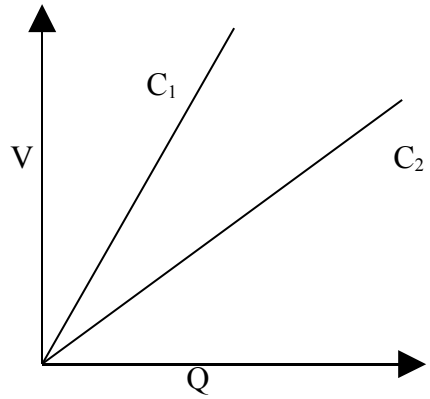
UNIT-1
ELECTROSTATICS

1. Where the energy of capacitor does resides?
2. Do electrons tend to go to region of low or high potential?
3. What is the net charge on the charged capacitor?
4. A Gaussian surface encloses an electric dipole within it. What is the total flux across sphere?
5. Find the dimension of $1/2\varepsilon_o E^2$.
6. In a certain l m^3 of space, electric potential is found to be V Volt throughout. What is the electric field in this Region?
7. If Coulomb law involves $1/r^3$ instead of $1/r^2$ dependence, would Gauss law be still true?
8. An electrostatic field line can't be discontinuous, why?
9. The given graph shows that the variation of charge versus potential difference V for the two capacitors

   C_1 & C_2. The two capacitors have same plate separation but the plate area of C_2 is doubled than that of

   C_1.Which of the line in the graph corresponds to C_1 &C_2 and why?



10. Three charges, each equal to +2C are placed at the corners of an equilateral triangle. If the force

    between any two charges be F, then what will be the net force on either Charge?
11. A point charge q is placed at O as shown in the figure.

    Is V_P-V_Q +ve or –ve when (i) q>0, (ii) q<0?

    Justify your answer.
12. An electric dipole of dipole moment 20 X 10^{-6} C.m is enclosed by a closed surface. What is the net flux

    coming out of the surface?
13. Why does the electric field inside a dielectric decrease when it is placed in an external electric field?
14. Write the magnitude and direction of electric field intensity due to an electric dipole of length 2a at the

    mid point of the line joining the two charges.

15. A spherical portion has been removed from a solid sphere having a charge distributed uniformly in its volume as shown in fig. What is the electric field inside the emptied sphere?

16. A charged particle is free to move in an electric field. Will it always move along an electric line of force?

17. If V ($=q/4\pi\varepsilon_o r$) is the potential at a distance r due to a point charge q, then determine the electric field due to a point charge q, at a distance r.

18. Can electric potential at any point in space be zero while intensity of electric field at that point is not zero?

19. Devise an arrangement of three point charges separated by finite distances that has zero electric potential energy.

20. Each of the uncharged capacitor in the fig. Has a capacitance of 25μF. What charge shall flow through the meter M when the switch S is Closed?

21. Charge of 2C is placed at the centre of a cube of volume 8 cm^3. What is the electric flux passing through one face?

22. A charged particle q is shot towards another charged particle Q which is fixed, with a speed v. It approaches Q up to a closest distance r and then returns. If q were given a speed 2v, then find the closest distance of approach.

23. Two capacitors of capacitance 6μF and 12μF are connected in series with the battery. The voltage across the 6μF capacitor is 2 volt .Compute the total battery voltage.

24. A parallel plate capacitor with air between the plates has a capacitance of 8 pF . The separation between the plates is now reduced by half and the space between them is filled with a medium of dielectric constant 5. Calculate the value of capacitance of parallel plate capacitor in second case.

25. Five identical capacitors, each of capacitance C are connected between points X and Y as shown in the figure. If the equivalent capacitance of the combination between X and Y is 5μF. Calculate the capacitance of each capacitor.

26. An uncharged capacitor is connected to a battery. Show that half of the energy supplied by the battery is lost as heat while charging the capacitor.

27. What is the angle between the electric dipole moment and electric field strength due to it on the equilateral line?

28. Find the equivalent capacitance between A & B, if capacitance of each capacitor is C.

29. Eight identically charged drops are joined to form bigger drop. By what factor the charge and potential change?

30. A uniform electric field of 2 kNC^{-1} is in the x-direction. A point charge of 3 μC initially at rest at the origin is released. What is the kinetic energy of this charge at x = 4m?

31. Two identical metal plates are given the charges Q_1 and Q_2 ($Q_2 < Q_1$) respectively. If they are now brought close together to form a parallel plate capacitor with capacitance C then what is the potential difference between them?

32. Three charges Q, +q and +q are placed at the vertices of a right angle isosceles triangle as shown. Find the magnitude of Q for which net electrostatic energy of the configuration is zero.

33. An infinite number of charges each having charge 'q' along x-axis at x=1 ,x=2, x=4 ,x=8 an so on. Find the electric field at x=0 due to these charges.

34. A charge Q is distributed over the two concentric hollow spheres of radii 'r' and 'R' (R>r) such that the surface densities are equal. Find the potential at the common centre.

35. An electric dipole is held in an uniform electric field. Using suitable diagram, show that it doesn't undergo any translatory motion, and (ii)Derive an expression for torque acting on it and specify its direction.

36. The field potential inside a charged ball depends only on the distance from its centre as $V=ar^2+b$,where a and b are constants. Find the space charge distribution ρ(r) inside the ball.

CHAPTER-2
CURRENT ELECTRICITY

1. Magnesium is used for making standard resistors, why?
2. The sequence of bands marked on a carbon resistor are: Red, Red, Red, Silver. Write the value of resistance with tolerance.
3. A wire of resistively ρ is stretched to three its initial length, what will be its new resistively.
4. If p.d.v applied across a conductor is increased to 2v, how will the draft velocity of the electrons change?
5. A 10Ω thick wire is stretched so that its length becomes three times. Assuming that there is no change in its density on stretching. Calculate the resistance of new wire.
6. You are given 8 Ω resistor. What length of wire of resistance 120 Ωm^{-1} should be joined in parallel with it to get a value of 6 Ω ?
7. Three resistance 3Ω,6Ω and 9Ω are connected to a battery. In which of them will the power

dissipation be maximum if

a) They are all connected in parallel
b) They are all connected in series

Give reason.

8. A silver wire has a resistance of 2.1Ω at 27.5˚c and a resistance of 2.7Ω at 100˚c. determine the temperature coeff. of resistivity of silver.

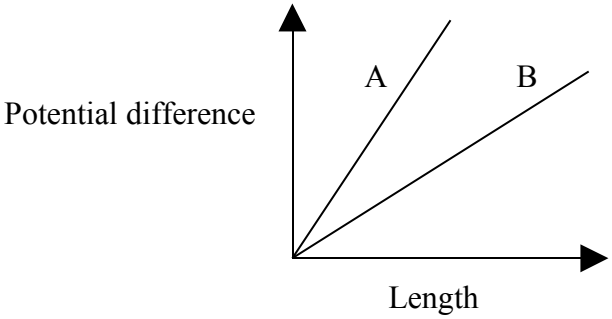
9. Give any two applications super conductors.

10. Two wire of equal length one copper and manganin have same resistance , which wire is thicker?.

11. Why manganin is used for making standard resistor?

12. A copper wire of resistivity ρ is stretched to reduce its diameter to half of its previous value .What will be the new resistances?

13. The variation of potential difference with length incase of two potentiometres A and B is given below.Which of the two is more sensitive.



14. If the length of the wire conductor is doubled by stretching it , keeping potential difference constant by what factor the drift speed of the electron changed.

15. If the temperature of the conductor increases, how does the relaxation time of electron changes.

16. A heater joined in series with the 60W bulb .With change of bulb with 100 W in the circuit, the rate heat produce by the heater will more or less or remain same.

17. What will be the change in the resistance of the circular wire , when its radius is halved and length is reduced by ¼ th of original length.

18. Two 120V light bulbs , one of 25W and another of 200W are connected in series . One bulb burnt out almost instantaneously ?.Which one was burnt and why?.

19. A given copper wire is stretched to reduce its diameter is half of its original value.What will the new resistance?.

20. A student has two wire of iron and copper of equal length and diameter.He first joins two wires in series and pass electric current through the combination which increases gradually.After that he joins two wires in parallel and repeats the process of passing current.Which wire will glow first in each case?

21. A cylindrical metallic wire is stretched to increase its length by 5% . Calculate the percentage change in resistances.

22. A wire of resistance 4R is bend in the form of circle .What is the effective resistance between the ends of diameter?.

23. Two wires A and B have same lengths and material , have their cross sectional areas 1:4 , what would be the ratio of heat produced in these wires when the voltage across each is constant.

24. Two bulbs whose resistance are in the ratio of 1:2 are connected in parallel to a source of constant voltage. What will be the ratio of power dissipation in these?

25. Total resistance of the circuit is R/3 in which three identical resistors are connected in parallel. Find the value of each resistance?.

UNIT -3
MAGNETIC EFFECTS OF CURRENT & MAGNETISM

1. Suppose a helical spring is suspended from the roof of a room and very small weight is attached to its lower end what will happen to the spring when a current is passed through it?Give reason to support your answer?
Ans Spring will contract due to the magnetic field produced by the turns of the coil and the weights will be lifted up.

2. One alpha particle and a deuteron entered perpendicularly in a uniform magnetic field with same velocity. Which one follow the greater circle?
Ans: As we know for a charge particle moving in a magnetic field, the radius of circular path: $r = mv/qB$
As both the particles have same velocity therefore

$$r_\alpha / r_d = m_\alpha q_d / m_d q_\alpha$$

$$\frac{4\ X\ 1}{2\ X\ 2} = \frac{1}{1}$$

Thus both particles will follow the same

3. Out of Voltmeter and Millivoltmeter, which has the higher resistance?
Ans: We know the resistance connected to galvanometer to convert it into voltmeter is
$R = (V / Ig) - G$
So if R is higher, range of V will also be higher, so a Voltmeter has the higher resistance.

4. Proton is moving along the axis of a solenoid carrying current of 2 A and 50 number of turns per unit length. What will be the force acting on the particle.
Ans: As the magnetic field produced by solenoid is always along its axis, so direction of velocity of proton is along the direction of field, therefore

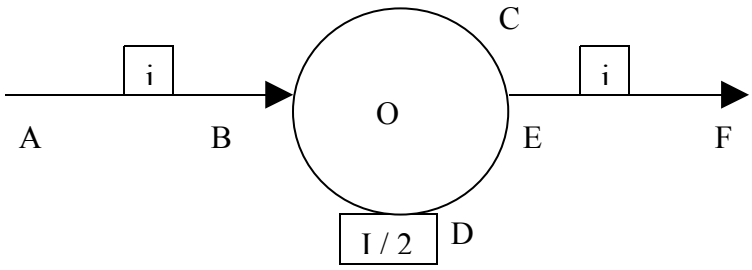
$$F = qvB \text{ Sin } 0 = 0$$

5. Out of Ammeter and Milliammeter, which has the higher resistance?
Ans: We know the resistance connected to galvanometer to convert it into ammeter is

$$S = (Ig/(I - Ig))xG$$

So for higher resistance, the range of I should be small, therefore milliammeter has the higher resistance.

6. What will be the direction of magnetic field at point O



Ans: The magnetic field due to AB and EF is as the direction of length vector is along the radius vector,

Also the magnetic field due to BCE and BDE are equal opposite and equal so they cancel the effect of each other. So the net magnetic field at O is 0.

7. Can a Moving Coil Galvanometer can be used to detect an A.C. in a circuit .Give reason.
Ans: As MCG detect only the average value of current and the average value of AC for a complete cycle is zero. Therefore MCG can not detect AC in a circuit.

8. Two wires of equal length are bent in the form of two loops. One loop is square whereas the other is circular. These are suspended in same magnetic field and same current is passed through them. Explain with reason which will experience greater torque?
Ans: For a given length, the circle has the greatest area, as

$$\tau = NIAB$$

i.e. torque is proportional to area, so circular current loop experiences the greater torque.

9. The pole of a magnet is brought near to a stationary charge. What will be the force experienced by pole?
Ans: The force will be zero as the stationary charge particle does not produce any force.

10. A charge particle moving in a magnetic field penetrates a layer of lead and thereby losses half of its kinetic energy. How does the radius of curvature of its path change?

Ans: $r = mv/qB$ ---------- (i)

Also $P = mv = \sqrt{2mE}$ ---------- (ii)

By equ (i) and equ (ii)

As the radius is $\boxed{r = \frac{\sqrt{2mE}}{qB}}$ proportional to square root of kinetic energy, so if the kinetic energy is halved the radius become $\sqrt{1/2}$ times of its initial value.

11. A Voltmeter, an ammeter and a resistance are connected in series with a battery. There is some deflection in voltmeter but the deflection of ammeter is zero. Explain why?
Ans: As the resistance of V is very high so the effective resistance of circuit become very high, so the current flows in circuit is extremely low therefore the deflection is almost zero, while the V measures the potential difference between the points so it shows the reading due to battery.

12. A Current 'I' flows along the length of an infinitely long straight thin walled pipe. What is the magnetic field at any point on the axis of pipe?
Ans: Zero.

13. The Earth's core contains iron but geologists do not regard this as a source of Magnetic Field, Why?
Ans: Temperature in the core of earth is higher than Curie temperature of Iron.

14. Is the Resistance of Voltmeter larger than or smaller than the resistance of Galvanometer from which it is converted.
Ans: Larger

15. A Magnetic Field dipole placed in a Magnetic Field experiences a net force. What can you say about the Nature of Magnetic Field?
Ans: Non-uniform.

16. Earth's Magnetic Field does not affect working of moving Coil Galvanometer. Why?
Ans: Magnitude of Earth's magnetic field is much smaller than magnitude of the field produced by poles of galvanometer.

17. Which type of Magnetism exists in all substances?
Ans: Diamagnetism.

18. For what orientation P.E. of a Magnetic dipole placed in uniform Magnetic Field minimum?
Ans: $\theta = 0$ (Dipole is parallel to field.)

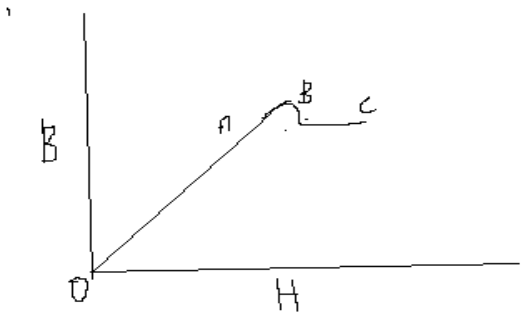
19. How does a ferromagnetic material change its Magnetic properties if it is heated beyond its curie temperature?
Ans: Becomes Paramagnetic.

20. A bar magnet is cut into two pieces, along its length. How will its pole strength be affected?
Ans: M1 = M/2, M=M/2

21. What is the work done by a magnetic force, in displacing a charged particle?
Ans: Zero.

22. What is the net magnetic flux from a north (or south) pole of a magnet (dipole) ?
Ans: Nil, because the number of magnetic lines entering the surface is equal to the number of lines going out of it.

23 An unmagnetised ferromagnetic substance is magnetized. Given figure shows the B-H curve. Identify the stage of saturation ,reverse region and irreversible region



stage of saturation is B to C . Reversible region O to A and A to B is irreversible region.

24. What is the magneticfield at the centre of the following circular coils carrying current I?

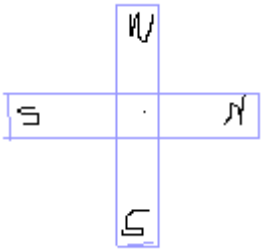
$\frac{\mu oI}{2R} + \frac{\mu oI}{2\Pi R}$ $\qquad$ $\frac{\mu oI}{2R} - \frac{\mu oI}{2\Pi R}$

25. Two long straight wires are set parallel to each other. Each carries a current I in the same direction and the separation between them is 2r. What is the intensity of the magnetic field midway between them?
Ans: The fields of the two wires will be in the opposite directions at the midway point.
$B = B_1 - B_2 = \mu_0 I/2\pi r - \mu_0 I/2\pi r = 0$

26. A proton is about 1840 times heavier than an electron. What will be its kinetic energy when it is accelerated by a potential difference of 1KV?
Ans: Kinetic Energy gained=qv=ex1Kv=1keV

27. A circular loop of radius R carrying current I ,lies in X-Y plane with its centre at origin.What is the total magnetic flux through X-Y plane?
Ans: $\varphi = B.A = \frac{\mu_o I \Pi r^2}{2r}$
$= \frac{\mu_O IR\Pi}{2}$
ie $\varphi \alpha R$

28. A hypothetical bar magnet is cut into two equal pieces and placed as shown in the figure. What is the magnetic moment of this arrangement?



magnetic moment of the arrangement $= \sqrt{M_1^2 + M_2^2 + 2M_1M_2\cos\theta}$
$= \sqrt{M^2/4 + M^2/4 + 2M/2 \times M/2 \cos 90}$
$= \sqrt{2M^2/4} = M/\sqrt{2}$

29. A circular current carrying coil has a radius R. What is the distance from the centre of the coil on its axis where the magnetic field is 1/8 th of its value at the centre?

Ans: $B_{axial} = 1/8\ B_{centre}$

$$\frac{\mu_0 IR^2}{2(R^2+r^2)^{3/2}} = \frac{1 \times \mu_0 I}{8 \times 2R}$$

$$(R^2+r^2)^{3/2} = 8R^2$$

$$R^2+r^2 = 4R^2$$

Hence , $r = \sqrt{}\ R$

30. A magnetic needle suspended freely in a uniform magnetic field experiences torque but no net force. A nail made up of iron kept near a bar magnet experience a force of attraction and torque .Give reason.

Ans- Due to the non uniform magnetic field of bar magnet nail experience torque and translatory force.

31. What is the work done by a magnetic field on moving a charge? Give reason.

Ans- $W = FS\cos\theta = FS\cos 90 = 0$

32. A particle with charge q moving with velocity v in the plane of the paper enters a uniform magnetic field B acting perpendicular to the plane of the paper. Deduce an expression for the time period of the charge as it moves in a circular path in the field .

Why does the kinetic energy of the charge not change while moving in the magnetic field.

Ans- particle moves in circular path

$$Bqv = mv^2/r$$

$$r = mv/Bq$$

Time period $T = 2\pi\ r/v = 2\ m/Bq$

33. A solenoid of length 0.6m has a radius of 1cm and is made up of 600 turns.It carries a current of 5A.What is the magnetic field inside and at ends of solenoid.?

Ans- (i)At the centre

N=1000, $B = \mu_0 ni = 4\pi \times 10^{-7} \times 1000 \times 5 = 6.2 \times 10^{-3}$ T

(ii) At the ends

$B = \frac{1}{2} \mu_0 ni = 3.1 \times 10^{-3}$ T

34. An element dl = dx i is placed at the origin and carries a large current I = 10A.What is the magnetic field on the y axis at a distance of 0.5m,

$$dB = \mu_0 Idl \sin\theta / 4\pi r^2$$

$$= 10^{-7} \times 10 \times 10^{-2} / 25 \times 10^{-2}$$

$$= 4 \times 10^{-8}\ T$$

Direction of dB is in +Z direction

35. You are given a copper wire carrying current I of length L. Now the wire is turned into circular coil. Find the number of turns in the coil so that the torque at the centre of the coil is to maximum.

Ans: Let the number of turns be = n
Radius = r
Length=l
Length of the wire = circumference of n turns of coil

$$L = n \times 2\pi r$$

$$r = L/2\pi r$$

Maximum torque = $nIBA = nIB\ \pi r^2$

$$= nIB\pi (L/2\pi n)^2$$

$$\alpha\ 1/n$$

For maximum torque n should be minimum
i.e. n = 1.

36. What is the magnetic field produced at the centre of curvature of an arc of wire of radius r carrying current I subtends an angle $\pi/2$radians at its centre.

Ans: $B1 = B \times \theta/2\pi = (\mu_0 I\pi/2r) \times (2\pi x2)$

$$B1 = \mu_0 I/8r$$

37. If B is the magnetic field produced at the centre of a circular coil of one turn of length L carrying current I then what is the magnetic field at the centre of the same coil which is made into 10 turns?

Ans : $B1 = n^2 B = 10^2 B = 100\ B.$

38. A copper wire is bent into a square of each side 6cm.If a current of 2A is passed through a wire what is the magnetic field at the centre of the square?

Ans: $B1 = 4 \times \mu_0 I/4\pi\ a/2\ (\sin 45 + \sin 45)$
$= 4 \times \mu_0 2/4\pi x3\ (1/1.414 + 1/1.414)$
$= 2\ \mu_0/3\pi\ (1/1.414 + 1/1.414)$ T

39. Find the magnetic moment of a wire of length l carrying current I bent in the form of a circle.

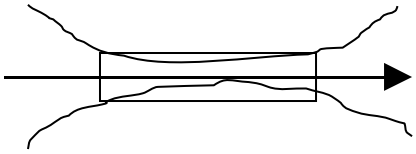
Ans: $M = IA = I \times \pi r^2$
But $l = 2\pi r$, i.e $r = l/2\pi$
$M = Il^2/4\pi$

40. When current is flowing through two parallel conductors in the same direction they attract while two beams of electrons moving in the same direction repel each other. Why?

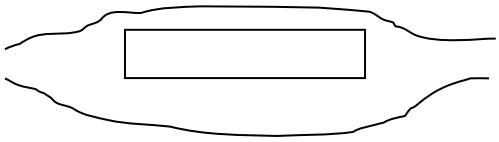
Ans- Two conductors carrying current in same direction produce magnetic field and hence they attract.
While two electron beams moving in the same directions repel due to its electric field (electrostatic force)

41. Draw diagrams to show behavior of magnetic field lines near a bar of (i) Alluminium (ii) copper and (iii) mercury cooled to a very low temperature 4.2 K

Ans- (i)Alluminium --- Paramagnetic



(ii) Copper and mercury = diamagnetic



42. The hysteresis loss for a sample of 6 kg is 150 J/M^2/cycle. If the density of iron is 7500 kg/m^3, calculate the energy loss per hour at 40cycle.

Ans: Volume of sample = mass/density = 6/7500 m^3

Energy loss/cycle = energy loss per volume/cycle x(volume)=150x6/7500

Energy loss/sec = 150x6x40/7500

Energy loss /hour = 150x6x40x60x60/7500 J

$=1.728 \times 10^4$ J

43. A current carrying solenoid of 100 turns has an area of cross section 10^{-4} m^2 .When suspended freely through its centre, it can turn in a horizontal plane .what is the magnetic moment of the solenoid for a current of 5A.Also calculate the net force and torque on solenoid if a uniform horizontal field of $10x10^{-2}$ T is set up at an angle of 30 degree with axis of solenoid when it is carrying the same current.

Ans: M = nIA = 100 x 5 x 10^{-4} =500 x 10^{-4} J/T

Net force = 0

Torque = MB sinθ = $5x10^{-2}$ x 0.1x sin30 = 25 x 10^{-4} Nm

H = R cos ð = .4x ½ = 0.2 G

44. Two concentric circular coils A and B of radii 10 cm and 6 cm respectively, lie in the same vertical plane containing the north to south direction. coil A has 30 turns and carries a current of 10 A . Coil B has 40 turns and carries a current of 15 A .the sense of the current in A is anticlockwise and clockwise in B for an observer looking at the coils facing west. Give the magnitude and direction of net magnetic field

Ans: B due to the coils at the centre.

Coil A –

R1 = 0.1m , n1=30,I1=10A

$B1 = \mu_0 n1I1/2r1 = 6\,\Pi \times 10^{-4}$ T directed towards east

Coil B-

R2 = 0.6 m , n2=40, I2= 15 A

$B2 = \mu_0 n2I2/2r2 = 2\Pi \times 10^{-}$T directed towards west

Net field B = B2 - B1 = $(20\Pi - 6\,\Pi)\,10^{-4}$ T towards west

45. The vertical component of earth's magnetic field at a given place is $\sqrt{3}$ times its horizontal component. If the total intensity of earth's magnetic field at a place is 0.4 G , find the value of horizontal component of earths field and angle of dip.

