analog and Digital communication

20 Modem

# LEVEL 3

1. Refer. NCERT textbook- P No 527

2 Because they cannot be reflected by ionosphere.

3 $E_{max} = E_c + E_m = 9\ V$ and $E_{min} = E_c - E_m$=1V

$$m = \frac{E_{max} - E_{min}}{E_{max} + E_{min}} = 0.8 = 80\%$$

4 $d_m = \sqrt{2Rh_T} + \sqrt{2Rh_R} = 45.5\ km$

5 $\lambda = \frac{c}{v}$ wavelength range will be from 25m to 40m.

6 Active: A satellite having transponders so that it can modify the uplinked signal before down linking it.

Passive: It just receives and reflected back the signals.

7 No of channels = $\frac{2\%\ of\ 10\ GHz}{8KHz} = 25000\ channels$

| | | | |
|---|---|---|---|
| 8 | Mobile Communication: | 896-901 MHz | Mobile to base station |
| | | 840-935 MHz | Base station to mobile |

| | | |
|---|---|---|
| Satellite Communication | 5.925-6.425 GHz | Uplink |
| | 3.7- 4.2 GHz | Downlink |

9 Refer to NCERT text book P. No 525-26

10 No modulation of the signal is done so signal will have less range, long antenna is required. To overcome these problems modulation should be done before radiating the signal and demodulation should be done after receiving.

11 $m = \frac{E_m}{E_c} = 0.8$

LSB: $\nu_c - \nu_m \; to \; \nu_c \; ie \; 0.98MHz \; to \; 1MHz$

USB: $\nu_c \; to \; \nu_c + \nu_m \quad ie \; 1MHz \; to \; 1.2MHz$

12 Line of Sight Communication (LOS)

13 54 MHz to 890 MHz

14 Derive relation $d = \sqrt{2hR}$ and refer to textbook

15 A transducer is a device which converts one form of energy into another.

A repeater is a combination of receiver and transmitter placed along the path of the signal, so as to extend the range of the communication of the system.