Ans: Tan ð = V/H =$\sqrt{3}$

ð = 60

As $V = \sqrt{3}H$ and

$B^2 = V^2 + H^2 = 3H^2 + H^2 = 4H^2$

$(0.4)^2 = 4H^2$ therefore

$H = 0.2$ G

46. An electron traveling west to east enters a chamber having a uniform electrostatic field in north to south direction.Specify the direction in which the uniform magnetic field should be set up to prevent the electron from deflecting from its straight line path.

Ans- Due to the electrostatic field electron will be deflected towards north. To keep it neutralized the magnetic force should deflect it towards south .For this purpose the magnetic field is to be applied perpendicular to the plane of the paper inward i.e vertically downward.

47. A straight horizontal conducting rod of length 0.5 m and mass 50 g is suspended by two vertical wires at its ends.A current of 5A is set up in the rod sdthrough the wires.(i) What magbnetric field should be set up normal to the conductor in order that the tension in the wires is zero?(ii)What will be the tension in the wire if the direction of current is reversed keeping the magbetic field same as before?(neglect the mass if wure abd taje $g=10m/s^2$)

Ans: (i) Magnetic force = weight

$IlB \sin\theta = mg$

$IlB = mg \quad (\theta = 90)$

$B = mg/Il = 500x10^{-3}/2.5 = 200 \times 10^{-3}$ T

(ii)When the direction of fidl is reversed an additional force which was equal to weight of rod will be acting on the wires.

Net tension in wires = mg + mg = 2 mg =$2 \times 50 \times 10^{-3} \times 10 = 1$ N

48. A circular coil of 20 turns and radius 10cm is placed in a uniform magnetic field of 0.d10T normal to the plane of the coil.If the current in the coil is 5a,What is the (i)Total torque on the coil (ii) total force on the coil (iii) average dsforce on each electron in the coil due to the magnetic field.(coil is made of copper, $A= 10^{-5}$ m^2 ,free electron density in copper is 10^{29} $/m^3$)

Ans: N= 20, r= .1 m, B = .1T, I = 5A

(i)Total torque = $nIBA\sin\theta \quad (\theta = 0)$

$= 0$

(ii)Total force on the coil is = 0, because force being equal and opposite and cancel eachother

(iii) Average force on electron = f = evB

$V = I/neA$

$F = IB/nA = 5x\ 0.1/10^{29} \times 10^{-5}$

$=5 \times 10^{-25}$ N

49. A Rowland ring of mean radius 15 cm has 3500 turns of wore wound on a ferromagnetic core of relative permeability 800.What is the magnetic field B in the core for a magnetizing current of 1.2 A?

Ans: N=3500, r= 15×10^{-2}m

$n = N/2\Pi r = 3500/2x3.14 \times .15 = 3715.5$ per m

$\mu_0 = 4\Pi \times 10^{-7}$ x TmA^{-1}, $\mu_r = 800$, $I = 1.2$

$B = \mu_0 \mu_r nI = 4.48$ T

50 A straight wire of mass 200g and the length 1.5m carries a current of 2A. It is suspended in mid air by a uniform horizontal magnetic field B. What is the magnitude of B in tesla?
Ans: For equilibrium of the wire in mid – air, weight of the wire = force exerted by magnetic field

$$Mg = IlB \sin 90^0$$
$$B = mg/Il = \frac{200 \times 10^{-3} \times 9.8}{2 \times 1.5} = 0.65T$$

51. A rigid circular loop of radius r and mass m lies in the x-y plane of a flat table and has a current I flowing in it. At this particular place the earth's magnetic field is B = Bxi +Bzk. What is the value of I, so that loop starts tilting?
Ans: M = IA =I r2k
B = Bxi +Bzk
T = M x B = (Iπ r2k) x(Bxi + Bzk)
= Iπ R2BXkxi = I r2BXj
Torque due to the weight of the loop = mgr
I r^2B_X = mgr Hence I = mg/ΠrB$_X$

52. In an ammeter, 10% of main current is passing through the galvanometer. If the resistance of the galvanometer is G, then what is the shunt resistance in ohms?

Ans: Ig=10% of I=0.1I

S=IgxG/I-Ig=0.1IG/I-0.1I=G/9

53. The two rails of arailway track insulated from each other and the ground is connected to a milli voltmeter. What is the reading g of the millivolmeter when the train passes at aspeed 180km/hr along the track, given that the vertical component of earth"s magnetic field is 0.2×10^{-4}T and rails are separated by 1m
e = Blv = $0.2 \times 10^{-4} \times 1 \times 180 \times 5/18$
= 10^{-3}V = 1Mv

54 A charged particle moving in a magnetic field penetrates a layer of lead and there by looses half of its kinetic energy.How does the radius of curvature of its path changes?
Radius r= mV/qB
Ans: If is the kinetic energy of the particle,then its momentum, p = mv√2mE$_k$
Radius , r =√2mE /Qb
rα√E$_k$
This shows that K.E is halved, the radius is reduced to 1/√2 times its initial value.

55 The velocities of two α particles X and Y entering in an uniform magnetic field are in the ratio 2:1.On entering the field ,they move in different circular paths .Give the ratio of the radii of their paths?
Ans: qvB = mv^2/r, r = mv/qB, rα v
$r_x/r_y = v_x/v_y = 2/1 = 2$

56 In an exercise to increase current sensitivity of a galvanometer by 25 % , its resisitance is increased by 1.5 times . How does the voltage sensititvity of the galvanometer be affected.

Ans: I s ' = I s + 25/100= 125/100 = 5/4 I s --------- 1

R' = 1.5 R ---------- 2

V s + I s / R & Vs " = Is'/R' =5/4 I s/1.5 R

+ 5/6 V s

% decrease in voltage sensitivity

= (1-Vs'/V s) X 100

(1-5/6) X 100 = 16.7%

UNIT IV
ELECTROMAGNETIC INDUCTION & ALTERNATING CURRNT

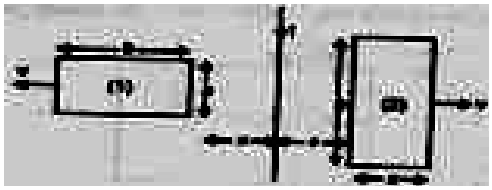
1. Three identical coils A, B and C are placed with their planes parallel to one another. Coils A and C carry current as shown. Coil B and C are fixed. The coil A is moved towards B with uniform motion. Is there any induced current in B?

ANS: - YES

2. Two coils are being moved out of magnetic field- one coil is moved rapidly and the other slowly. In which case is more work done and why?

ANS: - THE ONE WHICH IS MOVED RAPIDLY

3. The figure shows two identical rectangular loops (1) and (2), placed on a table along with a straight line current carrying conductor between them.



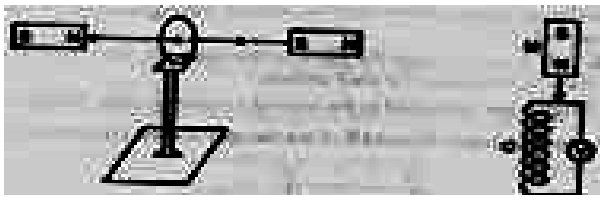
(i) What will be the directions of the induced currents in the loops when they are pulled away from the conductor with same velocity?

(ii) Will the e.m.f. induced in the two loops be equal? Justify your answer.

ANS: - (i) CLOCKWISE IN LOOP 1 AND ANTICLOCKWISE IN LOOP 2

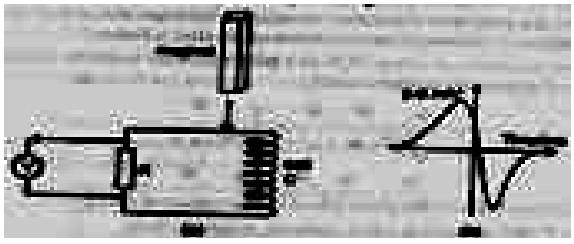
(ii) EMF INDUCED IS MORE IN LOOP 2 THAN IN LOOP 1

4. Give the direction in which the induced current flows in the coil mounted on an insulating stand when a bar magnet is quickly moved along the axis of the coil from one side to the other as shown.



Ans: - ANTICLOCKWISE

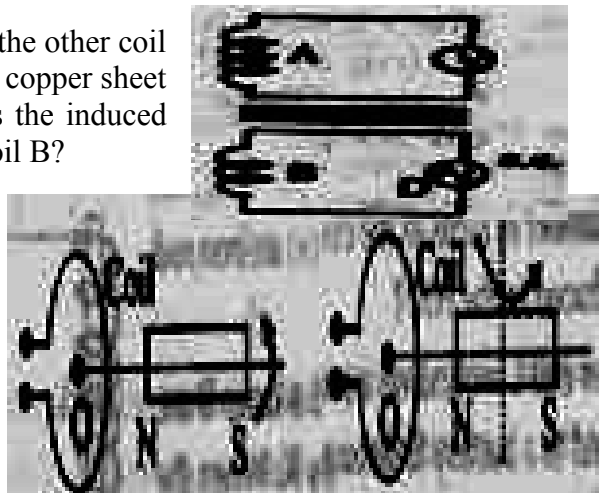
5. A bar magnet M is dropped so that it falls vertically through the coil C. The graph obtained for voltage produced across the coil vs time is shown in figure (b). (i) Explain the shape of the graph. (ii) Why is the negative peak longer than the positive peak?



ANS: - (i) As magnet approaches the coil the rate of change of magnetic flux increases and the induced emf also increases. As soon as one pole of magnet enters into the coil the emf decreases due to the other pole effect and also the induced emf polarity reverses due to the same reason.

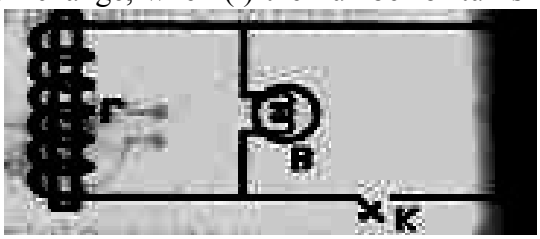
(ii) The longer peak is due to increase in the rate of change of magnetic flux as the magnet comes out of the coil.

6. A coil A is connected to a voltmeter V and the other coil B to an alternating current source D. If a large copper sheet C is placed between the two coils, how does the induced e.m.f. in the coil A change due to current in coil B?
ANS: - DECREASES



7. A cylindrical bar magnet is kept along the axis of a circular coil, when the magnet is rotated (a) about its own axis, and (b) about an axis perpendicular to the length of the magnet, in which case the induced emf will be more?
ANS: - IN CASE OF (b) IT IS MORE

8. How does the self inductance of an air core coil change, when (i) the number of turns in the coil is decreased, (ii) an iron rod is introduced in the coil? A copper coil L wound on a soft iron core and a lamp B are connected to a battery E through a tapping key K. When the key is suddenly opened, the lamp flashes for an instant to much greater brightness. Explain.

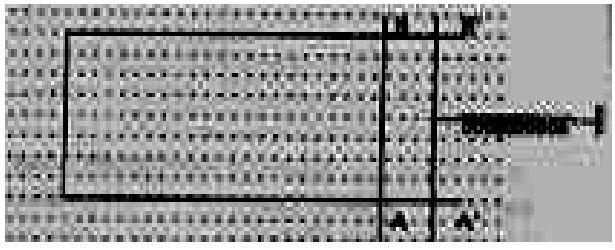


ANS: - (i) DECREASES (ii) INCREASES.

THERE IS AN OPPOSITION FOR THE CURRENT IN COIL DUE TO SELF INDUCTION SO THE BULB GETS MORE ELECTRIC CURRENT INITIALLY.

9. How is the mutual inductance of a pair of coils affected when separation between the coils is increased? The number of turns of each coil is increased? A thin iron sheet is placed between the two coils, other factors remaining the same? Explain your answer in each case.
ANS: - DECREASES, INCREASES, INCREASES.

10. A rectangular wire frame, shown below, is placed in a uniform magnetic field directed upward and normal to the plane of the paper. The part AB is connected to a spring. The spring is stretched and released when the wire AB has come to the position A'B' (t = 0). How would the induced emf vary with time? Neglect damping.

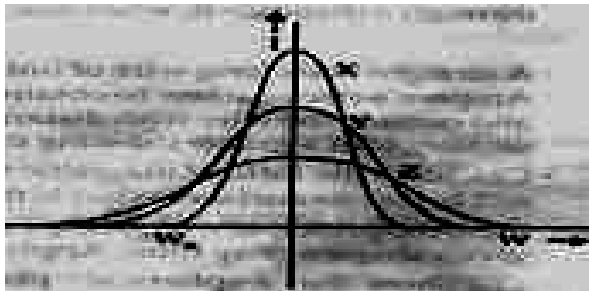


ANS: - THE RATE OF CHANGE OF AREA IS MORE INITIALLY AND DECREASES WITH TIME AND SO THE INDUCED EMF.

11. Why does metallic piece become very hot when it is surrounded by coil carrying high frequency alternating current?

ANS: - HIGH FREQUENCY AC PRODUCES CHANGING MAGNETIC FLUX AND THE LARGE EDDY CURRENTS PRODUCE HEAT.

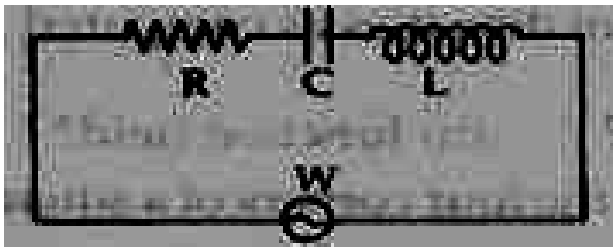
12. Three students X, Y, and Z performed an experiment for studying the variation of alternating current with angular frequency in a series LCR circuit and obtained the graphs as shown. They all used a.c sources of the same r.m.s. value and inductances of the same value. What can we (qualitatively) conclude about the (i) capacitance value (ii) resistance values Used by them? In which case will the quality factor be maximum? What can we conclude about nature of the impedance of the set up at frequency w_o?



ANS: - (i) DECREASES FROM X TO Z (ii) DECREASES FROM X TO Z

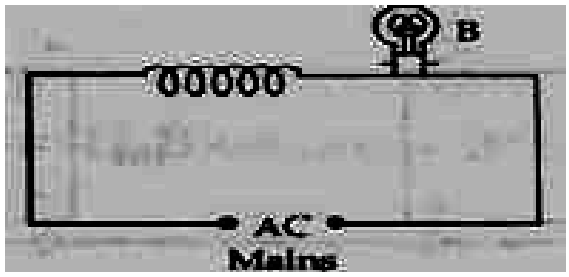
IN CASE OF X QUALITY FACTOR IS MORE, IMPEDANCE DECREASES FROM X TO Z

13. In the circuit shown below, R represents an electric bulb. If the frequency of the supply is doubled, how should the values of C and L be changed so that glow in the bulb remains unchanged?



ANS: - L SHOULD DECREASE AND C SHOULD INCREASE

14. An air cored coil L and a bulb B are connected in series to the mains as shows in the given figure: The bulb glows with some brightness. How would the glow of the bulb change if an iron rod is inserted in the coil? Give reasons in support of your answer.

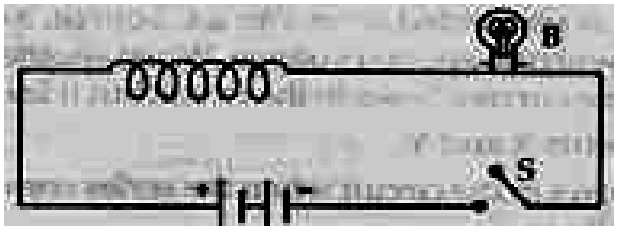


ANS: - DECREASES

15. When a circuit element 'X' is connected across an a.c. source, a current of √2A flows through it and this current is in phase with the applied voltage. When another element 'Y' is connected across the same a.c. source, the same current flows in the circuit but it leads the voltage by π/2 radians.(i) Name the circuit elements X and Y. (ii) Find the current that flows in the circuit when the series combination of X and Y is connected across the same a.c. voltage.

ANS: - (i) X IS RESISTOR (ii) Y IS CAPACITOR

16. Fig shows a light bulb (B) and iron cored inductor connected to a DC battery through a switch (S). (i) What will one observe when switch (S) is closed? (ii) How will the glow of the bulb change when the battery is replaced by an ac source of rms voltage equal to the voltage of DC battery? Justify your answer in each case.



ANS: - (i) BRIGHTNESS OF THE BULB INCREASES SLOWLY (ii) BRIGHTNESS REMAINS SAME

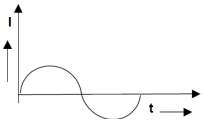
17. A circuit containing a 80 mH inductor and a 60 μF capacitor in series is connected to a 230 V, 50 Hz supply. The resistance of the circuit is negligible. (a) Obtain the current amplitude and rms values. (b) Obtain the rms values of potential drops across each element. (c) What is the average power transferred to the inductor? (d) What is the average power transferred to the capacitor? (e) What is the total average power absorbed by the circuit?
ANS: - (a) 8.24A, 11.7A (b) VL=207V, VC=437V (c) zero (d) zero (e) zero.

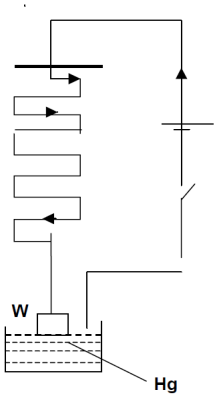
18. A series LCR-circuit with L = 0.12 H, C = 480 nF, R = 23 Ω is connected to a 230 V variable frequency supply. (a) What is the source frequency for which current amplitude is maximum? Obtain this maximum value. (b) What is the source frequency for which average power absorbed by the circuit is maximum? Obtain the value of this maximum power. (c) For which frequencies of the source is the power transferred to the circuit half the power at resonant frequency? What is the current amplitude at these frequencies? (d) What is the Q-factor of the given circuit?
ANS: - (a) 4167 rad s^{-1} , 1.41A (b) 2300 W (c) 648Hz, 678Hz, I0=10A(d)21.7

19. An LC-circuit contains a 20 mH inductor and a 50 μF capacitor with an initial charge of 10 mC. The resistance of the circuit is negligible. Let the instant the circuit is closed be t = 0(a) what is the total energy stored initially. Is it conserved during the LC-oscillations? (b) What is the natural frequency of the circuit? (c) At what times is the energy stored (i) Completely electrical (i.e., stored in the capacitor)? (d) At what times is the total energy shared equally between the inductor and the capacitor? (e) If a resistor is inserted in the circuit, how much energy is eventually dissipated as heat?
ANS: - (a)1 J,(b)159Hz (c)electrical at t = $0, \frac{T}{2}, T, \frac{3T}{2}, ----$ *magnetic at* $t = \frac{T}{4}, \frac{3T}{4}, \frac{5T}{4}, ---$

20. Define self-inductance in terms of work done against the induced emf.
ANS: - L = $\frac{2W}{I^2}$; Self-inductance is defined as double the work done against the induced emf in producing unit current in the coil itself

21. A circuit with a vertical copper wire bends as shown supports a small wooden piece W which floats in mercury. What do you expect when key is closed and current flows through the circuit?
ANS: - The woodden block sinks when current flows through the circuit, as parallel wires carrying currents in the opposite directions repel. The given wave form shows the input current of a transformer.





22. Draw the wave form of out put current. Substantiate your answer
ANS: - 180^0 phase difference due to Lenz's law

23. An electron beam is deflected in a given field. Identify whether it is an electric field or a magnetic field in the following cases?
(i) The trajectory of the beam is a parabola and its K.E changes.

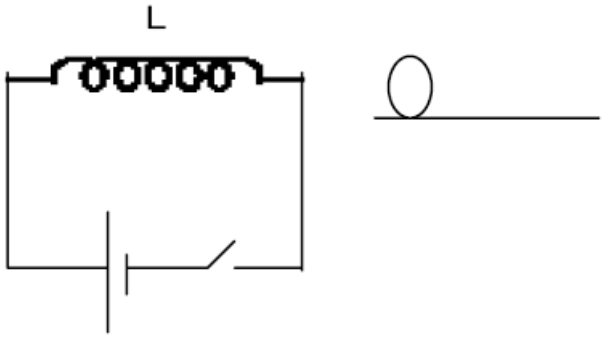
(ii) The trajectory of the beam is circular and its K.E. remains the same. Justify your answer.

24. A resting electron near a stationery bar magnet does not set into motion. But a moving magnet near an electron set it into motion. Why?

25. An irregularly shaped flexible current carrying loop when placed in an external magnetic field will assume a circular shape. Give reason

26. Alpha particles (m = 6.68 X 10^{-27} Kg., q = +2e) accelerated through a potential difference V to 2 kV, enter a magnetic field B = 0.2 T perpendicular to their direction of motion. Calculate the radius of their path.

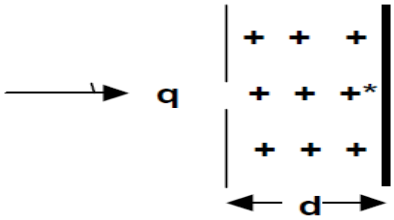
ANS: - $\left(r = \frac{1}{B}\sqrt{\frac{2Vm}{q}} = 32 \text{ m.}\right)$



27. The above figure shows a horizontal solenoid connected to a battery and a switch. A copper ring is placed on a frictionless track near the solenoid, the axis of the ring being along the axis of the solenoid. What will happen to the ring as the switch is closed? Justify your answer.

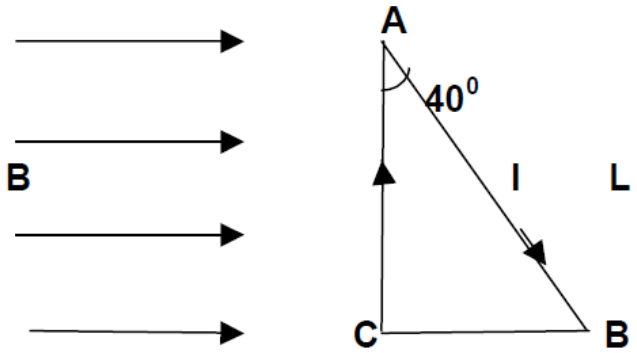
ANS: - THE RING MOVESAWAY FROM THE SOLENOID

28. A particle with charge 'q' and mass 'm' is shot with kinetic energy K into the region between two plates as shown in the figure. If the magnetic field between the plates is B and as shown, how large must B be if the particle is to miss collision with the opposite plate?

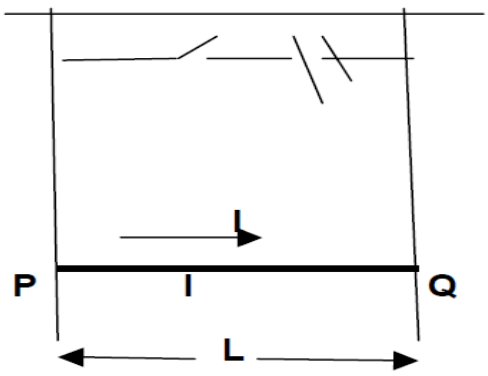


ANS: - Just to miss the opposite plate, the particle must move in a circular path with radius d so that Bqv = mv2/d, B = (2mK)1/2/(qd)

29. For the circuit shown below, find the magnitude and direction the force on wire AC, wire BC and wire AB. Also show that net force is zero.

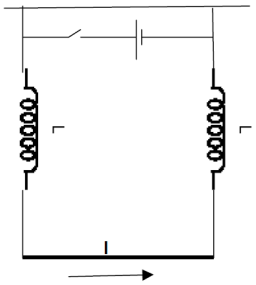


30. A bar PQ of mass M is suspended by two wires as shown below. Assume that a uniform magnetic field B is directed into the page. Find the tension in each supporting wire when the current through the bar is I.



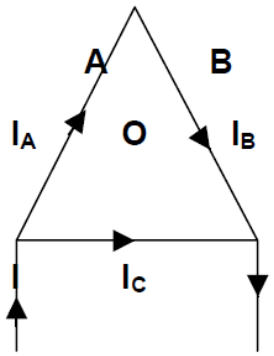
ANS: -According to the Flemings Right hand Rule, the magnetic force ILB is directed upward. Equilibrium in the vertical direction yields 2T + ILB = Mg, so that T = (Mg – ILB)/2

31. A bar of mass M is suspended by two springs as shown below. Assume that a magnetic field B is directed out of the page. Each spring has a spring constant K. Describe the bar's displacement when a current I is sent through it in the direction shown.



ANS: -Due to Flemings Right hand Rule the magnetic force ILB is directed downward. This constant force shifts the equilibrium position downward by a displacement = (ILB)/2K

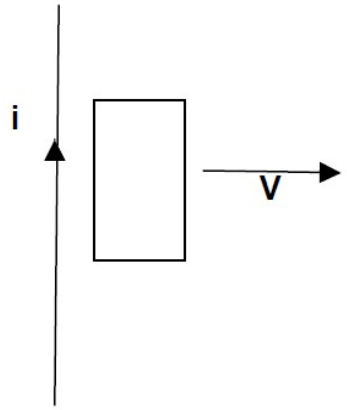
32. An equilateral triangle is formed from a piece of uniform resistance wire. Current is fed into one corner and led out of the other as detailed in the figure below. Show that the current flowing through the sides of the triangle produces no magnetic field at its centre 'O' (the intersection of the medians).



ANS: - Wires A and B are in series. $I_A = I_B = I/3$, $I_C = 2I/3$.Wire C makes a contribution to the field at O whose magnitude is twice that of A or B. By Flemings Right hand Rule, directions of field due to Wire A and B are directed down into the page. That due to wire C is upward. Net field at O is zero

33. In the following figure, the rectangular loop of wire is being pulled to the right, away from the long straight wire through which a steady current i flows upward as shown. Does the

current induced in the loop flow in the clockwise sense or in the counter clockwise sense ? Justify



ANS: -Due to Lenz's law, the magnetic field produced by the induced current must counteract the decrease in flux and hence it must be directed into the plane of the figure (within the loop).So the induced current must be clock –wise.

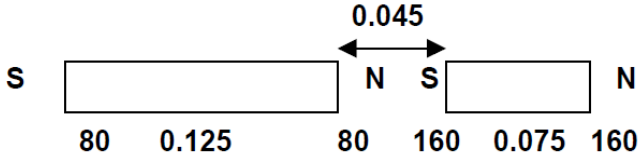
34. Determine the separate effects on the induced emf of a generator if (a) the flux per pole is doubled, and (b) the speed of the armature is doubled.
ANS: - In both the cases the induced emf doubles

35. An electromagnet has stored 648 J of magnetic energy when a current of 9A exists in its coils. What average emf is induced if the current is reduced to zero in 0.45 s?

ANS: - E = L $\frac{1}{2} LI^2$ = 16 H and e = 320 V

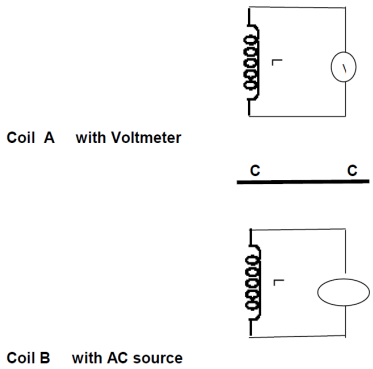
36. A 40 Ohm resistor is connected across a 15 V variable frequency electronic oscillator. Find the current through the resistor when the frequency is (a) 100 Hz and (b) 100 kHz. What is the current if the 40 Ohm resistor is replaced by a 2 mH inductor?
ANS: -With resistor, current is same both for 100 Hz and 100 kHz. With inductor, the current is 11.9 A and 11.9 mA respectively

37. The axes of two magnets are collinear. One has poles of strength 80 Am separated by 125 mm, and the second has a magnetic moment of 12 A-m2 with poles of strength 160 Am. Find the attractive force between the magnets if the north pole of one is 45 mm from the south pole of the second.



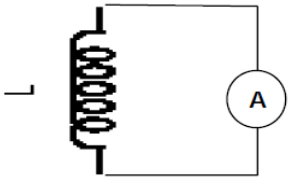
ANS: - Resultant force F = 2 attractive forces + 2 repulsive forces = 520 mN (attractive)

38. A coil A is connected to voltmeter V and the other coil B to an alternating current source D. If a large copper sheet CC is placed between the two coils, how does the induced e.m.f in the coil A change due to current in coil B?

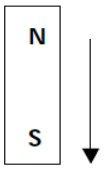


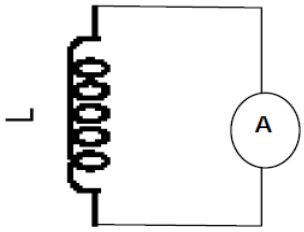
ANS: - The induced e.m.f in coil A decreases due to large copper plate introduced between the two coils as Cu is diamagnetic material

39. A magnet is moved in the direction indicated by an arrow between two coils A and B as shown below. Suggest the direction of induced current in each coil L.



Coil A



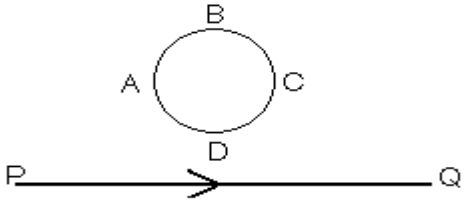


Coil B

ANS: - Due to Lenz's law, end A will behave as South Pole and end B will behave as North Pole. The end face A will have clock wise direction of current and end face B will have anti clock wise direction of current when seen from the magnet side.

40. An electromagnet has stored 648 J of magnetic energy when a current of 9 A exists in its coils. What average emf is induced if the current is reduced to zero in 0.45 sec.
ANS: - Calculate L = 16 H. e = L di/dt = 320 V

41. What is the magnitude of the induced current in the circular loop-A B C D of radius r, if the straight wire PQ carries a steady current of magnitude I ampere?



ANS: - Zero Induced emf.

42. Two identical loops, one of copper and another of aluminum are rotated with the same speed in the same M.F.In which case, the induced (a) e.m.f (b) current will be more and why?
ANS: - Induced emf will be same in the both but Induced Current will be more in Copper loop.

43. Why is spark produced in the switch of a fan, when it is switched off?
ANS: - A large Induced emf is setup across the gap in the switch.

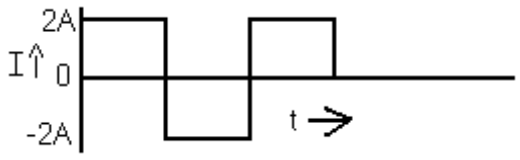
44. Coils in the resistance boxes are made from doubled up-insulated wire. Why?
ANS: - To cancel the effect of self Induced emf in the coil.

45. A galvanometer connected in an A.C. circuit does not show any deflection. Why?
ANS: - A galvanometer measures mean value of a.c., which is zero over a cycle.

46. A capacitor blocks D.C. but allows A.C to pass through it. Explain. Why?
ANS: - $X_c = \frac{1}{2\pi \vartheta c} = \infty$

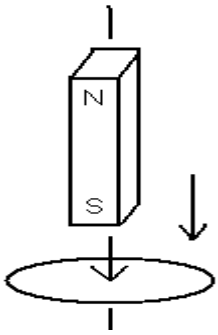
47. Can we use transformer to step up D.C. voltage? If not, why?

ANS: - Magnetic flux linked with Primary coil does not vary with time so no Induced emf in secondary.



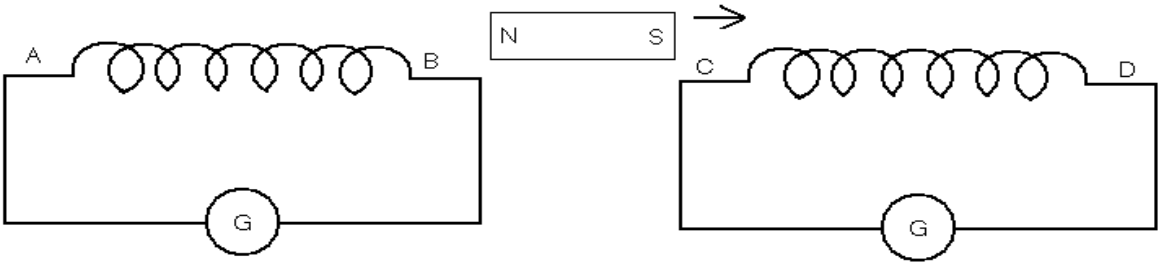
48. Calculate the r.m.s value of alternating current shown in the figure.
ANS: - 2A.

49. The algebraic sum of potential drop across the various – elements in LCR circuit is not equal to the applied voltage. Why?
ANS: - Voltages across different elements of the LCR circuit are not in same phase.

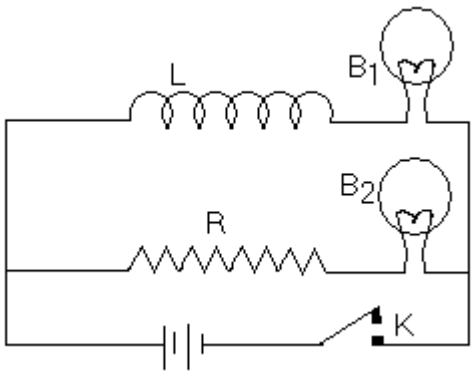


50. A copper ring is held horizontally and bar magnet is dropped through the ring with its length along the axis of the ring. Will the acceleration of the falling magnet be equal to, greater than or less than that due to gravity?
ANS: - Less than that due to gravity.

51. A magnet is moved in the direction indicated by an arrow between two coil A B and C D as shown in the figure. Suggest the direction of current in each coil.
ANS: -For Coil AB: Anticlockwise.
For Coil CD: Anticlockwise.



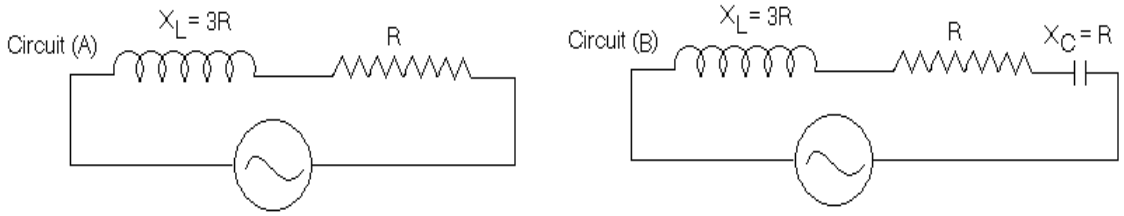
52. Figure shows an inductor L and a resistance R connected in parallel to a battery through a switch. The resistance R Which of the bulbs lights up earlier, when K is closed?
Will the bulbs be equally bright after same time?



ANS: -(i) The bulb B_2 will light up earlier. (ii) The bulb B_1 will grow more brightly.

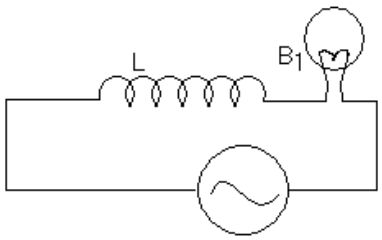
53. How does the self inductance of a coil change, when Number of turns in the coil is decreased? An iron rod is introduced into it. Justify your answer in each case.
ANS: -i. $L \alpha n^2 \Rightarrow L$ is decreased.
ii. L will Increase.

54. Figure shows two electric circuits A and B. Calculate the ratio of power factor of the circuit B to the Power factor of the circuit A.



ANS: - $\sqrt{2}$.

55. An inductor L of reactance X_L is connected in series with a bulb B to an A.C. source as shown in the figure. Briefly explain, how does the brightness of the bulb change when
(a) Number of turns of the inductor is reduced and
(b) A capacitor of reactance $X_C = X_L$ is included in series in the same circuit.



ANS: -(a) Bulb will grow more brightly.
(b) Brightness of the bulb will become maximum.

56. When a series combination of a coil of inductance L and a resistor of resistance R is connected across a 12 V-50 Hz supply, a current of 0.5.A flows through the circuit. The current differs in phase from applied voltage by $\frac{\Pi}{3}$ radian. Calculate the value of L and R.

ANS: -L=0.066 H, R=12Ω

57. An A.C. generator is connected to a sealed box through a pair of terminals. The box may contain R L C or the series combination of any two of the three elements. Measurements made outside the box reveal that:

$$E = 75 \text{ Sin } \omega t \text{ (in volt) and}$$

$$I = 1.2 \text{ Sin } (\omega t + \frac{\Pi}{5}) \text{(in ampere)}$$

Name the circuit elements

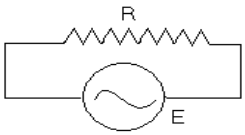
What is the Power factor of the circuit?
What is the rate, at which energy is delivered by the generator to the circuit?

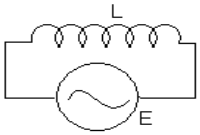
ANS: -(a). Series combination of a register and a capacitor.

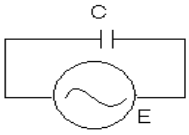
(b). Power factor = cosΦ = 0.81

(c). $P_{av} = E_v I_v \text{Cos}\Phi = 72.9\text{W}$

58. Figure (a), (b) and (c) Show three alternating circuits with equal currents. If frequency of alternating emf be increased, what will be the effect on currents In the three cases. Explain.







ANS: -(i) No effect (ii) current will decrease (iii)Current will Increase.

59. Does the current in an A.C. circuit lag, lead or remain in phase with the voltage of frequency υ applied to the circuit when

(i) $\upsilon = \upsilon_r$ (ii) $\upsilon < \upsilon_r$ (iii) $\upsilon > \upsilon_r$

where υ_r is the resonance frequency.

ANS: -(i) Current and Voltage are in the same phase.

(ii) Current leads voltage by Phase angleΦ .

(iii) Current lags behind voltage by Phase angleΦ .

60. Two different coils have self inductance L_1=8 mH and L_2 = 2 mH. At a certain instant, the current in the two coils is increasing at the same constant rate and the power supplied to the two coils is same. Find the ratio of (a) induced voltage (b) current and (c) energy stored in the two coils at that instant?

ANS: - $e = \dfrac{LdI}{dt} \Rightarrow \quad \dfrac{e_1}{e_2} = 4$ As P= eI = const $= \dfrac{I_1}{I_2} = \dfrac{1}{4} \quad \therefore \dfrac{U_1}{U_2} = \dfrac{1}{4}$

UNIT-5
ELECTROMAGNETIC WAVES

1.Why is the quantity $\varepsilon_0 d\Phi_E/dt$ called the displacement current?

2. Using a d.c. source, a capacitor has been fully charged. What are the magnitudes of conduction and displacement currents?

3. What is the ratio of speed of infrared and ultraviolet rays in vacuum?

4. An electromagnetic wave consists of oscillating electric and magnetic fields. What is the phase relationship between these oscillations?

5. Radio waves diffract predominately around building while light waves, which are also electromagnetic waves, do not. Why?

6. Electromagnetic waves with wavelength

(i) λ_1 are used to treat muscular strain.

(ii) λ_2 are used by a FM radio station for broadcasting

(iii) λ_3 are used to detect fracture in bones

(iv) λ_4 are absorbed by the ozone layer of the atmosphere.

Identify and name the part of electromagnetic spectrum to which these radiations belong. .Arrange these wavelengths in decreasing order of magnitude.

7. (a) Which of the following, if any, can act as a source of electromagnetic waves?

(i) A charge moving with a constant velocity.

(ii) A charge moving in a circular orbit.

(iii) A charge at rest.

Give reason. (b) Identify the part of the electromagnetic spectrum to which waves of frequency (i) 10^{20} Hz (ii)10^{9} Hz belong to microwaves.

8)If the area of the TV telecast is to be doubled then what will be the height of the transmitting antenna ?.

9.Which of the physical quantity is NOT transported by the em waves?

10.What happens to the average temperature on the surface of the earth if there is no atmosphere?.

11. Mention the law, that which asserts that the electric field lines cannot form close loops?

12.What are the characteristics properties of electromagnetic waves?

13.The energy of the electromagnetic wave is in the order of 15KV . To which part of the spectrum does it belong?

14. Name em waves are used in telecommunication.

15.what is condition for obtaining displacement current between the plate of the capacitor?

16.Mention the pair of space and time varying E and B fields which would generate a plane em wave travelling in the z-direction?

Ex and By

17. A plane electromagnetic wave travels, in vacuum, along the y-direction. Write (i) the ratio of the magnitude, and (ii) the directions of its electric and magnetic field vectors.

(ii) For an electromagnetic wave traveling along y-diretion, its electric and magnetic field vectors are along z-axis and x-axis respectively. The direction of $\vec{E} \times \vec{B}$ is same as that of direction of wave propagation and $\hat{k} \times \hat{i} = \hat{j}$.

18. Suppose that the electric field amplitude of an electromagnetic wave is E_0=120 NC^{-1} and that its frequency is v=50.0 MHz.

(a) Determine, B_0, w,k and λ. (b) Find expressions for E and B.

19. Answer the following questions:

(a) Long distance radio broadcasts use short-wave bands. Why?

(b) It is necessary to use satellite for long distance TV transmission. Why?

(c) Optical and radio telescopes are built on the ground but X-ray astronomy is possible only from satellites orbiting the earth. Why?

(d) If the earth did not have an atmosphere, would its average surface temperature be higher or lower than what it is now?

OPTICS

1.When a photon collides with an electron, which of the following characteristics of the photon increases?

2.Which of the following does not support the wave nature of light?

3.The distance travelled by the ray of light during the time octagonal mirror rotates through 90^{o} is'L' if the mirror rotates at N revolution per second, what is the speed of light.

4. A star appear yellow . If it starts accelerating towards earth, how will its colour appears to change.

5.Two points A and B are situated at the same distance from the source of light, but in opposite direction from it.What is the phase difference between the light waves passing through A and B?

6.When the light is polarized by reflection , what is the angle between reflected and refracted rays.

7. For double refracting crystal the refractive indices , for the ordinary and extraordinary denoted by μ_o and μ_e. What is the relation valid along the optical axis of the crystal.

8.What is the angle between planes of electric and magnetic field oscillation in case of light waves?

9.What is the colour of the interference fringe nearest to the white central maximum incase of white light?

10. What happens to the fringe pattern when YDS experiment is performed in water instead of air?

11. A man stands in front of a mirror of special shape. He finds that his image has a very small head, a fat body and legs of normal size. What can we say about the shapes of the three arts of the mirror?

12. In which direction relative to the normal, does a ray of light bend, when it enters obliquely a medium in which its speed is increased?

13. For the same angle of incidence, the angles of refraction in three different media A,B and C are 15° ,25° and 35°,respectively. In which medium will the velocity of light be minimum?

14. For what angle of incidence, the lateral shift produced by a parallel sided galss slab is maximum?

15. If a plane glass slab is placed on letters of different colours, the red coloured letters appear more raised up. Why?

16. Does refraction in a water tank make apparent depth same throughout?

17. The critical angle for glass-air interface is i_c. Will the critical angle for glass-water interface be greater than or less than i_c?

18. An air bubble in a jar of water shines brightly. Why?

19.What happens to the shining of diamond if it is dipped in a transparent oil?

20.What type of a lens is a tumbler filled with water?

21.What type of a lens is an air bubble inside water? Give reason also.

22.A lens immersed in a transparent liquid is not visible. Under what condition can this happen?

23. A lens whose radii of curvature are different is forming the image of an object placed on its axis. If the lens is placed with its faces reversed, will the position of the image change?

24.What happens to focal length of a convex lens, when it is immersed in water ?

25.How does the focal length of a convex lens change if monochromatic red light is used instead of violet light?

26.The radii of curvature of both the surfaces of a lens are equal. If one of the surfaces is made plane by grounding, how will the focal length and power change?

27.A glass prism is held in water. How is the angle of minimum deviation affected?

28.A ray of light is normally incident on one face of an equilateral prism.Trace the course of the ray through the prism and emerging from it.

29. What will be the colour of the sky in the absence of atmosphere?

30. Why do clouds appear white?

31. Why do sometimes we observe haloes (rings) round the sun or the moon?

32. Bees can see objects in the ultraviolet light while human beings cannot do so. Why?

33. A chicken wakes up early in the morning and goes to sleep by sunset. Why?

OR

Why is a chicken not able to see in the dim light?

35. Why is the focal length of an objective in compound microscope little shorter than the focal length of the eyepiece?

36. You are provided with four lenses of focal length 1 cm, 3cm, 10cm and 100cm. Which two would you prefer for a microscope and which two for a telescope?

37. Can we increase the range of a telescope by increasing the diameter of its objective?

38. A telescope has been adjusted for the relaxed eye. You are asked to adjust it for the least distance of distinct vision, then how will you change the distance between the two lenses?

39. The distances of an object and its real image, measured from the focus of a concave mirror, are a and b respectively. Show that $f^2 = ab$.

40.A ray of light goes from medium 1 to medium 2. velocities of light in the two media are c_1 and c_2 respectively. For an angle of incidence θ in medium 1, the corresponding angle of refraction in medium 2 is $\theta/2$.

(i) Which of the two media is optically denser and why?

(ii) Establish the relationship between θ, c_1 and c_2.

41.A beam of light converges at a point on the screen. A plane parallel glass plate is introduced in the path of this converging beam. How will the point of convergence be affected? Draw the relevant ray diagram.

42. A microscope is focused on a dot at the bottom of a beaker. Some oil is poured into the beaker to a height of y cm and it is found necessary to raise the microscope through a vertical distance of x cm to bring the dot again into focus. Express refractive index of oil in terms of x and y.

43. A ray of light while traveling from a denser to a rarer medium undergoes total reflection. Derive the expression for the critical angle in terms of the speed of light in the respective media.

44.Explain the twinkling of stars. Why do the planets not show twinkling effect?

.

45. Only the stars near the horizon twinkle while those overhead do not twinkle. Why?

46.Show that a convex lens produces an N times magnified image when the objet distances, from the lens, have magnitudes ($f \pm f / N$). Here f is the magnitude of the focal length of the lens. Hence find the two values of object distance, for which a convex lens, of power 2.5D, will produce am image that is four times as large as the object?

47.Use the lens equation to deduce algebraically what you know otherwise from explicit ray diagrams. (a) An object placed within the focus of a convex lens produce a virtual and

enlarged image. (b) A concave lens produces a virtual and diminished image independent of the location of the object.

48. A beam of white light on passing through a hollow prism gives no spectrum. Why?

49. Give reasons for the following observations on the surface of the moon: (i) Sunrise and sunset are abrupt. (ii) Sky appear dark. (iii) A rainbow is never formed.

.

NUMERICAL PROBLEMS

50. The bottom of a container is a 4.0 cm thick glass. (μ=1.5) slab. The container contains two immiscible liquids And B of depths 6.0 cm and 8.0 cm respectively. What is the apparent position of a scratch on the outer surface of the bottom of the glass slab when viewed through the container? Refractive indices of A and B are 1.4 and 1.3 respectively.

51. The refractive index of water is 4/3. Obtain the value of the semivertical angle of the cone within which the entire outside view would be confined for a fish under water. Draw an appropriate ray diagram.

52. A lens forms a real image of an object. The distance of the object to the lens is 4 cm and the distance of the image from the lens is v cm. The given graph shows the variation of v with u. (i) What is the nature of the lens? (ii) Using this graph, find the focal length of this lens.

53. A ray of light passes through an equilateral glass prism, such that the angle of incidence is equal to the angle of emergence. If the angle of emergence is ¾ times the angle of the prism, Calculate the refractive index of the glass prism.

OPTICS

54. State the conditions which must be satisfied for two light sources to be coherent.

55. Two independent light sources cannot act as coherent sources. Why?

56. No interference pattern is detected when two coherent sources are infinitely close to one another. Why?

57. If the path difference produced due to interference of light coming out of two slits for yellow colour of light at a point on the screen be $3\lambda/2$, what will be the colour of the fringe at the point. Give reason also.

58. What happens to the interference pattern if the phase difference between the two sources varies continuously?

59. Radiowaves diffract pronouncedly around the buildings, while light waves, which are e.m. waves do not why?

60. Coloured spectrum is seen, when we look through a muslin cloth. Why.

SHORT ANSWER QUESTIONS

61. How is a wavefront different from a ray? Draw the geometrical shape of the wavefronts when (i) light diverges from a point source, and (ii) light emerges out of convex lens when a point source is placed at its focus.

62. In a young's double slit experiment, the position of the first fringe coincides with S1 and S2 respectively. What is the wavelength of light?

63. Draw the diagram showing intensity distribution of light on the screen for diffraction of light at a single slit. How is the width of central maxima affected on increasing the

(i) Wavelength of light used (ii) width of the slit/

What happens to the width of the central maxima if the whole apparatus is immersed in water and why?

64. What two main changes in diffraction pattern of single slit will you observe when the monochromatic source of light is replaced by a source of white light?

65. Explain with reason, how the resolving power of a compound microscope will change when (i) frequency of the incident light on the objective lens is increased. (ii) focal length of the objective lens is increased, and (iii) aperture of the objective lens is increased.

66. The critical angle between a given transparent medium and air is denoted by i_c, A ray of light in air medium enters this transparent medium at an agle of incidence equal to the polarizing angle(i_p). Deduce a relation for the angle of refraction (r_p) in terms of i_c.

NUMERICAL QUESTIONS

67. Two Sources of Intensity I and 4I are used in an interference experiment. Find the intensity at points where the waves from two sources superimpose with a phase difference (i) zero (ii) $\pi/2$ (iii) π.

68. In a two slit experiment with monochromatic light, fringes are obtained on a screen placed at some distance D from the slits. If the screen is moved 5×10^{-2} m towards the slits, the charge in fringe width is 3×10^{-5} m. If the distance between the slit is 10^{-3} m . calculate the wavelength of the light used.

69. A narrow monochromatic beam of light of intensity I is incident a glass plate. Another identical glass plate is kept close to the first one and parallel to it. Each plate reflects 25% of

the incident light and transmits the reaming. Calculate the ratio of minimum and maximum intensity in the interference pattern formed by the two beams obtained after reflection from each plate.

UNIT-VII
DUAL NATURE OF MATTER AND RADIATIONS

1. If wavelength of electromagnetic waves are doubled what will happen to energy of photon?
2. Alkali metals are most suitable for photoelectric emission. Why?
3. Out of microwaves, UV, IR which radiation will be most effecting for emission of electrons from a metallic surface?
4. Can X-rays cause photoelectric effect?
5. If the intensity of incident radiation on a metal is doubled what happens to the K.E of electrons emitted?
6. What is the value of stopping potential between the cathode and anode of photocell? If the max K.E of electrons emitted is 5eV?
7. It is easier to remove an electron from sodium than from copper, which has a higher value of threshold wavelength?
8. What is the role of photocell in cinematography?
9. An electron and photon possessing same K.E. Which one will have greater wavelength?
10. In Davisson – Germer experiment if the angle of diffraction is 52^0 find Glancing angle?
11. What is the energy associated with a photon of wavelength 6000 A^0 ?
12. What is the effect on the velocity photo electrons, if the wavelength of incident light is decreased?
13. Show graphically how the stopping potential for a given metal varies with a frequency of the incident radiation.
14. To work functions 2ev and 5ev for two metals x and y respectively. Which metal will emit electrons, when it is irradiated with light and wave length 400nm and why?
15. A photon and an electron have same de-broglie wavelength. Which has greater total energy.Explain?
16. The de-broglie wave length of a photon is same as the wave length of electron. Show that K.E. of a photon is $2mc\lambda/h$ times K.E. of electron. Where 'm' is mass of electron,c is velocity of light.
17. Derive the expression of de-broglie wave length in terms of energy of energy and temperature?
18. Light from bulb falls on a wodden table but no photon electrons are emitted why ?
19.Following table gives values of work function for a few photosensitive metal.

S.NO	Metal	Work function(ev)
1	Na	1.92
2	K	2.15
3	Mo	4.17

If each metal is exposed to radiation of wavelength 300nm which of them will not emit photo electron.
20.An electron and alpha particle and proton have same kinetic energy , which have shortest De-broglie wavelength?
21. The De-broglie wave length associated with proton and neutron are equal.Which has greater kinetic energy?.

22.A stream of electron travelling with a speed at right angle to a uniform electric field E, is deflected in a circular path of radius "r" . Prove that $e/m = v^2/rE$.

23.If the potential difference used to accelerate electron is doubled , by what factor the De-broglie wave length of the electron beam changed.

24. The De-broglie wave length associated with an electron accelerated through the potential difference "V" is λ. What will be its wave length , when accelerating potential is increased to 4v?

25.Visible light can not eject photo electrons from copper surface, whose work function is 4.4 ev , why? Prove mathematically.

EXTRA QUESTIONS

1. Neutrons, in thermal equilibrium with matter have an average KE = 3/2 kT . Compute de-Broglie's wavelength associated
2. A nucleus of mass M initially at rest splits in two fragments of masses M/3 & 2M/3. Find the ratio of de-Broglie's wavelength of two fragments.
3. X-rays of wavelength 0.82 A^0 fall on metallic surface. Calculate de-Broglie's wavelength of emitted photoelectrons. Ignore φ of the metal.
4. Wavelength of photon and de-Broglie's wavelength of electron has same value. Show that energy of photon is $2\lambda mc/h$ times the KE of electron.
5. Compare energy of electron of de-Broglie's wavelength 1 A^0 with that of an X-ray photon of the same wavelength.
6. Calculate the ratio of de-Broglie wavelength associated with deutron moving with velocity '2v' and a α-particle moving with velocity 'v'.
7. An α-particle and proton are accelerated from rest through same PD 'V'. Find the ratio of de-Broglie wavelength associated with them.
8. Calculate de-Broglie's wavelength associated with an electron of energy 200eV. What will be the change in λ if accelerating potential is increased to 4 times.
9. What is the (i) momentum (ii) speed and (iii) de-Broglie wavelength of electron of kinetic energy 120 eV.
10. Show that the wavelength of electromagnetic radiation is equal to the de-Broglie wavelength of its photon.
11. An electron, α-particle and a proton have same KE. Which of these particles have shortest wavelength?
12. The threshold frequency for a certain metal is $3.3*10^{14}$ Hz. If light of frequency $8.2*10^{14}$ Hz is incident on the metal. Predict the velocity of ejected electrons and cut-off voltage.
13. The work function of two metals A and B are respectively 1.2 eV and 2.4 eV. Light of wavelength 600nm falls on these metals.
    (i) Which metal / metals will give photoelectric emission?
    (ii) What is the maximum velocity and cut-off potential?
    (iii) If the source is moved away, how does it affect the stopping potential?

14. The energy flux of sun reaching the earth is $1.3888*10^3$ Wm^{-2}. How many photons per square m is incident on the earth per sec. Assume average wavelength of sunlight = 550nm.
15. In an experiment on photoelectric effect, the slope of cut-off voltage versus frequency of light is found to be $4.12*10^{-15}$ Vs. Calculate the value of Plank's constant.
16. The Photoelectric cut-off voltage for certain metal is 1.5V. What is the maximum KE of photoelectrons?
17. The threshold frequency of metal is 'f'. When the light of frequency 2f is incident on it the maximum velocity of photoelectrons is 'v_1'. When the frequency is increased to 5f, the maximum velocity of photoelectrons is 'v_2' Find v_1 / v_2.
18. The work function of cesium is 2.14 eV. Find (i) threshold frequency (ii) wavelength of light if the photoelectrons are stopped with stopping potential 0.6V.
19. In a plot of photoelectric current versus anode potential, how does
    a. the saturation current vary with anode potential for incident radiations of different frequencies but same intensity.
    b. The stopping potential varies for incident radiations of different intensities but same frequency?
    c. Photoelectric current vary for different intensities but same frequency of incident radiations?

    Justify your answer in each case.
20. The radiations of frequency 10^{15} Hz are incident on two photosensitive surfaces A and B. Following observations are recorded:

    Surface A: no photo electric emission takes place.

    Surface B: Photoemission takes place photo electrons have zero energy.

    Explain the above observations on the basis of Einstein's photoelectric equations. How will the observations with surface B change when the wavelength of incident radiations is decreased?
21. An electron, α-particle and a proton have same de-Broglie wavelength. Which of these particles has (i) minimum KE and (ii) maximum KE and why? In what way has the wave nature of electron beam exploited in electron microscope?
22. Calculate the (i) momentum and (ii) de- Broglie wavelength of electron accelerated through a potential difference of 56 V. On increasing the potential how this can improve the resolving power of a microscope.

23. Light of frequency $2.5\ \nu_0$ is incident on surface of threshold frequency ν_0 and the photoelectric current is 1 mA. If frequency of light is halved and intensity is doubled, find new photoelectric current.
24. For what KE of neutron, will the associated de Broglie wavelength be $1.32*10^{-10}$ m?

25. The work function of three metals Na, K and Mo are respectively 1.92, 2.15 and 4.17 eV. If each of the metal is exposed to light of wavelength 300 nm, which of them will not emit photoelectrons and why?

26. By how much would the Stopping Potential a for given surface goes up if the frequency of the Incident radiation were to be increased from 4×10^{15}Hz to 8×10^{15}Hz?

27. Calculate de-Broglie wave length of

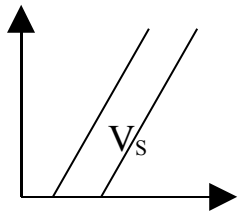
(i) an electron (mass 3×10^{-2} kg moving with speed 100 m/s. Hence show that wave nature in hydrogen atom) moving with speed 1/100 of speed of light in vacuum and (ii) a ball of radius 5 mm and of matter is important at atomic level but is not really relevant at the macroscopic level.

28. The de-Brouglie wavelength associated with proton and a neutron is found to be equal. Which of the two has higher value of kinetic energy?

29. Graph showing variation of V_S with frequency for two M_1 M_2 material is given.

(i) What are the values of work function for M_1 and M_2

(ii) The values of V_S for these for frequency ν_3 ($\nu_3 > \nu_{02}$) are V_1 and V_2. Show that slope of lines equals $V_1 - V2) / (\nu_{02} - \nu_{01})$



30. Through what potential difference should an electron be accelerated so that its de-broglie wavelength becomes 0.4 A^o.

31. Monochromatic light of frequency $6x10^{14}$ Hz is produced by a LASER. The power emitted is $2x10^{-3}$ W. a) What is the energy of photon in the light beam. b) How many photons per sec on the average are emitted by the source. [Ans. (a) 2.49 eV, (b) $5x10^{15}$ sec^{-1}]

32. If 5 % of the energy supplied to an incandescent light bulb is radiated as visible light, how many visible quantas are emitted by a 100W bulb? Assuming the wavelength of all the visible light to be 5000 A^o.

[Ans. $1.41x10^{19}$ J]

33. If the wavelength of incident light changes from 4400 A^o to 4000 A^o, then find the change in stopping potential. [Ans. -0.26 eV]

UNIT-VIII
ATOMIC NUCLEUS

1) what conclusions were drawn from the observation in which few alpha-particle were seen rebounding from gold foil?
2) which observation led to the conclusion in the α-particle scattering exp. That atom has vast empty space?
3) Compare the radii of two nuclei with mass number 1 and 27 respectively.
4) Two nuclei have mass numbers in the ratio 1:8.What is the ratio of their nuclear radii?
5) which have greater ionizing power:α-particles or β-particles?
6) The half life of a radioactive substance in 30 days. What is the time taken for ¾ of its original mass to disintegrate?
7) Why neutrons are considered as ideal particle for nuclear reactions?
8) Does the ratio of neutrons and protons in the nucleus increase, decreases or remain the same after the emission of ά – particles?
9) Why is the ionization power of ά – particle of greater than γ – rays?
10) A radio isotope of silver has a half life of 20 minutes. What fraction of the original mass would remain after one hour?
11) What changes takes place in the nucleus when a γ – rays is emitted?
12) Can a single nucleus emit ά – particle, β – particle and a γ – rays together?
13) Two nuclei have mass no. in the ratio 1:2. What is the ratio their nuclear densities?
14) Establish the relationship between half life of a radio- active substance and decay constant.
15) Explain how ά particle scattering experiment led to Rutherford to estimate the size of the nucleus.
16) The activity of a radio active material drops to 1-16th of its initial value in 30 days. Find its half life.
17) In a particular fission reaction, a U^{235} nucleus captures a slow neutron. The fission products are 3 neutrons, a La ^{142} and fission products X y z .What is the value of Y and Z.
18) You are given two nuclides X_____
b) Which one of the two is likely to be more stable? Give reason.
19) A certain radio active substance has a half life of 30 days. What is the disintegration constant? Find its average life.
20) Find the time required to decay 3/4th of a radioactive sample whose half life is 60 days.
21) Neon -23 decays in the following way

$^{23}Ne_{10}$ ----------→ $^{23}Na_{11}$ + $^{0}e_{-1}$ +γ

Find the minimum and maximum kinetic energy that the β-particle can have. The atomic masses of $^{23}Ne_{10}$ and $^{23}Na_{11}$ are 22.99454 and 22.98984 respectively.

22) The disintegration rate of a certain radioactive sample at any instant is 4750 disintegrations per minute. Five minutes later the rate becomes 2700 per minute. Calculate

a) Decay constant

b) Half-life of the sample

23) Explain with an example, whether neutron-proton ratio increases or decreases during beta decay.

24) The half life period of radioactive element A is the same as the mean half time of another radioactive element B.Initially both of them have the same number of atoms. The radioactive element B decays faster than A. Explain why?

25) Obtain the binding energy of a nitrogen nucleus from the following data m_h=1.007834; m_n=1.00867; m_N=14.03074
Give your answer in MeV.

26) Write nuclear equations for
a) The α-decay of $^{226}Ra_{88}$
b) The β^- -decay of $^{32}P_{15}$
c) The β^+ decay of $^{32}P_{15}$

27) A neutron is absorbed by a $^{6}Li_3$ nucleus with the subsequent emission of an alpha particle.

i) Write the corresponding nuclear reactions.

ii) Calculate the energy released in MeV, in this reaction.
Given mass $^{6}Li_3$=6.0151264; mass (neutron) =1.00966544
Mass (alpha particle)=4.00260444 and mass(triton)=3.01000004

Extra Questions

1. Calculate the energy released in the following nuclear reaction. ${}_3Li^7 + {}_0n^1 \longrightarrow {}_2He^4 + {}_1H^3$

2. When a deutron of mass 2.0141amu is absorbed by a ${}_3Li^6$ nucleus of mass 6.015amu, the nucleus splits into two α-particles each of mass 4.0026amu. Calculate energy carried by each α-particles.

3. A nucleus ${}_{10}Na^{23}$ undergoes β-decay to give ${}_{11}Na^{23}$. Write down the nuclear reaction. Calculate KE of electron. Given mass of ${}_{10}Na^{23}$ = 22.994466amu, mass of ${}_{11}Na^{23}$ = 22.989770amu.

4. A neutron is absorbed by ${}_3Li^6$ nucleus with the subsequent emission of a α-particle. (i) Write the corresponding nuclear reaction. (ii) Calculate the energy released. M ${}_3Li^6$ = 6.015126amu, m(n) = 1.0086654amu, mass of triton = 3.0100000amu.

5. The mass of the star is $5 * 10^{32}$ kg. It generates energy at the rate of $5 * 10^{30}$ W. How long does it take to convert all Helium to carbon at this rate.
$3\ {}_2He^4 \longrightarrow {}_6C^{12} + 7.27$ MeV

6. Prove mathematically that the fraction N / N_0 of a radioactive element left over after a time 't' equals 1 / x where $x = 2^{t/T}$. T is half-life period.

7. The radioactive nuclei X and Y contain equal number of atoms. Their half-life periods are 1 H and 2 H respectively. Calculate the ratio of their activity after 2 Hrs.

8. How many disintegrations per sec will occur in one gm of $_{92}U^{238}$, if its half-life period is $1.42 * 10^{17}$ sec.

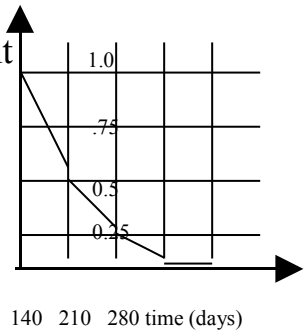
9. A radioactive sample contains 2.2mg of pure $_{6}C^{11}$, having half-life period 1224seconds. Calculate (i) Number of active atoms (ii) Activity when 5 μgm of sample is left.

10. The half-life period of $_{92}U^{238}$ against α-decay is $4.5 * 10^9$ years. What is the activity of 1g sample?

11. Obtain the amount of $_{27}Co^{60}$ necessary to provide a radioactive source of 8 mC. The half-life period of Co^{60} is 5.3 years.

12. A 12.5 MeV α-particle approaching a gold nucleus is deflected back by 180^0.
How close does it approach the nucleus

15. Calculate half-life period and decay constant



16. The half-life period of radioactive sample is 5500 years. Its initial activity is
found to be 15 decays per min per gram. In how much time would its activity reduces to 10 decays per min per gm? (Given $\log_e 3 = 1.0986$ and $\log_e 2$ 0.693)

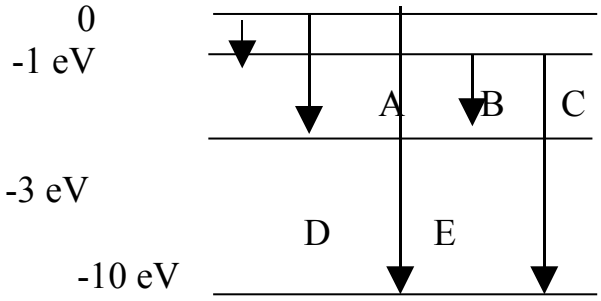
17. The decay constant for a given radioactive sample is 0.3465 $days^{-1}$. What % of this sample gets decayed in a period of 4 days?

18. The nucleus $_{92}U^{238}$is unstable against α-decay with a half-life of about $4.5x\ 10^9$ years. Write down the equation of this decay and estimate the KE of emitted α-particle from the following data {m ($_{92}U^{238}$ = 238.05081

amu, m ($_2$ He^4 = 4.00260 amu, m ($_{90}Th^{234}$ = 234.04363 amu} (4.19 MeV)

19. How many α and β particles are emitted when $_{92}U^{238}$ changes into $_{82}Pb^{206}$.

20. The energy level of an atom of element X is given below.
Which one of the level transitions results in the emission of photon of wavelength 620 nm. Justify your answer with proper calculation



20. Calculate the longest and shortest wavelength of Lyman series. Given R = 10967700 m^{-1}. (911.6 A^0, 1215 A^0)

21. The wavelength of second line of the Balmer series in hydrogen spectrum is 4861 A^0. Calculate the wavelength of first line. (6562 A^0)

22. Which state of the triply ionized beryllium atom (Be^{+3}) has the same orbital radius as that of the ground state of hydrogen atom? {$r_n \propto n^2 / Z$} Ans n = 2.

23. Which level of double ionized lithium (Li^{+2}) has same energy as the ground state energy of hydrogen atom? Compare the orbital radius of two levels. {$E_n \propto Z^2 / n^2$)

24. Calculate the frequency of photon, which can excite the electron to – 3.4 eV from – 13.6 eV. (2.47×10^{15} Hz)

25. Show that the shortest wavelength lines in Lyman, Balmer and Paschen series have their wavelength ratio 1: 4: 9.

26. The potential energy of the electron in ground state is –27 eV, what is its potential and kinetic energies?

27. Show that the wavelength of electromagnetic radiation is equal to the de Broglie wavelength of its photon.

28. A radioactive sample has N_0 nuclei at t = 0. Its no. of undecayed nuclei get reduced to N_0 /e at t = τ. What does the term τ stand for? Write in term of τ the time interval 'T' in which half of original number of nuclei, of this radionucleide would have got decayed?

29. If the nucleus $_{26}Fe^{56}$ splits into two nuclei of $_{13}Al^{28}$. Would the energy be released or needed for this process to occur? Also calculate this energy. Given m ($_{26}Fe^{56}$) = 55.93494 amu, m($_{13}Al^{28}$) = 27.98191 amu.

30. Calculate the ratio of energies of photon due to transition of electron of hydrogen atom from (i) second permitted energy level to first level (ii) highest permitted energy level to second permitted level.

31. Prove that the instantaneous rate of change of activity of a radioactive substance is inversely proportional to the square of its half-life period.

32. The nucleus of an atom $_{92}Y^{235}$ initially at rest decays by emitting an α-particle as per equation ▶ $_{92}Y^{235}$ $_{90}X^{231} + _{2}He^{4}$ + energy. It is given that BE per nucleon of parent and the daughter nuclei are 7.8 MeV and 7.835 MeV and that of α-particle is 7.07 MeV / nucleon. Assuming the daughter nucleus to be formed in unexcited state and neglecting its share of in energy of the reaction, calculate the speed of emitted α-particle. Take mass of α-particle = 6.68×10^{-27} kg.

33. Four nuclei of an atom fuse together to form a heavier nucleus. If the process is accompanied by release of energy, which of the two parent or daughter nucleus have higher BE/nucleon?

34. The spectrum of a star in the visible and the ultraviolet region was observed and wave-length of some of the lines were identified were found to be

824 A^0, 970 A^0, 1120 A^0, 2504 A^0, 5173 A^0, 6100 A^0

Which of these lines cannot belong to hydrogen atom spectrum.

(Given R = 1.03×10^7 m^{-1}) and 1 / R = 970 A^0. Support your answer with proper calculation.

35. Why a nucleus can eject electron (B particle) though it contain no electron?

36. Why nucleuses have mass less than the sum of masses of individual nucleons in them?

37. How wills the distance of closest approach changes: a) when the kinetic energy is of the projectile is doubled? B) when the velocity of projectile is halved.

38. The second member of Lyman series in hydrogen spectrum has wavelength 5400 A°. Find the wavelength of first number.

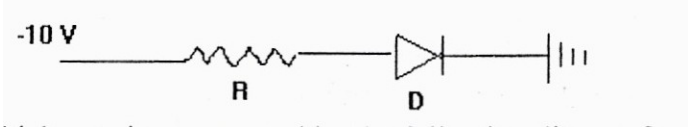
39. What is the effect of temperature and pressure on the radioactivity?

40. What is the value of impact parameter of alpha particle scattered through an angle of 180°.

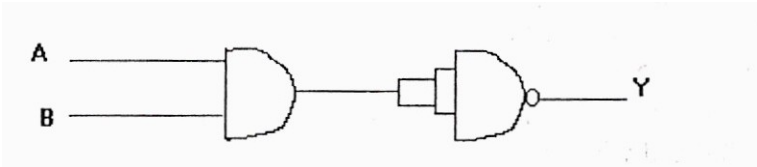
41. Draw the graph showing the distribution of electron's emitted during beta decay.

UNIT-9
ELECTRONIC DEVICES

1.What is the order of energy gap in a conductor, semi conductor, and insulator?.
2.Why does the conductivity of a semi conductor change with the rise in temperature ?
3. Is the number of electrons greater than, less than (or) equal to the number of holes in an intrinsic semi conductor?
4.Show in a energy band diagram the donor level for an N-type semi conductor.
5.. Draw in a energy band the acceptor level for a P-type semi conductor .
6.what is knee voltage in a junction Diode?
7. In transistor a current controlled (or)temperature controlled device?.
8. In a given diagram ,is the diode reverse (or) forward biased?.



9.which gate is represented by the following diagram?.

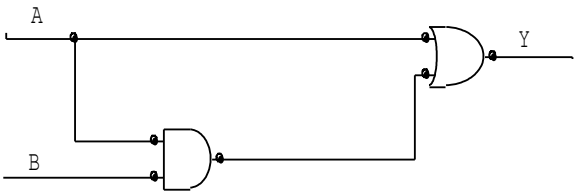


10.The ratio of number of free electrons to holes n_e/n_h for two different materials A and B are 1 and <1 respectively. Name the type of semi conductor to which A and B belongs.
11.In half wave rectification , what is the output frequency if the input frequency is 50 hz. What is the output frequency of a full wave rectification for the same input frequency.
12. How can you relate drift velocity and mobility of an electron?
13. Show by the graph how does the current vary with the voltage change for a junction diode.
14. Why do semiconductors obey OHM'S law for only low fields?
15. Mention the factors upon which Tranconductance of a transistor depend.
16. For faster action which transistor is used and why?
17. What are input and output characteristics of a transistor? Draw the graphs.
Ans:

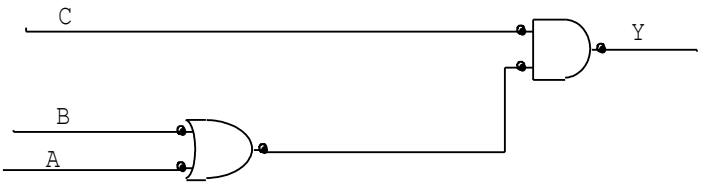
18. A germanium diode is preferred to a silicon one for rectifying small voltages. Explain why?

Ans: Because the energy gap for Ge (Eg = 0.7 ev) is smaller than the energy gap for Si (Eg = 1.1ev) . Moreover, the germanium diode is much more open to the danger of high temperature affect than silicon at high voltage.

19.Express by a truth table the output Y for all possible inputs A and B in the circuit shown below.



20. Write the Boolean equation and truth table for the circuit shown below.What is the output when all the inputs are high?



21) Construct AND gate using NAND GATE and give its truth table.

23. For a common emitter amplifier, current gain = 50. If the emitter current is 6.6mA, calculate collector and base current. Also calculate current gain, when emitter is working as common base amplifier.

24.The base current is 100μA and collector current is 3mA.

a) Calculate the values of β, Ie, and α
b) A change of 20μA in the base current produces a change of 0.5mAin the collector current. Calculate βa.c.

25. In NPN transistor circuit, the collector current is 5mA. If 95% of the electrons emitted reach the collector region, what is the base current?

Ans: Here

I_c=95% of Ie = (95 / 100) I_e

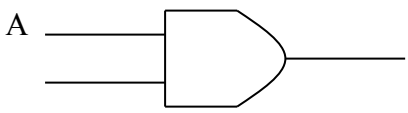
$I_e = (100 / 95) \times 5$ mA = 5.26mA

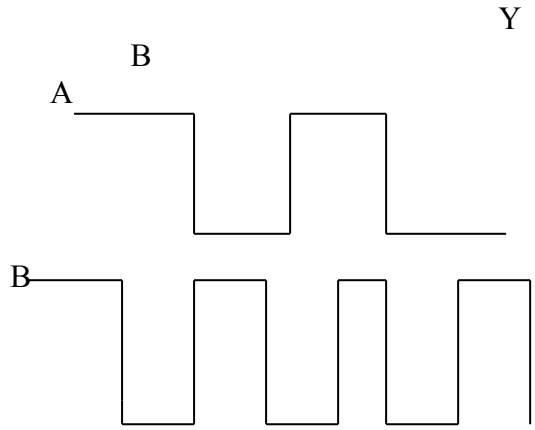
$I_e = I_c + I_b$

I_b = 0.25 mA

26. In a transistor circuit shown the figure, the emitter current is 5mA and collector current 4.75 mA. Calculate the base current and the value of Rb.

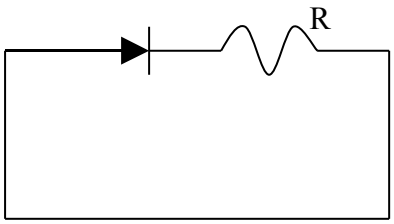
27.A circuit symbol of a logic gate and two input wave forms A and B are shown.





a) Name the logic gate
b) Give the output wave form

28. The diode shown in the figure has a constant voltage drop of 0.5V at all currents and a maximum power rating of 100mW. What should be the value of resistance R connected in series, for maximum current.?



29.For a transistor working as a common base amplifier, current gain is 0.96. If the emitter current is 7.2mA, then calculate the base current.

30. For a common emitter amplifier, the current gain is 70. If the emitter current is 8.8mA, calculate the collector and base current.

31.The base current of a transistor is 105 μA and collector current is 2.05 mA.

a) Deterine the value of β , Ie , and α
b) A change of 27 μA in the base current produces a change of 0.65 mA in the collector current . Find βa.c.

32. In a silicon transistor, a change of 7.89mA in the emitter current produces a change of 7.8 mA in the collector current. What change in the base current is necessary to produce an equivalent change in the collector current?

ADDITIONAL QUESTIONS

(1) Out of electrons and holes, which has higher mobility?

(2) Which special type of diode can act as a voltage regulator? Give the symbol of this diode and draw the general shape of its V-I characteristics.

(3) What do you mean by rectification?

(4) If a semiconductor has an intrinsic carrier concentration of $1.04\times10^{14}/m^3$ when doped with $10^{28}/m^3$ phosphorous atoms, calculate the concentration of $hole/m^3$ at room temperature .

(5) In a common emitter circuit, if V_{CE} is changed by 0.5 V, collector current Changes by 0.002 mA. What is the output resistance?

(6) Name the electrical circuits used to get smooth D.C. output from a rectified circuit.

(7) How does the energy gap of an intrinsic semiconductor vary when doped with a trivalent impurity?

(8) Draw energy band diagram of n-type semiconductor.

(9) A semiconductor has equal electron and hole concentration $6\times10^8/m^3$ .On doping with a certain impurity, electron concentration increases to $8\times10^{12}/m^3$ .Identify the type of semiconductor after doping.

(10) How does the dc current gain of a transistor change, if the width of the base region is increased?

(11) Why are photodiodes used preferably in reverse bias condition?

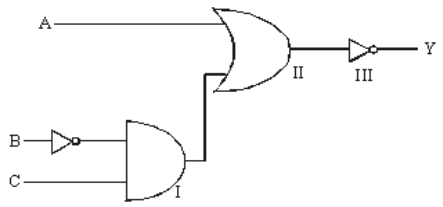
2 marks questions

(1) In the working of a transistor, emitter base junction is forward biased, while the collector base junction is reverse biased, why:
To make transistor to act as an amplifier.

(2) In a transistor base is lightly doped and is a thin layer, why?
To reduce the neutralization in the base emitter junction.

(3)What is the condition for the state of saturation of a transistor?

(4)Write the truth table for the following logic circuit shown in the figure below.



3 marks questions

(1) Discuss how the OR gate is realized from the NOR gate.

(2) Why is the base region of a transistor usually made thin?In a common emitter mode of transisitor, d.c. current gain is 20, the emitter current is 7 mA. Calculate (i) base current, and (ii) collector current.

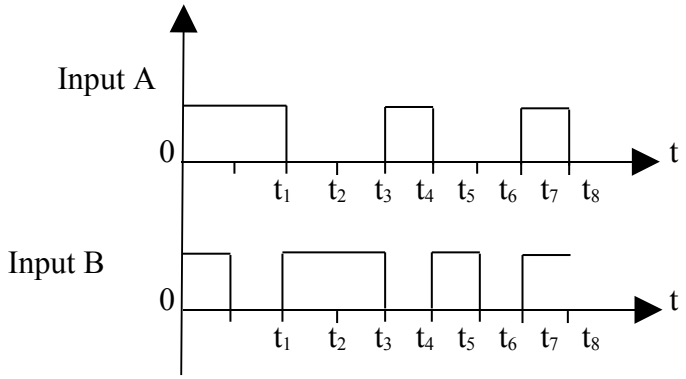
(3) The input resistance of a silicon transistor is 665 Ω. Its base current is changed by 15 μA, which results in change of collector current by 2mA. This transistor is used as a common emitter amplifier with a load resistance of 5 k Ω. Calculate (i) current gain A_{ac}, (ii) transconductance g_m, and (iii) voltage gain A_v of the amplifier.

(4) Draw the energy band diagram of a p-type semiconductor. Distinguish between p-type and n-type semiconductor.

(5)Explain briefly with the help of a circuit, how V-I characteristics of a p-n junction diode are obtained in (a) Forward bias (b) Reverse bias. Draw the shape of curves obtained.

(6)In a common emitter transistor amplifier, the input resistance of a transistor is 100 ohm. On changing its base current by 10μA, the collector current increases by 2mA.If a load resistance of 5kilo ohm is used in the circuit, calculate (a) current gain (b) voltage gain of the amplifier

(7) Two signals A, B as given below, are applied as input to (i) AND (ii) NOR and (iii) NANDgates. Draw the output wave-form in each case.



5 marks questions

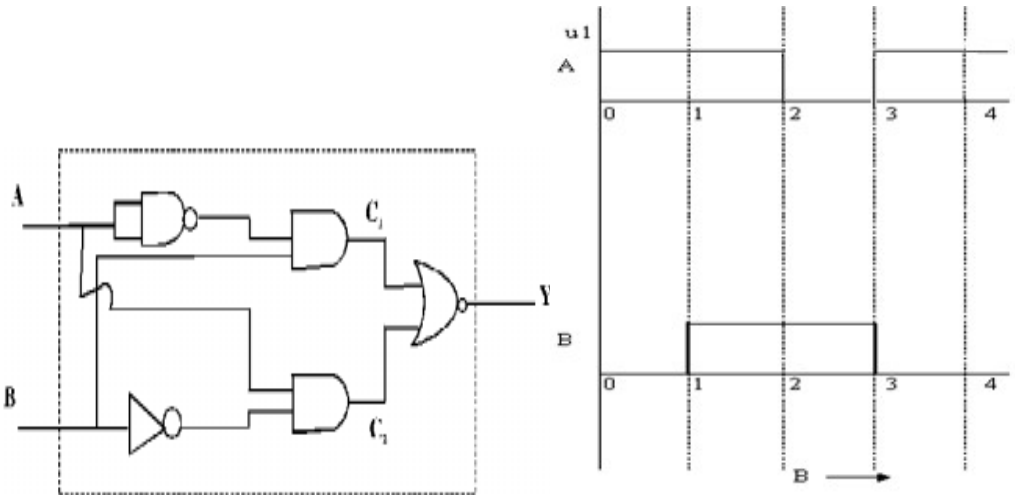
(1) Draw a circuit diagram to obtain the characteristics of a n-p-n transistor in common emitter configuration. Describe how you will obtain input and output characteristics. Give shape of the curves.

(2) Explain the function of base region of a transistor. Draw a circuit diagram to study the input and output characteristics of NPN transistor in a common emitter (CE) configuration. Show these characteristics graphically. Explain how the current amplification factor is calculated from these characteristics.

(3) Explain the working of transistor as an oscillator with the help of a neat diagram.

(4) A student has to study the input and output characteristics of a n-p-n silicon transistor in the Common Emitter configuration. What kind of a circuit arrangement should she use for this purpose? Draw the typical shape of input characteristics likely to be obtained by her. What do we understand by the cut off, active and saturation states of the transistor? In which of these states does the transistor not remain when being used as a switch?

(5) Input signals A and B are applied to the input terminals of the 'dotted box' set-up shown here. Let Y be the final output signal from the box. Draw the wave forms of the signals labeled as C1 and C2 within the box, giving (in brief) the reasons for getting these wave forms. Hence draw the wave form of the final output signal Y. Give reasons for your choice. What can we state (in words) as the relation between the final output signal Y and the input signals A and B?



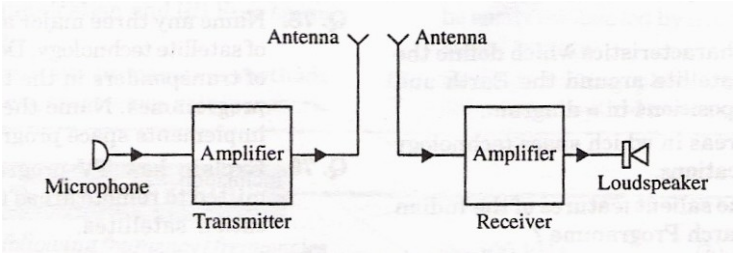
UNIT-10
COMMUNICATIONS SYSTEMS.

1) Why are micro wave used in radars?
2) Why sky waves are not used in the transmission of television signals?
3) What should be the desirable characteristic of a diode detector?

4) Give a velocity factor of a line.
5) Why is delta modulation a convenient method of digital modulation.
6) Where the two wire transmission line, Coaxial cable, Optical fiber are employed.
7).what is heterodyning?.
8).What is population inversion? How is it achieved?.
9).Enumerate the various types of Lasers?.
10)Lists some of the applications of Lasers?.
11)Name the prime elements of a telecommunications network.
12) Audio signal cannot be transmitted directly in to the space why?
13) What is pulse modulation?
14) What is precisely meant by the term channel in a communication system "?
15) Why does the electrical conductivity of earths atmosphere increase with altitude ?
16) Explain numerical aperture in fibre optical
17) Differentiate between (i) PAM and (II) PPM .
18)Why the transmission of signal is not possible for frequency greater than 20Mhz .
19)How does the effective power radiated by the antenna vary with wavelength?
20)what should be the length of the dipole antenna for a carrier wave of 5 X 10 ^{8}hz ?
21)By how much should the height of the antenna be increased to double the coverage range R= 6400 Km.
22) A TV. tower has a height of lOOm . How much population is covered by the TV. broadcaste if the average population density around the tower is 1000/km^2

23)Ground receiver station is receiving a signal at (i) 5MH and (ii 100MHz transmitted from a round transmitter at a height of 300 m, located at a distance of 100 km from the receiver station. Identify whether the signal is coming via space wave or sky wave propagation or satellite transponder. Radius of earth = 6.4 x 10_6 m. Nmax of the Isosphere = 10^{12} m^3

24)A schematic arrangement for transmitting a message signal (20 Hz to 20kHz) is given below:



Give two drawbacks from which this arrangement suffers. Describe briefly with the help of a block diagram the alternative arrangement for the transmission and reception of the message signal.

25) The maximum peak-to-peak voltage of an AM wave is 16mV and the minimum peak-to peak voltage is 4mV.Calculate the modulation factor.

26) An AM wave is represented by the expression:

$v = 5(1+0.6\cos 6280t) \sin 221 \times 10^4 t$ volts

(i) What are the maximum and minimum amplitudes of the AM wave.

(ii) What frequency components are contained in the modulated wave.

27) An audio signal of 1 kHz is used to modulate a carrier of 500 kHz. Determine

(i) Sideband frequency.

(ii) Bandwidth required.

28) The antenna current of an AM transmitter is 8A when only carrier is sent but it increases to 8.93A when the carrier is sinusoid ally modulated. Find the percent-age modulation index.

29) A 100 MHz carrier is modulated by a 12 kHz sine wave so as to cause a frequency swing of $\pm$50kHz. Find the modulation index.

30) The TV transmission tower at a particular place has a height of 160m. What is its coverage range? By how much should the height be increased to double its coverage range? Given that radius of earth = 6400 km.

31) A TV tower has a height of 110m. How much population is covered by the TV broadcast if the average population density around the tower is 1000 km^{-2}? Given that radius of Earth = 6.4 X 10^6m.

32)A microwave telephone link operating at the cenral frequency of 10 GHz has been established .If 2 % of this is available for microwave communication channel, then how many telephones channels can be simultaneously granted if each telephone is allotted a band width of 8 KHz .

33) You are given three semiconductors A,B,C with respective band gaps of 3eV, 2eV and 1eV for use in a photodetector to

detect λ = 1400nm . Select the suitable semiconductor. Give reasons.

34) Frequencies higher than 10MHz are found not to be reflected by the ionospere on a particular day at a place. Calculate th maximum electron density of the ionosphere.

ADDITIONAL QUESTIONS:

35) Draw a block diagram of data transmission and a data receiver. Explain them briefly.
36). Explain how the optical communication system offers the possibility of millions of channels with increased band width. Give an additional advantage of optical communication system over a system employing a co axial cable.
37) Give the names of the Indian satellites launched from the erstwhile USSR for remote sensing.
38) Expand the following abbreviations:
APPLE, INSAT, IRS, ISRO, ASLV.
39) . What is the role played by launch vehicles in space exploration ? How is it different from a space shuttle ? Merition any two facilities a country needs to develop to achieve self-sufficiency in space programmes.
40) Explain how TV programmes are transmitted to remote areas through communication satellites.
41) Explain (a) Modem Transmission (b) Modem Reception.
42) How does Heterodyning distinguish from CW signals?.
43) In a diode AM detector the output circuit consists of R =$10^8\Omega$ and C = 10 pF. A carrier signal of frequency 10^5hz is to be detected .Is it good?.
44) On a particular day maximum frequency reflected from the ionosphere is 9Mhz.On another day it was found to increase by one Mhz.What is the ratio of the maximum electron density of the ionosphere on the two days.Hints: Nmax / nmax $= (\nu_c'/\nu_c)^2 = 1.23$

HINTS FOR CLASS-XII(PHYSICS) – HOTS FOR THE YEAR-2009-10

HINTS FOR HOTS-CLASS-XII(PHYSICS)
UNIT-1
HINTS FOR ELECTROSTAICS

1. In the dielectric medium between the plates.
2. High potential, as electrons are negatively charged.
3. Zero
4. Zero
5. $ML^{-1}T^{-2}$
6. Zero
7. No.
8. Because they are indicators of electric field, extending to infinite distance.
9. C is proportional to A (area) Therefore $C_2 = 2C_1$

Since C = Q/V ,So the slope represents more capacitance. Hence P represents C_2,Q represents C_1

10. Each charge experiences two forces each of magnitude F inclined at an angle of 60^0.Their resultant is given by $[F^2 + F^2 + 2F^2\cos 60]^{1/2} = \sqrt{3}.F$

11. (i)According to defn of P.D.,
$V_P > V_Q$ .So $V_P - V_Q$ is +ve for q>0.
(ii)For q<0, $V_Q > V_P$ .So $V_P - V_Q$ is -ve

12. Flux = 0, since Qen = 0

13. Due to polaraisation,opposing electric field is created.

14. Electric field at the midpoint of a dipole of length 2a is 2kq/a pointing towards the –ve charge or in the
direction opposite to the dipole moment.

15. Inside the cavity field at any point is uniform and non zero.

16. No. If the initial velocity of the charged particle makes a certain angle with a line of force, then the
charged particle shall not move along the line of force.

17. $E = -dv/dr = -d(q/4\pi\varepsilon_o r)/dr = q/4\pi\varepsilon_o r^2$

18. Yes, at the mid point of electric dipole.

19. $U = kq^2/a - kq^2/2a - kq^2/2a = 0$.

20. $C' = C+C+C = 3C = 75\mu F$
Therefore, charge = $75\mu F \times 4200$ V = 315 mC*

21. Total $\phi = q_0/\varepsilon_{o=2}/\varepsilon_o, \rightarrow$ flux through one face = $\phi/6 = 1/3\ \varepsilon_o$.

22. q →---------- Q
$1/2mv^2 = kQq/r$
Or, $v^2 \alpha\ 1/r$
Or, $r \alpha\ 1/v^2$
Or, r' = r/4

23. $V = V_1 + V_2$
$Q = C_1V = 6 \times 10^{-6} \times 2 = 12\mu C$
As C_2 is in series same amount of charge will also flow through it.
Now $V_2 = Q/C_2 = (12 \times 10^{-6})/(12 \times 10^{-6}) = 1$ Volt
Total battery Voltage,V = 2 + 1 = 3 Volt

24.Capacitance of parallel plate capacitor with air between the plates is $C_0 = \varepsilon_0 A/d$
When the separation between the plates reduced to half,
$C_1 = \varepsilon_0 A/(d/2) = 2\varepsilon_0 A/d$
Thus final capacitance is C_2=10 X 8 pF=80 pF

25.The arrangement is of 5 capacitors in series.Therefore
$1/C' = (1/C) + (1/C) + (1/C) + (1/C) + (1/C) = (5/C)$
Therefore C'=C/5 Or 5=C/5 or C=25μF.

26. The charge given to a capacitor is given by q=CV
So the remaining energy,qV- 1/2 qV =1/2 qV is lost as heat

27. On equatorial line ,the direction of electric field is reversed to that of axial line. Hence the angle between
electric dipole moment& electric field strength is 180^0

28. Eq. network is the Eq.capacitance
= (2C series C) ‖ (2C series C)
=4C/3

29. $4/3\ \pi R^3 = 8 \times 4/3\ \pi r^3$

30. $dV = -E \cdot dx = -2 \times 10^3 \times 4$ V = -8×10^3 V
$E = E_1 - E_2 = Q_1 - Q_2/2A\ \varepsilon_o$
Now, V1 – V2 = E . d = $Q_1 - Q_2/2C$

32. $U = k\ (q^2/a + qQ/a + qQ/\sqrt{2}a)$

But, U = 0

Therefore, Q = -2q/(2 + √2)

33. $E= q/4\pi\varepsilon_{0[1+1/4+1/16+1/64]} = q/3\pi\varepsilon_{0.}$

34. Let q & q' be the charges on inner and outer sphere.

Hence $q/4\pi r^2= q'/4\pi R^2$

$q=Qr^2/(R^2+r^2)$ & $q'=Q-q=Q- (Qr^2/R^2+r^2)$

Now potential at O is given by

35 (i) Dipole has two equal and opposite charges. In the uniform electric field they will experience equal and

opposite force. Net force is zero. So there can't be any translatory motion.

(ii) Torque, $\tau = r\perp F=2l \sin\theta\ qE = p \times E$

Torque experienced by the dipole will rotate it.So the direction of the torque will be outward from the

surface.

36. We have $V=ar^2+b$

The electric field,$Er = - dV/dr=-2ar$-------(1)

From Gauss theorem, $\int E.dS=q/\varepsilon_0$, where S is the spherical surface containing the charge q

Or $E.4\pi r^2=(1/\varepsilon_0)(4\pi/3)\ r^3\rho$-------(2)

From 1 and 2 $\rho=-6\pi\varepsilon_0$

UNIT-2

HINTS FOR CURRENT ELECTRICITY.

1. They have high resistively and low temperature coefficient of resistance.
2. $22*10^2\ \Omega\ \pm 10\%$
3. Resistively remains the same.
4. As Vd α V.

The different velocity will be doubled.

5. $R=\rho(l/A)$

$= \rho(l^2/Al)$

$= \rho l^2/V)$

since, ρ and V are constants

therefore, $R \alpha\ l^2$

➔ $(R_2/R_{1)}= (l_2/l_1)^2=9$

because $R_2=9R_1$

$=9*10=90\ \Omega$

6. Now, $1/R=1/R_1+1/R_2$

because l = 48/240 = 0.2 m

7. a) in parallel, power dissipation α 1/R

Therefore 3Ω wire will dissipate more power

b) In series , power dissipation α R

Therefore 9Ω wire will dissipate more power

8. $R_{100}/R_{27.5}= (1+100\alpha)/(1+27.5\alpha)$

On solving, we get

$\alpha = 0.0039/^\circ c$

9. Superconductors are the materials that lose all its resistance at very low temperature =0 K

Application:

Super conductor are used

a) In making very strong electromagnets
b) In producing very high speed computers .

10. Resistivity of copper is less , hence manganin wire is thicker.
11. High value of resistivity and low value of temperature coefficient.
12. Resistivity will be unchanged because it depends upon nature of the materials.
13. B is more sensitive.
14. Reduced by half.
15. Relaxation time decreases with increase of temperature.
16. Increase in heat.
17. Reistance remains same.
18. $P \alpha 1/R$. (i.e) 25Watts
19. 16 times of the original reisitance.
20. (i)Series - Iron
    (ii)Parallel - Copper.
21. $R = \rho L/A$.
    (i.e) 10.25%
22. Parallel(i.e) R.
23. 1:4.
24. 2:1
25. R.

Unit-5

HINTS FOR EM WAVE.

1. Due to change in electric field.

3. Same as velocity of light.

4. 90 degree

6. γ rays, radio waves, X-rays, UV rays

7. i)X-rays
   ii)microwave.

8. doubled

9. Charge.

10..Increases.

11. Gauss's law

13. X-rays because $\lambda = 0.825A^{o}$

14. Micro waves

15.By varying potential difference.

16. Ex and By.

UNIT-6

ANSWER KEY FOR OPTICS

1.Ans:Wavelength

2. Ans:Photo electric effect.

3. Ans:4NL.

4. Ans: It will turn gradually blue.

5. Ans:Zero.

6. Ans:90^{o}.

7. Ans:$\mu_{o=}\ \mu_{e}$

8. Ans:90^{o}

9. Ans:Violet.

10. Ans: Shrinks.

11. Ans.(i) The upper part of the mirror is convex.

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

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

12. Ans. The ray of light bends away from the normal.

13. Ans.

As $\mu = \sin i/\sin r = c/v$ or $v = \sin r/\sin i * c$

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 $\sin 15° < \sin 25° < \sin 35°$.

$\therefore\ v_A < v_B < v_C$.

i.e. the velocity of light is minimum in medium A.

14 Ans.For $i = 90°$, lateral shift is maximum and is equal to the thickness of the slab.

$d = t \sin(i - r)/ \cos r$

$d_{max} = t \sin(90° - r)/\cos r = t \cos r/\cos r = t$.

15. Ans.The apparent shift caused by a slab of thickness ‘t’ is given by

$d = t(1 - 1/\mu)$

As the refractive index of the galass is maximum for red light, so red coloured letters are more raised up.

16. Ans. No Apparent depth is maximum for that part of the bottom of the tank which is observed normally. Apparent depth decreases with increasing obliquity. Due to this unequal refraction, the flat bottom of the tank appears concave.

17. Ans. For glass-air interface, $\sin i_c = 1/{}^a\mu_g$

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

$\text{Sin } i'_c = 1/{}^w\mu_g$

Now ${}^w\mu_g < {}^a\mu_g$,

$\text{Sin } i'_c > \text{Sin } i_c$ or $i'_c > i_c$

18. Ans. Light entering water is totally reflected from the air bubble. For the observer, this light appears to come from the buble. So it shines.

19. Ans. 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 a transparent oil.

20. Ans. It behaves like a biconvex lens.

21. Ans. Air bubble has spherical surface and is surrounded by medium (water) of higher refractive index. When light passes from water to air it gets diverged. So air bubble behaves as a concave lens.

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

23. Ans. 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 interchangeR_1 and R_2, the magnitude of 'f' remains the same.

24. Ans. focal length'f' of a convex lens is related to its refractive index as

$f \propto 1/(\mu - 1)$

As ${}^{w}\mu_g < {}^{a}\mu_g$, so focal length of a convex lens will increase when it is immersed in water.

25. Ans.Focal length, $f \propto 1/(\mu - 1)$

As $\mu_R < \mu_V$, so the focal length of a convex lens will increase when red light is used.

26. Ans:For the original lens: $R_1 = +R$ and $R_2 = -R$, so we can write

$1/f = (\mu - 1)\,[\,1/R + 1/R\,] = 2(\mu - 1)/R.$

When one surface is made plane by grounding, we have $R_1 = +R$ and $R_2 = -\infty$.

Therefore, $1/f' = (\mu - 1)\,[\,1/R + 1/\infty\,] = (\mu - 1)/R$

$\therefore\ f' / f = 2$ or $f' = 2f$

Thus the focal length becomes double and power becomes one –half.

27. Ans. When the prism is held in water,

${}^{w}\mu_g = \text{Sin}\,(A + \delta m/2)\,/\text{Sin}A/2$

As ${}^{w}\mu_g < {}^{a}\mu_g$, so the angle of minimum deviation decreases in water.

28. Ans. Total internal reflection.

29. Ans. The sunlight will not be scattered in the absence of atmosphere. So the sky will appear dark.

30. Ans. Clouds have large particles like dust and water droplets which scatter light of all colours almost equally, hence clouds generally appear white.

31Ans. When the sun or the moon is seen through a thin veil of high clouds, holes are seen. These are formed due to reflection of light by the icy crystals present in the atmosphere.

32. Ans. Ultra-violet light has wavelength shorter than that of violet light. Bees have some retinal cones that are sensitive to ultra violet light, so they can see objects in ultra-violet light. Human eyes do not posses retinal cones sensitive to ultra-violet light, so human beings cannot see objects in ultra-violet light. In other words, human beings are ultra-violet blind.

33. Ans. In a chicken's eye, the retina has a large number of cones but only few rods. The rods are sensitive to bright light only. That is why a chicken is not able to see in dim light. As it needs bright light to see, so it wakes up early in the morning with the sunrise and goes to sleep by sunset.

34. Ans. Magnifying power of a simple microscope ,

$$m = 1 + D/f$$

as $f_V < f_R$ so the magnifying power is greater when the object is seen in violet light.

35. Ans. This is done so that the objective lens forms image within the focal length of the eyepiece.

36. Ans. (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.

37. Ans. Yes, because the light gathering power of objective will increase and even faint objects will become visible.

38. Ans. For relaxed eye,

$$L = f_0 + f_e \text{ (normal adjustment)}$$

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.

SHORT ANSWER TYPE QUESTIONS

39. Ans. Here u = - (f+a), v = -(f+b), f = -f

As $1/f = 1/u + 1/v$

$F = uv/ u + v$

Or $-f = [-(f+a)] \times [-(f+b)] / -(f+a) - f(a+b)$

$= f^2 + af + bf + ab / -(2f+a+b)$

or $2f^2 + af + bf = f^2 + af + bf + ab$

or $f^2 = ab$

40.Ans. (i) Angle of refraction (θ/2) in medium 2 is less than the angle of incidence (θ) in medoum 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,

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

Also $\mu = c_1 / c_2$

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

41. Ans. The point of convergence shifts away from the glass, as shown in the ray diagram given below. The screen has to be moved towards right to receive the point of convergence again.

42. Ans. Real depth = y cm

Apparent depth = y- x cm

Refractive index of oil,

μ = real depth/ apparent depth = y / y-x

43. Ans. Using Snell's Law for refraction from glass to air,

$\text{Sin } i/\sin r = {}^{g}\mu_a = v / c$

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

$\text{Sin } i_c/ \sin 90^0 = v / c$ or $\text{Sin } i_c = v / c$

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

44. Ans. **Twinkling of stars.** The light from stars undergoes refraction continuously before it reaches earth. So the apparent position of the stars is slightly different than its actual position. Due to variation in atmosphere conditions, like change in temperature, density etc., and this apparent position keeps on changing. The amount of light entering our eyes from a particular star increases and decreases randomly with time. Sometimes, the star appears brighter and other times, it appears fainter. This gives rise to the twinkling effect of stars.

The planets do not show twinkling effect. As the planets are much closer to the earth, the greater and the fluctuations caused in the amount of light due to atmospheric refraction are negligible as compared to the amount of light received from them.

45. Ans. 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.

46. Ans. Magnification produced by any lens,

$m = v/u = f / f + u$

given $m = \pm N$ $\pm N = f / f + u$

or $f + u = \pm f / N$ or $u = - f \pm f / N$

hence magnitude of object distances,

$|u| = f \pm f / N$

given $P = 1/f = + 2.5$ D

$f = 1/ 2.5 = 0.4$ m = 40 cm
Also $N = 4$
$|u| = 40 \pm 40/4 = 40 \pm 10 = 50$ cm or 30 cm.

47. Ans.
(a) for a convex lens, $f>>0$ and for an object on left, $u<0$. when the object is placed within the focus of a convex lens,

$0 < |u| < f$ or $0< 1 / |u| > 1/f$
$1/v = 1/f+1/u=1/f-1/|u|<0$

i.e. $v < 0$ so a virtual image is formed on left.
Now as $u<0$ and $v<0$, so $1/v = 1/f + 1/u$

$= - 1/ |v| = 1/f – 1/|u|$ or $1/|u| - 1/|v| = 1/f$
As $f>0$
$1/|u| - 1/|v| > 0$ or $1/|u| > 1/|v|$ or $|u|<|v|$
i.e. $|v|>|u|$ $|m| = |v/u| > 1$

Hence image is enlarged.
(b) For a concave lens $f<0$ and for an object on left, $u<0$
$1/v = 1/f +1/u = 1/|f| - 1/|u|$
$= - [1/|f|+1/|u|] < 0$ for all u.
i.e. $v<0$ for all values of u. hence a virtual image is formed on the left.
Also $1/|v| = 1/|f| + 1/|u|$ $1/|v| > 1/|u|$
Or $|v|<|u|$ $|m| = |v/u| < 1$
i.e. the image is diminished in size.
48. Ans. A hollow prism contains air which does not cause dispersion. The faes AB and AC of the hollow prism behave like parallel sides of glass plates. The beam is laterally deviated at each of the two refracting faces. However, the rays of different colours emerge parallel to each other. So there is no dispersion.
49. Ans. (i) Moon has no atmosphere. There is no scattering of light. Sunlight reaches moon 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. No 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 no rains on the moon. So rainbow is never observed.

NUMERICAL PROBLEMS

50. Ans. The total apparent shift in the position of the image due to all the three media is 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

51. Ans. Clearly , the fish can see the outside view of the cone with semi vertical angle,

But $\mu = 1 / \sin i_c$

Or $1/3 = 1 / \sin i_c$

Or $\sin i_c = ¾ = 0.75$

$\theta/2 = i_c = \sin^{-1} (0.75) = 48.6^0$

52. Ans. (i) As the lens forms a real iamge, it must be a convex lens.
(ii) From the graph, when u=20 cm , we have v = 20 cm.
For the convex lens forming a real iamge, u is negative and v and f are positive.
U = -20 cm v = +20cm
Using this lens formula,
$1/f = 1/v – 1/u = 1/20 – 1/-20 = 1/10$ or f = + 10 cm

53. Ans. $A=60^0$, $\delta_m=30^0$

$i = e = ¾ A = 45^0$,

as $A + \delta = i + e$

$60 + \delta = 45 + 45$

or $\delta = 30^0$

Refractive index,

$\mu = \sin a+\delta_m /2 /\sin A/2 = \sin 60^0+30^0/2 / \sin 60^0/2$

$= \sin 45^0/\sin 30^0 = 1/\sqrt{2} / ½ = \sqrt{2} = 1.414$

WAVE OPTICS

54. Ans. Two light sources will be coherent if

(i) The frequency of the two light sources is same and,

(ii) The phase difference between them remains constant.

55. Two independent light sources cannot act as coherent sources. Why?

Ans. Two independent sources of light cannot be coherent. This is because light is emitted by individual atoms, when they return to ground state. Even the smallest source of light contains billions of atoms which obviously cannot emit light waves in the same phase.

56. Ans. Fringe width , $\beta = \lambda D/d$

i.e. $\beta \propto 1/d$, when $d \to 0, \beta \to \infty$

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

57. Ans. The given path difference satisfies the condition for the minimum of intensity for yellow light, Hence if yellow light is used, a dark fringe will be formed at the given point. If white light is used, all components of white light except the yellow one would be present at this point.

58. Ans. 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.

59. Ans. 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.

60. Ans. Muslin cloth is mde of very fine threads and as such fine slits are formed. White light passing through these silts gets diffracted giving rise to colored spectrum. The central maximum is white while the secondary maxima are coloured. This is because the positions of secondary maxima (except central maximum) depend on the wavelength of light.

In a coarse cloth, the slits formed between the threads are wider and the diffraction is not so pronounced. Hence no such spectrum is seen.

SHORT ANSWER QUESTIONS

61. Ans. 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.

The wavefronts of light emerging from a point source are spherical, as shown in figure. When a point source is placed at the focus of a convex lens, the emerging light has the plane wavefronts, as shown in figure.

62. Ans. As shown in figure the bright fringes B1 and b2 on either side of O coincide with S1 and S2 respectively.

Clearly ,

$$\beta = d/2$$

As $\beta = D\lambda/d$ $d/2 = D\lambda/d$ or $\lambda = d^2/2D$

63Ans. For intensity distribution of light in diffraction at a signal slit, see figure

Width of central maximum is given by

$$\beta_0 = 2D\lambda/d$$

(i) When wavelength of light λ 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.

64. Ans. When 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 $\propto$ 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.

65. Ans. R.P.of a compound microscope

$$= 2\,\mu \sin\theta/\lambda = 2\,\mu \sin\theta \times v/c$$

(i)When the frequency v of the incident light increases, the resolving power increases (R.P. $\propto$ v).

(ii) Resolving power does not change with change in focal length of objective lens.

(iii) When the aperture of the objective lens increases, the semi-vertical angle θ increases and hence the resolving power of the microscope increases.

66. Ans. According to the Brewster law, when a ray of light is incident on a transparent refracting medium at olarising angle,

$$\mu = \tan i_p$$

but $i_{p+rp} = 90^0$ or $i_p = 90^0 - r_p$

$$\mu = \tan(90^0 - r_p) = \text{Cot } r_p = 1/\tan r_p$$

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

$$\mu = 1/\sin i_c$$

on comparing (i) and (ii) we get

$$\tan r_p = \sin i_c \quad \text{or} \quad rp = \tan^{-1}(\sin i_c)$$

NUMERICAL QUESTIONS

67. Ans. The resultant intensity at a point where phase difference is Φ is

$$I_R = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \Phi$$

As $I_1 = I$ and $I_2 = 4I$ therefore

$I_R = I + 4I + 2\sqrt{1.4I} \cos \Phi = 5I + 4I \cos \Phi$

(i) when $\Phi = 0$, $I_R = 5I + 4I \cos 0 = 9\ I$

(ii) when $\Phi = \pi/2$, $I_R = 5I + 4I \cos \pi/2 = 5\ I$

(iii) when $\Phi = \pi$, $I_R = 5I + 4I \cos \pi = I$

68. Ans. The fringe width in the two cases will be $\beta = D\lambda/d$

And $\beta' = D'\lambda/d$

$\beta - \beta' = (D-D')\lambda/d$

or wavelength $\lambda = (\beta - \beta')d / (D-D')$

But $D-D' = 5 \times 10^{-2}$ m

And $\beta - \beta' = 3 \times 10^{-5}$ m, $d = 10^{-3}$m

$$\lambda = 3 \times 10^{-5} \times 10^{-3} / 5 \times 10^{-2} = 6 \times 10^{-7} \text{ m} = 6000\text{A}$$

69. Ans. Let I be the intensity of beam I incident on first glass plate. Each plate reflects 25% of light incident on it and transmits 75%.

Therefore,

$I_1 = I$ and $I_2 = 25/100 I = I/4$

$I_3 = 75/100\ I = 3/4I$

$I_4 = 25/100\ I_3 = ¼ \times ¾\ I = 3/16\ I$

$I_5 = 7/100\ I_4 = ¾ \times 3/16\ I = 9/64\ I$

Amplitude ratio of beams 2 and 5 is

$R = \sqrt{I_2/I_5} = \sqrt{I/4 \times 64/91} = 4/3$

$I_{min}/ I_{max} = [r-1/r+1]^2 = [4/3-1 / 4/3+1]^2 = 1/49 = 1:49$

UNIT-7

HINTS FOR DUAL NATURE OF MATTER

1. $E = h\nu$

$= hc/\lambda$

$E \propto 1/\lambda$ energy of proton reduces to half.

2. Alkali metals have too low work functions. Even visible light can eject electrons from them.

3. UV are most effective since they have highest frequency hence more energetic.

4. Yes. X-rays cause photoelectric effect in sodium, zinc & copper.

5. K.E of photons remains unaffected since they do not depend

6. stopping potential $V_0 = K_{max}/e = 5ev/e = 5$ V

7. $w_0 = h\nu_0 = hc/\lambda_0$

$\therefore \lambda_0 \propto 1/ w_0$

Since sodium has lower work functions than copper it is easier for electron ejection.

As it is lower work function, higher wavelength.

8. Photocells are used for reproduction of sound.

9. $1/2\ mv^2 = (m^2 v^2)/2m = p^2/2m$

According to De Broglie wave length $\lambda = h/p$

$\lambda_e/ \lambda_p = p_p/p_e = \sqrt{(m_p/m_e)}$

$m_e < m_p$

$\lambda_e > \lambda_p$

electrons have greater De broglie wavelength than proton .

10. $\theta = 90 - \phi/2$

$= 90 – 52/2 = 64°$

11. $E = hc / \lambda$

$= 3.3 \times 10^{-19}$ J

12. KE of photoelectrons is given by Einstein's photoelectric equation.

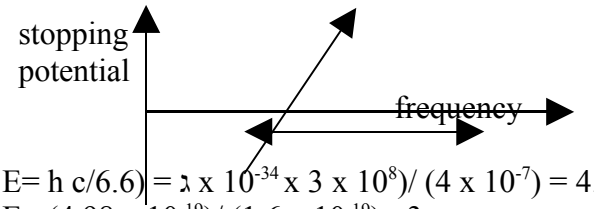
$E_k = 1/2\ mv^2$

$= h\upsilon - w_0$

$V \alpha 1/ \sqrt{\lambda}$

As wavelength decreases velocity increases.

13.



14. $E = h c/6.6) = ג \times 10^{-34} \times 3 \times 10^8)/ (4 \times 10^{-7}) = 4.98 \times 10^{-19}$ j

$E = (4.98 \times 10^{-19})/ (1.6 \times 10^{-19}) = 3ev$

Hence, metal x will emit electrons.

15. For a photon $E_1 = hc/ג$

For an electron ƛ=h/mv or m=h/ƛv

$E_2/E_1=c/v>1$

Therefore,$E_2>E_1$.thus, electron has total energy greater than that of photon.

16. $ƛ_{ph}=ƛ_e=ƛ=h/mv$

K.E. of electrons $E=1/2mv^2=1/2\ m\ [h/m\ ^2[ƛ$

$=h^2/2m\ ^2\ ƛ$

$\therefore E_{ph}=E_e(2mc\ ƛ/h)$

17 . $E=1/2\ mv^2=m^2v^2/2m=p^2/2m \qquad \therefore p=\sqrt{2}Em$

$\therefore ƛ=h/p=h/\sqrt{2}Em$

From Kinetic theory of gases average K.E.=3/2 KT

$ƛ=h/(\sqrt{2}m(3/2\ KT)=h/(\sqrt{3}m\ KT)$

18. The energy of light obtained from the bulb is much less than work function of the wodden block.Hence no photon electrons are emitted.

19. Mo will not emit photo electron , because its work function is more than 4 ev.

20. Alpha particles due to its largest mass.

21. $R\ \alpha\ 1/q$

22. $Ee = Mv^2/r$

23. $\lambda = \lambda/\sqrt{2}$.

24. $\lambda/2$.

25. $\lambda = hc/\Phi = 2823\ \text{Å}$.

UNIT-8
HINTS FOR ATOMS AND NUCLEI.

1) The entire positive charge and the mass were concentrated at one place inside the atom, called the nucleus.

2) A larger number of alpha particle went through undeflected.

3) $R=R_0A^{1/3} \quad R_1/R_2=A_1^{1/3}/A_2^{1/3}=1^{1/3}/27_{1/3}=1/3$

4) $R= R_0A^{1/3} \quad R_1/R_2=A_1^{1/3}/A_2^{1/3}=(1/8)^{1/3}=1/2$

$R_1: R_2=1:2$

5) α-particles have more ionizing power than β-particles.

6) $N/N_0=(1/2)^n$

$t=2T=2*30=60$ days

7) They are neutral in nature and get absorbed by nucleus, thus distributing the neutron proton ratio.

8) The ratio of neutrons to proton ratio increases, after the emission of a ά – particle.

9) Owing to greater mass and charge, it is able to knock out/pull out electrons which colliding with atoms and molecules in its path.

10) T = 20 minutes t = 60 minutes

N/No = (1/2)n = (1/2)60/20 = (1/2) 3 =1/8

After one hour, $1/8^{th}$ of the original mass would remain.

11) The nucleus looses energy, but remains same isotope it was.

12) No a nucleus either emits a ά – particle or a β – particle and if left in the exited state, it

may emit γ – ray also.

13) 1:1 (independent of A).

14) At t = T ½ N = No / 2 Using $N = No\ e^{-\lambda t}$

$No / 2 = No\ e^{-\lambda t_{1/2}}$

Solving we get, $T1/2 = \ln 2/\lambda = 0.693/\lambda$

15) Size of nucleus can approximately be estimated using the concept of distance of closest approach. The rebounding particle is selected and its information is substituted in the expression $Ro = 1/4\pi Eo \times 2Ze2 / E$ for ά particle where E is its energy.

A. Using $N = No\ (1/2)^{t/\pi/2}$ $N = 1/16No$

$1/16 = ½(1/2)^{t/\pi/2}$

$T1/2 = 30/4 = 7.5$ days.

17) $235 = 142+Y+3$

$Y = 90$

And $92 = 57+Z+0$

$Z = 35$

18) a) Yes. Since X & Y are having same atomic number.

b) $\underline{Y^4_3}$ is likely to be more stable because for its neutron to proton ratio is smaller.

19) Disintegration constant $\lambda = 0.693/T1/2$

$=0.693/30x24x60x60$

Therefore T avg $=1.44xT1/2 = 1.44x30 = 43.2$ days.

20) Remaining amount (undecayed) $=1/4N_0$

Using $N= N_0 (1/2)^{t/T1/2}$

$1/4= (1/2)^{t/60}$

Solving $t=2x60=120$days

21) Mass defect $\Delta m= (22.9945-22.9898) =0.00474$

Energy $Q= (0.00474)(931.5)$

$=4.4$MeV

Hence the energy of beta particle can range from 0 to 4.4MeV.

22) a) Using $R=R_0e^{-\lambda t}$

$2700=4750\ e^{-5t}$

$\lambda=0.113min^{-1}$

b) Using $T_{1/2}=0.693/\lambda =0.693/0.113 =6.132$min

23) In the process of beta decay, a neutron gets converted to proton inside the nucleus . Hence number of neutrons decreases by one whereas number of proton increases by one. Hence n/p ratio decreases.

$^{210}Bi_{83} \longrightarrow {}^{210}Po_{84} + {}^{0}\beta_{-1} + \gamma$

Before decay =127/83

After decay=126/84

24) Let λ and λ' be the decay constant of element A and B respectively. Given is

$T_{1/2}(A) = T_{1/2}(B)$

$0.693/\lambda=1/\lambda'$ or $\lambda/\lambda' =0.693$

Let N be the number of atoms of each of the two samples and R and R' their disintegration rate, then

$R/R'= \lambda N/\lambda' N= \lambda/\lambda'=0.693$

→R' > R

25) Find Δm using

$\Delta m= (7x1.00783+7x1.00867-14.003074)$ U

Calculate $\Delta E_b=\Delta mx931.5$ MeV

26) a) $^{226}Ra_{88}$ ----------→ $^{222}Rn_{86} + ^{4}He_{2}$

b) $^{32}P_{15}$ ----------→ $^{32}S1_{6} + ^{0}e_{-1} + \gamma$

c) $^{32}P_{15}$ ----------→ $^{11}B_{5} + ^{0}e_{+1} + \gamma$

27) i) $^{6}Li_{3} + ^{1}n_{0}$ ----------→ $^{3}H_{1} + ^{4}He_{2} + Q$ (energy)

ii) $Q = \Delta m \times 931$ MeV

Where $\Delta m = 6.01512 + 1.0086654 - 4.0026044 - 3.0100000$

UNIT-9

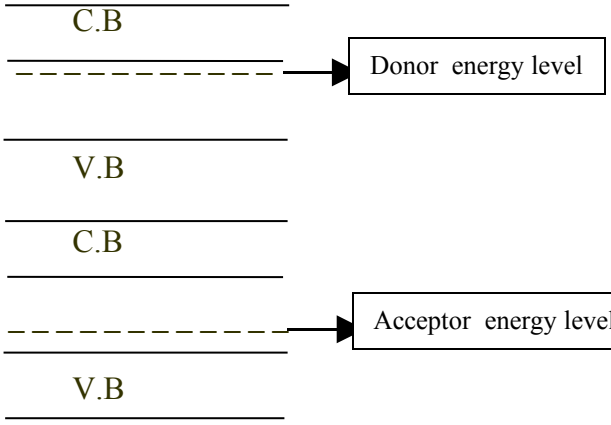
HINTS FOR ELECTRONIC DEVICES

1. Conductor - no energy gap
Semi Conductor - It is of the order of 1 ev.
Insulator - 6 ev (or) more than 6 ev.

2. When a semi conductor is heated more & more electrons get enough energy to jump across the forbidden energy gap from valence band to the conduction band, where they are free to conduct electricity. Thereby increasing the conductivity of a semi conductor.

3. In an intrinsic semi conductor the number of free electrons and holes is same.

4.



5.

6. About 0.3V germanium .About 0.67V for silicon.

7. Transistor is a current controlled devices.

8. Reverse biased.

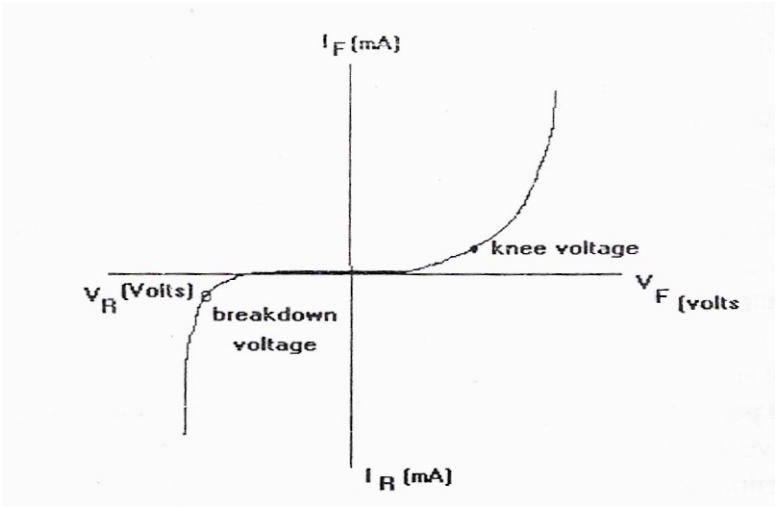
9.NAND GATE.

10.If $n_e/n_{h=1}$. Hence A is intrinsic semi conductor.
If $n_e/n_h < 1$, $n_e < n_h$ hence B is P-type.

11. For half wave rectification 50 Hz.
For Full wave rectification 100Hz.

12. Mobility of an electron is defined as the drift velocity of electron per unit electric field,
i.e. $\mu_{e=} V_e/E$
Mobility of a hole is defined as the drift velocity of hole per unit electric field,
i.e. $\mu_h = V_{h/E}$
The electrical conductivity(σ) is the reciprocal of resistivity (p), therefore
Conductivity, $\sigma = 1/\rho = e(n_e \mu_e + n_h \mu_h)$ Where n_e & n_h are free electron density & hole density respectively.

13. Diagram



14. The drift velocity of a charge carrier is proportional to electric E.

Therefore V = eET/m ie. V α E

But V cannot be increased indefinitely by increasing E . At high speed relaxation time (T) begins to decrease due to increase in collision frequency. S: so drift velocity saturates at thermal velocity (lOms^{-1}). An electric field of 10^6 V/m causes saturation of drift velocity. Hence semi- conduction obey ohm's law for low electrical field and above this field (E < 10^6 V/m) current becomes independent of potential.

15. The factors upon which transconductance of a transistor depend are as follows--

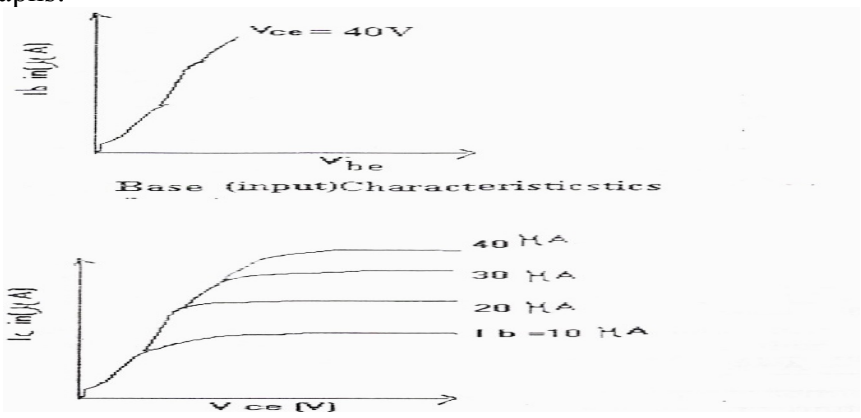
i) Geometry of the transistor

ii) Doping levels.

iii) Biasing of the transistors.

16. For faster action NPN Transistor is used .In an NPN transistor, current conduction is mainly by free electron ,whereas in PNP type transistor .it is mainly holes Since electron are more mobile than holes we prefer NPN for faster action as well as high conduction current.

17. graphs:



:

18. Because the energy gap for Ge (Eg = 0.7 ev) is smaller than the energy gap for Si (Eg = 1.1ev) . Moreover, the germanium diode is much more open to the danger of high temperature affect than silicon at high voltage.

19. The output of the AND gate is Y = A.B consequently the input of the OR gate are A and A.B . Then the final Y = A + A.B

Input for AND gate	Output of AND gate	Input of OR gate	output of OR gate

A	B	Y= A.B	A	Y	Y = A + Y
0	0	0	0	0	0
0	1	0	0	0	0
1	0	0	1	0	1
1	1	1	1		1

20. The output of OR gate is A+B. Consequently, the inputs of AND gate are A+B & C
Hence the Boolean equation for the given circuit is
Y=(A+B).C

A	B	C	Y'=A+B	Y=(A+B).C=Y'.C
0	0	0	0	0
0	0	1	0	0
0	1	0	1	0
0	1	1	1	1
1	0	0	1	0
1	0	1	1	1
1	1	0	1	0
1	1	1	1	1

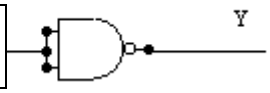
21) AND Gate using NAND GATE:-

A	B	Y= A.B
0	0	0
0	1	0
1	0	0
1	1	1

22. NOT gate using NAND gate:-
Truth Table:-

A	Y=$\overline{A}$
0	1
1	0

NAND acts as NOT gate



23. Here β=50

I_e=6.6mA

$\beta=I_c/I_b$

$I_c=\beta I_b = 50 I_b$

$I_e=I_c + I_b$

$I_b=0.129mA$

Hence,

$I_c = 50 \times 6.6/51 = 6.47mA$

$\beta = \alpha / (1 - \alpha)$

$\alpha = \beta / (1 + \beta)$

$\alpha = 0.98$

24. Here

$I_b = 100\mu A = 0.1mA$

$I_c = 3mA$

a) $\beta = I_c / I_b = 30$

$\beta = \alpha / (1- \alpha)$

$\therefore \alpha = 0.97$

$\alpha = I_c / I_e$

$\therefore Ie = 3.1$ mA

b) Δ Ib = 20μA 0.02 mA

$\beta a.c. = \Delta I_c / \Delta I_b$

$\beta a.c. = 25$

25. Here

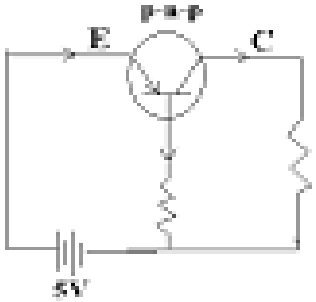
I_c=95% of Ie = (95 / 100) I_e

$I_e = (100 / 95) \times 5$ mA = 5.26mA

$I_e = I_c + I_b$

$I_b = 0.25$ mA

26. **Here**



Ie = 5mA

Ic = 4.75 mA

Ie = Ic + Ib

Ib = 75×10^{-5} A

V = Ib Rb

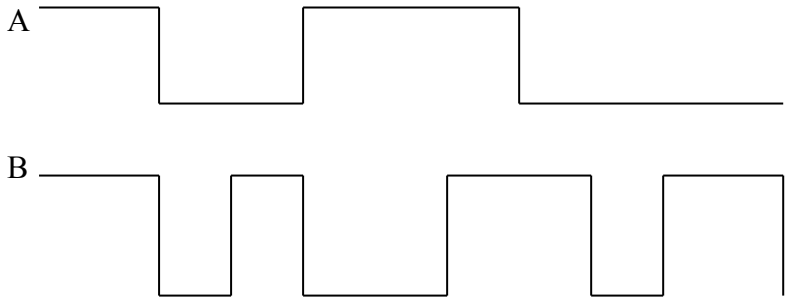
V = 5V

Rb = V / Ib

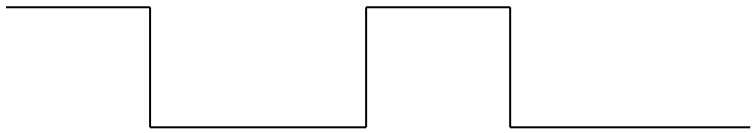
Rb = 6.67 kΩ

27. This is AND logic gate

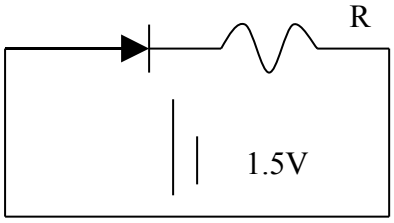
Output wave form



Y



28.



Here e.m.f of the source, E = 1.5V

Voltage drop across the diode , $V_d = 0.5V$

Maximum power rating of the diode

$I = (P / V_d)$

$I = 0.2A$

Potential drop across resistance R

$V = E - V_d$

$= 1V$

$R = V / I = 1 / 0.2 = 5\Omega$

29. $\alpha = 0.96$, $I_e = 7.2mA$

$\alpha = I_c / I_e$

$\therefore I_c = \alpha I_e = 6.91$ mA

$I_b = I_e - I_c$

$I_b = 0.29$ mA.

30. **$\beta = 70$**

$I_e = 8.8mA$

$I_e = I_c + I_b$

$\therefore I_b = 8.8 / 71$

$I_b = 0.124$ mA

31. **$Ib = 105 \times 10^{-6}$ A** **$Ic = 2.05 \times 10^{-3}$A**

$\beta = Ic / Ib = 19.5$

Also,

$Ie = Ib + Ic = 2.155 \times 10^{-3}$ A

$\alpha = Ic / Ie = 0.95$

$\triangle Ib = 27\mu A = 27 \times 10^{-6}$ A

$\beta = \triangle Ic / \triangle Ib = 24.1$

32. $\triangle Ie = 7.89 \times 10^{-3}$ A

$\triangle Ic = 7.8 \times 10^{-3}$ A

Now $\alpha_{a.c.} = \triangle I_c / \triangle I_e = 0.9886$

We have, $\beta_{ac} = \alpha_{ac} / (1-\alpha_{ac}) = 86.72$

Also,

$\beta_{ac} = \triangle I_c / \triangle I_b$

$\therefore \triangle I_b = \triangle I_c / \beta_{ac}$

$\triangle I_b = (7.8 \times 10^{-3}) / (86.72)$

$\triangle I_b = 89.94 \times 10^{-6}$A

UNIT-10
HINTS FOR COMMUNICATION SYSTEMS

1) In a radar, a beam signal is needed in particular direction which is possible if wavelength of signal waves is very small. Since the wavelength of microwave is a few millimeter, hence they are used in radar.

2 The television signals have frequencies in 100-200 MHz range. As ionosphere cannot reflect radio waves of frequency greater than 40 M back to earth, the sky waves cannot be used in the transmission of TV signals.

3) A diode detector should have the following characteristic for proper detection a) high rectification efficiency.

b) negligible loading effect on previous stage

c) low distortion.

4) Velocity factor (VF) of a cable is the ratio of reduction speed of light in the dielectric of the cable.

Velocity of light in vacuum is 3 $x10^8$ m/sec. It reduces when light passes through a medium. Velocity of light in a medium is given by

$v=c / \sqrt{k}$ & where, c-velocity of light in vacuum and

k- is the dielectric constant of the medium

$Vf. = v/c = l/\sqrt{k}$

For a line velocity factor is generally of the order of 0.6 to 0.9.

5) Delta modulation involves simple pulse coding and decoding methods. A simple delta modulation uses just one bit per sample i.e. a 'non-zero' sample or one per sample. Thus, this method is convenient to use.

6) Two wire transmission line and coaxial cable are employed for AF and UHF region. For optical fiber is employed for optical frequency.

7). Mixing two frequencies across nonlinear impedance.

8). When light strikeds the atoms of the Laser medium, it must stimulate emission rather than be absorbed. This means that more atoms must be in an excited state than in the ground state. This is an unnatural condition and is known as population inversion.

9). Solid Lasers, Semi conductor Laser, Liquid laser, Gas Laser.

10) Laser surgery ,Laser printing, Optical communication .

11) 1)Transmission System, 2) Switching Systems and 3) Signaling Systems.

12) 1 .The length of the antenna required is so large (L = 5000m) that is practically impossible
to set up it.

2 The energy radiated from the antenna in audio frequency range is Practically zero

3 The audio signals transmitted from the different broadcasting stations will get inseparably mixed.

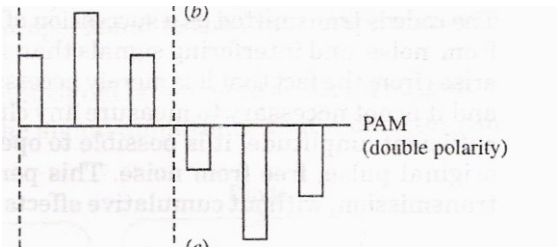
13) Pulse modulation is a system in which continuous wave forms are sampled at regular intervals. Information regarding the signal is transmitted only at the sampling times together with any synchronizing pulses that maybe required. Pulse modulation is the process of transmitting signals in the form of pulses (dis continuous signals) by using special techniques.

14) The term channel is commonly used to special the frequency range allotted to a particular transmission from a broadcast station or a transmitter eg a telephone channel is also used for a link in a transmitter and receiver.

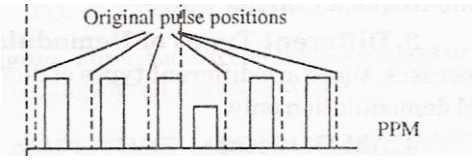
15) Atmospheric pressure decreases with in crease in altitude. The high energy particles (ie & rays and cosmic rays) coming from outer space and entering our earths atmosphere cause ionization of the atoms of the gases present there . The ionizing power of these radiation decreases rapidly as they approach the earth. due to decrease in number of collision with the gas atoms . It is due to this reason that the electrical conductivity of earths atmosphere increases with altitude
receives
the signal
16) Refractive index p of core of core of optical fibre is slightly higher than glass cladding . Light propagates through and along the fibre by the series of bounces caused by internal reflection at the interface of the core and cladding. For total internal reflection the light should enter the fibre at an angle θ in accordance with core of acceptance angle θ_c

$$NA = \sin\theta_c = \sqrt{(\mu_1^2 - \mu_2^2)}$$

Numerical aperature depends upon diameter of the core It decreases as the diameter of core decreases vice versa
17) i) Pulse Amplitude Modulation : Amplitude of the pulse varies in accordance with the modulating signal.



(ii) Pulse Position Modulation. : Pulse position (ie) time of rise or fall of the pulse) changes with the modulating signal.



.
18)Dielectric loss increase beyond this frequency.
19)How does the effective power radiated by the antenna vary with wavelength?

Power is inversely proportional to wave length
20)what should be the length of the dipole antenna for a carrier wave of 5 X 10^8hz ?

$L = c/2\nu$.

21) four times.
22) $d = \sqrt{2hR}$

$d = \sqrt{2} \times 0.1 \times 6400$

$= \sqrt{1280}$ km

Area covered by broadcaste, $A = \pi d^2 = 3.14 \times 1280$

$= 3919.2$ km^2

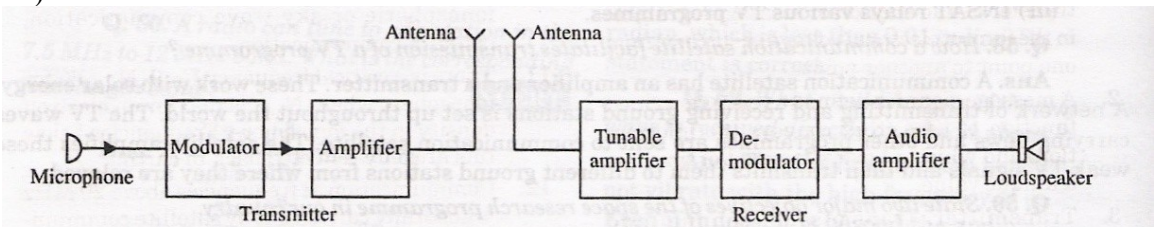
population covered = Area x population density

$= 3919.2 \times 1000 = 3919200$

23) (i) 5 MHz <fc sky wave propagation (ionospheric propagation).

(ii) 100 MHz > fc satellite mode of communication.

24)



25) Maximum voltage of AM wave,

$$V_{max} = \frac{16}{2} = 8mV$$

Minimum voltage of AM wave,

$$V_{min} = \frac{4}{2} = 2mV$$

$$m_a = \frac{V_{max} - V_{min}}{V_{max} + V_{min}}$$

$$= \frac{8-2}{8+2} = \frac{6}{10} = 0.6$$

26) The AM wave equation is given by ;

$$v = 5(1+0.6\cos 6280t)\sin 221 \times 10^4 t \text{ volts} \quad \ldots\ldots\ldots\ldots(i)$$

(i) Maximum amplitude of AM wave

$$= E_C + m_a E_C = 5 + 0.6 \times 5 = 8V$$

Minimum amplitude of AM wave

$$= E_C - m_a E_C = 5 - 0.6 \times 5 = 2V$$

(ii) The AM wave will contain three frequency viz

$f_c - f_s$,	f_c,	$f_c + f_s$
336-1	336	336+1
335kHz	336kHz	337kHz

27) (i) The AM wave has sideband frequency of $(f_c + f_s)$ and $(f_c - f_s)$.

Sideband frequency = (500+1) kHz and (500-1) kHz

501 kHz and 499 kHz

(ii) Bandwidth required = 499 kHz to 501 kHz = 2 kHz

28)

$$P_S = \tfrac{1}{2} m_a^2 P_C$$

$$1.246 = 1 + \frac{m_a^2}{2}$$

$$m_a^2/2 = 0.246$$

$$m_a = (2 \times 0.246)^{1/2} = 0.701 = 70.1\%$$

29) Modulation index ,

$$m_f = \frac{\text{Maximum frequency deviation}}{\text{Minimum signal frequency}}$$

30) $d = (2 \times 6400 \times 10^3 \times 160)^{1/2} = 45255m$

Coverage range, $d = (2Rh)^{1/2}$

$h_2 = 4h_1 = 4 \times 160 = 640m$

31) Radius of the area covered by TV broadcast is

$d = (2Rh)^{1/2}$

$= 37500m = 37.5\ km$

$= 4.4 \times 10^6$

32) Microwave communication channel width =

$\frac{2}{100} \times 10GHz$ $= 0.2$ GHz

band width of channel = 8 KHz

$= 2.5 \times 10^{4}$

33) Energy corresponding to $\lambda = 1400nm = 1400 \times 10^{-9}$ m is

$E = \frac{hc}{\lambda} = \frac{1.42 \times 10^{-19}}{1.6 \times 10^{-19}} eV = 1eV$

For detection E must be equal to greater then Eg. Hence only suitable semiconductor is C.

34) Critical frequency fc and maximum electron density nmax are related as

$fc = 9(nmax)^{1/2}$

Squaring we get $nmax = \frac{fc^2}{81}$

Given $fc = 10MHz = 10 \times 10^{6} = 10^{7}$ Hz

ie, $nmax = \frac{(10^{7})^2}{81} = 1.23 \times 10^{12} m^{-3}$

HINTS FOR HOTS-CLASS-XII(PHYSICS)
UNIT-1
HINTS FOR ELECTROSTAICS

1. In the dielectric medium between the plates.
2. High potential, as electrons are negatively charged.
3. Zero
4. Zero
5. $ML^{-1}T^{-2}$
6. Zero
7. No.
8. Because they are indicators of electric field, extending to infinite distance.
9. C is proportional to A (area) Therefore $C_2 = 2C_1$
   Since C = Q/V ,So the slope represents more capacitance. Hence P represents C_2,Q represents C_1
10. Each charge experiences two forces each of magnitude F inclined at an angle of 60^0.Their resultant is given by $[F^2 + F^2 + 2F^2\cos 60]^{1/2} = \sqrt{3}.F$
11. (i)According to defn of P.D.,
    $V_P > V_Q$ .So $V_P - V_Q$ is +ve for q>0.
    (ii)For q<0, $V_Q > V_P$ .So $V_P - V_Q$ is -ve
12. Flux = 0, since Qen = 0
13. Due to polaraisation,opposing electric field is created.
14. Electric field at the midpoint of a dipole of length 2a is 2kq/a pointing towards the –ve charge or in the
    direction opposite to the dipole moment.
15. Inside the cavity field at any point is uniform and non zero.
16. No. If the initial velocity of the charged particle makes a certain angle with a line of force, then the
    charged particle shall not move along the line of force.
17. $E = -dv/dr = -d(q/4\pi\varepsilon_0 r)/dr = q/4\pi\varepsilon_0 r^2$
18. Yes, at the mid point of electric dipole.
19. $U = kq^2/a - kq^2/2a - kq^2/2a = 0$.
20. C' = C+C+C = 3C = 75μF
    Therefore, charge = 75μF x 4200 V = 315 mC*
21. Total $\phi = q_0/\varepsilon_{o=2/}\varepsilon_{o,\rightarrow}$ flux through one face = $\phi/6 = 1/3\ \varepsilon_o$.
22. q →---------- Q
    $1/2mv^2 = kQq/r$
    Or, $v^2 \alpha\ 1/r$
    Or, $r \alpha\ 1/v^2$
    Or, r' = r/4
23. $V = V_1 + V_2$
    $Q = C_1V = 6 \times 10^{-6} \times 2 = 12\mu C$
    As C_2 is in series same amount of charge will also flow through it.
    Now $V_2 = Q/C_2 = (12 \times 10^{-6})/(12 \times 10^{-6}) = 1$ Volt
    Total battery Voltage,V = 2 + 1 = 3 Volt

24.Capacitance of parallel plate capacitor with air between the plates is $C_0 = \varepsilon_0 A/d$

When the separation between the plates reduced to half,

$C_1=\varepsilon_0 A/(d/2) = 2\varepsilon_0 A/d$

Thus final capacitance is C_2=10 X 8 pF=80 pF

25.The arrangement is of 5 capacitors in series.Therefore

$1/C' = (1/C) +(1/C) +(1/C) +(1/C) +(1/C) =(5/C)$

Therefore C'=C/5 Or 5=C/5 or C=25μF.

26. The charge given to a capacitor is given by q=CV

So the remaining energy,qV- 1/2 qV =1/2 qV is lost as heat

27. On equatorial line ,the direction of electric field is reversed to that of axial line. Hence the angle between

electric dipole moment& electric field strength is 180^0

28. Eq. network is the Eq.capacitance

= (2C series C) ‖ (2C series C)

=4C/3

29. $4/3\ \pi R^3 = 8 \times 4/3\ \pi r^3$

30. $dV = -E \cdot dx = -2 \times 10^3 \times 4\ V = -8 \times 10^3\ V$

$E = E_1 - E_2 = Q_1 - Q_2/2A\ \varepsilon_o$

Now, $V1 - V2 = E \cdot d = Q_1 - Q_2/2C$

32. $U = k\ (q^2/a + qQ/a + qQ/\sqrt{2}a)$

But, U = 0

Therefore, $Q = -2q/(2 + \sqrt{2})$

33. $E= q/4\pi\varepsilon_{0[1+1/4+1/16+1/64]} = q/3\pi\varepsilon_0$.

34. Let q & q' be the charges on inner and outer sphere.

Hence $q/4\pi r^2= q'/4\pi R^2$

$q=Qr^2/(R^2+r^2)$ & $q'=Q-q=Q- (Qr^2/R^2+r^2)$

Now potential at O is given by

35 (i) Dipole has two equal and opposite charges. In the uniform electric field they will experience equal and

opposite force. Net force is zero. So there can't be any translatory motion.

(ii) Torque, $\tau = r \perp F=2l \sin\theta\ qE = p \times E$

Torque experienced by the dipole will rotate it.So the direction of the torque will be outward from the

surface.

36. We have $V=ar^2+b$

The electric field,$Er = - dV/dr=-2ar$-------(1)

From Gauss theorem, $\int E.dS=q/\varepsilon_0$, where S is the spherical surface containing the charge q

Or $E.4\pi r^2=(1/\varepsilon_0)(4\pi/3)\ r^3\rho$-------(2)

From 1 and 2 $\rho=-6\pi\varepsilon_0$

UNIT-2

HINTS FOR CURRENT ELECTRICITY.

1. They have high resistively and low temperature coefficient of resistance.
2. $22*10^2\ \Omega\ \pm 10\%$
3. Resistively remains the same.
4. As Vd α V.

The different velocity will be doubled.

5. $R=\rho(l/A)$

$= \rho(l^2/Al)$

$= \rho l^2/V$)

since, ρ and V are constants

therefore, R α l^2

➔ $(R_2/R_{1)} = (l_2/l_1)^2=9$

because $R_2=9R_1$

$=9*10=90\ \Omega$

6. Now, $1/R=1/R_1+1/R_2$

because l = 48/240 = 0.2 m

7. a) in parallel, power dissipation α 1/R

Therefore 3Ω wire will dissipate more power

b) In series , power dissipation α R

Therefore 9Ω wire will dissipate more power

8. $R_{100}/R_{27.5} = (1+100\alpha)/(1+27.5\alpha)$

On solving, we get

$\alpha = 0.0039/^{\circ}c$

9. Superconductors are the materials that lose all its resistance at very low temperature =0 K

Application:

Super conductor are used

b) In making very strong electromagnets

b) In producing very high speed computers .

10. Resistivity of copper is less , hence manganin wire is thicker.
11. High value of resistivity and low value of temperature coefficient.
12. Resistivity will be unchanged because it depends upon nature of the materials.
13. B is more sensitive.
14. Reduced by half.
15. Relaxation time decreases with increase of temperature.
16. Increase in heat.
17. Reistance remains same.
18. Pα 1/R. (i.e) 25Watts
19. 16 times of the original reisitance.
20. (i)Series - Iron

(ii)Parallel - Copper.

21. R = ρ L/A.

(i.e) 10.25%

22. Parallel(i.e) R.
23. 1:4.
24. 2:1
25. R.

Unit-5

HINTS FOR EM WAVE.

1. Due to change in electric field.

3. Same as velocity of light.

4. 90 degree

6. ɣ rays, radio waves, X-rays, UV rays

7. i)X-rays

ii)microwave.

8. doubled

9. Charge.

10..Increases.

11. Gauss's law

13. X-rays because $\lambda = 0.825A^{o}$

14. Micro waves

15.By varying potential difference.

16. Ex and By.

UNIT-6

ANSWER KEY FOR OPTICS

1.Ans:Wavelength

2. Ans:Photo electric effect.

3. Ans:4NL.

4. Ans: It will turn gradually blue.

5. Ans:Zero.

6. Ans:90^{o}.

7. Ans:$\mu_{o} = \mu_{e}$

8. Ans:90^{o}

9. Ans:Violet.

10. Ans: Shrinks.

11. Ans.(i) The upper part of the mirror is convex.

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

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

12. Ans. The ray of light bends away from the normal.

13. Ans.

As μ = sini/sinr = c/v or v = sinr/sini *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 $\sin 15° < \sin 25° < \sin 35°$.

$\therefore v_A < v_B < v_C$.

i.e. the velocity of light is minimum in medium A.

14 Ans.For i = 90°, lateral shift is maximum and is equal to the thickness of the slab.

$d = t \sin(i – r)/ \cos r$

$d_{max} = t \sin(90° - r)/\cos r = t \cos r/\cos r = t.$

15. Ans.The apparent shift caused by a slab of thickness 't' is given by

$d = t(1 - 1/\mu)$

As the refractive index of the galass is maximum for red light, so red coloured letters are more raised up.

16. Ans. No Apparent depth is maximum for that part of the bottom of the tank which is observed normally. Apparent depth decreases with increasing obliquity. Due to this unequal refraction, the flat bottom of the tank appears concave.

17. Ans. For glass-air interface, $\sin i_c = 1/{}^a\mu_g$

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

$$\text{Sin } i'_c = 1/ {}^w\mu_g$$

Now ${}^w\mu_g < {}^a\mu_g$,

$$\text{Sin } i'_c > \text{Sin } i_c \quad \text{or } i'_c > i_c$$

18. Ans. Light entering water is totally reflected from the air bubble. For the observer, this light appears to come from the buble. So it shines.

19. Ans. 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 a transparent oil.

20. Ans. It behaves like a biconvex lens.

21. Ans. Air bubble has spherical surface and is surrounded by medium (water) of higher refractive index. When light passes from water to air it gets diverged. So air bubble behaves as a concave lens.

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

23. Ans. 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 interchangeR_1 and R_2, the magnitude of 'f' remains the same.

24. Ans. focal length'f' of a convex lens is related to its refractive index as

$f \propto 1/(\mu -1)$

As ${}^{w}\mu_g < {}^{a}\mu_g$, so focal length of a convex lens will increase when it is immersed in water.

25. Ans.Focal length, $f \propto 1/(\mu -1)$

As $\mu_R < \mu_V$, so the focal length of a convex lens will increase when red light is used.

26. Ans:For the original lens: $R_1 = +R$ and $R_2 = -R$, so we can write

$1/f = (\mu -1) [1/R +1/R] = 2(\mu -1)/R.$

When one surface is made plane by grounding, we have $R_1 = +R$ and $R_2 = - \infty$.

Therefore, $1/f' = (\mu -1) [1/R +1/\infty] =(\mu -1)/R$

$\therefore$ f ' / f = 2 or f ' = 2f

Thus the focal length becomes double and power becomes one –half.

27. Ans. When the prism is held in water,

${}^{w}\mu_g = \text{Sin } (A + \delta m/2) / \text{Sin} A/2$

As ${}^{w}\mu_g < {}^{a}\mu_g$, so the angle of minimum deviation decreases in water.

28. Ans. Total internal reflection.

29. Ans. The sunlight will not be scattered in the absence of atmosphere. So the sky will appear dark.

30. Ans. Clouds have large particles like dust and water droplets which scatter light of all colours almost equally, hence clouds generally appear white.

31Ans. When the sun or the moon is seen through a thin veil of high clouds, holes are seen. These are formed due to reflection of light by the icy crystals present in the atmosphere.

32. Ans. Ultra-violet light has wavelength shorter than that of violet light. Bees have some retinal cones that are sensitive to ultra violet light, so they can see objects in ultra-violet light. Human eyes do not posses retinal cones sensitive to ultra-violet light, so human beings cannot see objects in ultra-violet light. In other words, human beings are ultra-violet blind.

33. Ans. In a chicken's eye, the retina has a large number of cones but only few rods. The rods are sensitive to bright light only. That is why a chicken is not able to see in dim light. As it needs bright light to see, so it wakes up early in the morning with the sunrise and goes to sleep by sunset.

34. Ans. Magnifying power of a simple microscope ,

$$m = 1 + D/f$$

as $f_V < f_R$ so the magnifying power is greater when the object is seen in violet light.

35. Ans. This is done so that the objective lens forms image within the focal length of the eyepiece.

36. Ans. (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.

37. Ans. Yes, because the light gathering power of objective will increase and even faint objects will become visible.

38. Ans. For relaxed eye,

$$L = f_0 + f_e \text{ (normal adjustment)}$$

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.

SHORT ANSWER TYPE QUESTIONS

39. Ans. Here $u = -(f+a)$, $v = -(f+b)$, $f = -f$

As $1/f = 1/u + 1/v$

$F = uv/ u + v$

Or $-f = [-(f+a)] \times [-(f+b)] / -(f+a) - f(a+b)$

$= f^2 + af + bf + ab / -(2f+a+b)$

or $2f^2 + af + bf = f^2 + af + bf + ab$

or $f^2 = ab$

40.Ans. (i) Angle of refraction ($\theta/2$) in medium 2 is less than the angle of incidence (θ) in medoum 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,

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

Also $\mu = c_1 / c_2$

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

41. Ans. The point of convergence shifts away from the glass, as shown in the ray diagram given below. The screen has to be moved towards right to receive the point of convergence again.

42. Ans. Real depth = y cm

Apparent depth = y- x cm

Refractive index of oil,

μ = real depth/ apparent depth = y / y-x

43. Ans. Using Snell's Law for refraction from glass to air,

$\text{Sin } i/\sin r = {}^{g}\mu_a = v / c$

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

$\text{Sin } i_c/ \sin 90^0 = v / c$ or $\text{Sin } i_c = v / c$

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

44. Ans. **Twinkling of stars.** The light from stars undergoes refraction continuously before it reaches earth. So the apparent position of the stars is slightly different than its actual position. Due to variation in atmosphere conditions, like change in temperature, density etc., and this apparent position keeps on changing. The amount of light entering our eyes from a particular star increases and decreases randomly with time. Sometimes, the star appears brighter and other times, it appears fainter. This gives rise to the twinkling effect of stars.

The planets do not show twinkling effect. As the planets are much closer to the earth, the greater and the fluctuations caused in the amount of light due to atmospheric refraction are negligible as compared to the amount of light received from them.

45. Ans. 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.

46. Ans. Magnification produced by any lens,

$m = v/u = f / f + u$

given $m = \pm N$ $\pm N = f / f + u$

or $f + u = \pm f / N$ or $u = - f \pm f / N$

hence magnitude of object distances,

$|u| = f \pm f / N$

given $P = 1/f = + 2.5$ D

$f = 1/ 2.5 = 0.4$ m = 40 cm
Also $N = 4$
$|u| = 40 \pm 40/4 = 40 \pm 10 = 50$ cm or 30 cm.

47. Ans.
(a) for a convex lens, f>>0 and for an object on left, u<0. when the object is placed within the focus of a convex lens,

$0 < |u| < f$ or $0< 1 / |u| > 1/f$
$1/v = 1/f+1/u=1/f-1/|u|<0$

i.e. $v < 0$ so a virtual image is formed on left.
Now as u<0 and v<0, so $1/v = 1/f + 1/u$

$= - 1/ |v| = 1/f – 1/|u|$ or $1/|u| - 1/|v| = 1/f$
As f>0
$1/|u| - 1/|v| > 0$ or $1/|u| > 1/|v|$ or $|u|<|v|$
i.e. $|v|>|u|$ $|m| = |v/u| > 1$

Hence image is enlarged.
(b) For a concave lens $f<0$ and for an object on left, $u<0$

$1/v = 1/f + 1/u = 1/|f| - 1/|u|$

$= - [1/|f|+1/|u|] < 0$ for all u.

i.e. $v<0$ for all values of u. hence a virtual image is formed on the left.

Also $1/|v| = 1/|f| + 1/|u|$ $1/|v| > 1/|u|$

Or $|v|<|u|$ $|m| = |v/u| < 1$

i.e. the image is diminished in size.

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

49. Ans. (i) Moon has no atmosphere. There is no scattering of light. Sunlight reaches moon 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. No 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 no rains on the moon. So rainbow is never observed.

NUMERICAL PROBLEMS

50. Ans. The total apparent shift in the position of the image due to all the three media is 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

51. Ans. Clearly , the fish can see the outside view of the cone with semi vertical angle,

But $\mu = 1 / \sin i_c$

Or $1/3 = 1 / \sin i_c$

Or $\sin i_c = ¾ = 0.75$

$\theta/2 = i_c = \sin^{-1}(0.75) = 48.6^0$

52. Ans. (i) As the lens forms a real iamge, it must be a convex lens.

(ii) From the graph, when u=20 cm , we have v = 20 cm.

For the convex lens forming a real iamge, u is negative and v and f are positive.

U = -20 cm v = +20cm

Using this lens formula,

$1/f = 1/v - 1/u = 1/20 - 1/-20 = 1/10$ or $f = +10$ cm

53. Ans. $A=60^0$, $\delta_m=30^0$

$i = e = ¾ A = 45^0$,

as $A + \delta = i + e$

$60 + \delta = 45 + 45$

or $\delta = 30^0$

Refractive index,

$\mu = \sin a+\delta_m /2 /\sin A/2 = \sin 60^0+30^0/2 / \sin 60^0/2$

$= \sin 45^0/\sin 30^0 = 1/\sqrt{2} / ½ = \sqrt{2} = 1.414$

WAVE OPTICS

54. Ans. Two light sources will be coherent if

(i) The frequency of the two light sources is same and,

(ii) The phase difference between them remains constant.

55. Two independent light sources cannot act as coherent sources. Why?

Ans. Two independent sources of light cannot be coherent. This is because light is emitted by individual atoms, when they return to ground state. Even the smallest source of light contains billions of atoms which obviously cannot emit light waves in the same phase.

56. Ans. Fringe width , $\beta = \lambda D/d$

i.e. $\beta \propto 1/d$, when $d \to 0, \beta \to \infty$

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

57. Ans. The given path difference satisfies the condition for the minimum of intensity for yellow light, Hence if yellow light is used, a dark fringe will be formed at the given point. If white light is used, all components of white light except the yellow one would be present at this point.

58. Ans. 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.

59. Ans. 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.

60. Ans. Muslin cloth is mde of very fine threads and as such fine slits are formed. White light passing through these silts gets diffracted giving rise to colored spectrum. The central maximum is white while the secondary maxima are coloured. This is because the positions of secondary maxima (except central maximum) depend on the wavelength of light.

In a coarse cloth, the slits formed between the threads are wider and the diffraction is not so pronounced. Hence no such spectrum is seen.

SHORT ANSWER QUESTIONS

61. Ans. 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.

The wavefronts of light emerging from a point source are spherical, as shown in figure. When a point source is placed at the focus of a convex lens, the emerging light has the plane wavefronts, as shown in figure.

62. Ans. As shown in figure the bright fringes B1 and b2 on either side of O coincide with S1 and S2 respectively.

Clearly ,

$$\beta = d/2$$

As $\beta = D\lambda/d$ $d/2 = D\lambda/d$ or $\lambda = d^2/2D$

63Ans. For intensity distribution of light in diffraction at a signal slit, see figure

Width of central maximum is given by

$$\beta_0 = 2D\lambda/d$$

(i) When wavelength of light λ 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.

64. Ans. When 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 $\propto$ 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.

65. Ans. R.P.of a compound microscope

$= 2\mu \sin\theta/\lambda = 2\mu \sin\theta \times v/c$

(i)When the frequency v of the incident light increases, the resolving power increases (R.P. $\propto$ v).

(ii) Resolving power does not change with change in focal length of objective lens.

(iii) When the aperture of the objective lens increases, the semi-vertical angle θ increases and hence the resolving power of the microscope increases.

66. Ans. According to the Brewster law, when a ray of light is incident on a transparent refracting medium at olarising angle,

$$\mu = \tan i_p$$

but $i_{p+rp} = 90^0$ or $i_p = 90^0 - r_p$

$$\mu = \tan(90^0 - r_p) = \text{Cot } r_p = 1/\tan r_p$$

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

$$\mu = 1/\sin i_c$$

on comparing (i) and (ii) we get

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

NUMERICAL QUESTIONS

67. Ans. The resultant intensity at a point where phase difference is Φ is

$$I_R = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos\Phi$$

As $I_1 = I$ and $I_2 = 4I$ therefore

$I_R = I + 4I + 2\sqrt{1.4I} \cos\Phi = 5I + 4I \cos\Phi$

(i) when $\Phi = 0$, $I_R = 5I + 4I \cos 0 = 9I$

(ii) when $\Phi = \pi/2$, $I_R = 5I + 4I \cos \pi/2 = 5I$

(iii) when $\Phi = \pi$, $I_R = 5I + 4I \cos \pi = I$

68. Ans. The fringe width in the two cases will be $\beta = D\lambda/d$

And $\beta' = D'\lambda/d$

$\beta - \beta' = (D-D')\lambda/d$

or wavelength $\lambda = (\beta - \beta')d / (D-D')$

But $D-D' = 5 \times 10^{-2}$ m

And $\beta - \beta' = 3 \times 10^{-5}$ m , d= 10^{-3}m

$$\lambda = 3 \times 10^{-5} \times 10^{-3} / 5 \times 10^{-2} = 6 \times 10^{-7} \text{ m} = 6000\text{A}$$

69. Ans. Let I be the intensity of beam I incident on first glass plate. Each plate reflects 25% of light incident on it and transmits 75%.

Therefore,

$I_1 = I$ and $I_2 = 25/100 I = I/4$

$I_3 = 75/100\ I = 3/4I$

$I_4 = 25/100\ I_3 = ¼ \times ¾\ I = 3/16\ I$

$I_5 = 7/100\ I_4 = ¾ \times 3/16\ I = 9/64\ I$

Amplitude ratio of beams 2 and 5 is

$R = \sqrt{I_2/I_5} = \sqrt{I/4 \times 64/91} = 4/3$

$I_{min}/ I_{max} = [r-1/r+1]^2 = [4/3-1 / 4/3+1]^2 = 1/49 = 1:49$

UNIT-7

HINTS FOR DUAL NATURE OF MATTER

1. $E = h\nu$

$= hc/\lambda$

$E \propto 1/\lambda$ energy of proton reduces to half.

2. Alkali metals have too low work functions. Even visible light can eject electrons from them.
3. UV are most effective since they have highest frequency hence more energetic.
4. Yes. X-rays cause photoelectric effect in sodium, zinc & copper.
5. K.E of photons remains unaffected since they do not depend
6. stopping potential $V_0 = K_{max}/e = 5ev/e = 5$ V
7. $w_0 = h\nu_0 = hc/\lambda_0$

$\therefore \lambda_0 \propto 1/ w_0$

Since sodium has lower work functions than copper it is easier for electron ejection.

As it is lower work function, higher wavelength.

8. Photocells are used for reproduction of sound.
9. $1/2\ mv^2 = (m^2 v^2)/2m = p^2/2m$

According to De Broglie wave length $\lambda = h/p$

$\lambda_e/ \lambda_p = p_p/p_e = \sqrt{(m_p/m_e)}$

$m_e < m_p$

$\lambda_e > \lambda_p$

electrons have greater De broglie wavelength than proton .

10. $\theta = 90 - \phi/2$

$= 90 – 52/2 = 64°$

11. $E = hc / \lambda$

$= 3.3 \times 10^{-19}$ J

12. KE of photoelectrons is given by Einstein's photoelectric equation.

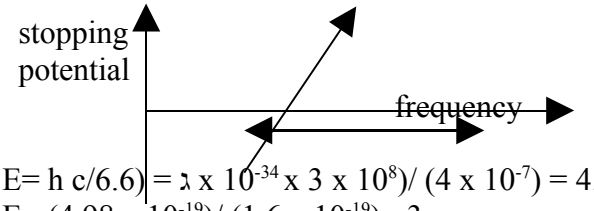
$E_k = 1/2\ mv^2$

$= h \upsilon - w_0$

$V \alpha 1/\sqrt{\lambda}$

As wavelength decreases velocity increases.

13.



14. $E= h c/6.6) = ג \times 10^{-34} \times 3 \times 10^{8})/ (4 \times 10^{-7}) = 4.98 \times 10^{-19}$ j

$E= (4.98 \times 10^{-19})/ (1.6 \times 10^{-19}) =3$ev

Hence, metal x will emit electrons.

15. For a photon $E_1=hc/ג$

For an electron $ג=h/mv$ or $m=h/גv$

$E_2/E_1=c/v>1$

Therefore,$E_2>E_1$.thus, electron has total energy greater than that of photon.

16. $ג_{ph}=ג_e=ג=h/mv$

K.E. of electrons $E=1/2mv^2=1/2\ m\ [h/m\ ^2[ג$

$=h^2/2m\ ^2\ ג$

$\therefore E_{ph}=E_e(2mc\ ג/h)$

17 . $E=1/2\ mv^2=m^2v^2/2m=p^2/2m \quad \therefore p=\sqrt{2Em}$

$\therefore ג=h/p=h/\sqrt{2Em}$

From Kinetic theory of gases average K.E.=3/2 KT

$ג=h/(\sqrt{2m(3/2\ KT)}=h/(\sqrt{3m\ KT})$

18. The energy of light obtained from the bulb is much less than work function of the wodden block.Hence no photon electrons are emitted.

19. Mo will not emit photo electron , because its work function is more than 4 ev.

20. Alpha particles due to its largest mass.

21. $R \alpha 1/q$

22. $Ee = Mv^2/r$

23. $\lambda = \lambda/\sqrt{2}$.

24. $\lambda/2$.

25. $\lambda = hc/\Phi = 2823$ $\mathring{A}$.

UNIT-8
HINTS FOR ATOMS AND NUCLEI.

1) The entire positive charge and the mass were concentrated at one place inside the atom, called the nucleus.

2) A larger number of alpha particle went through undeflected.

3) $R=R_0A^{1/3} \quad R_1/R_2=A_1^{1/3}/A_2^{1/3}=1\ ^{1/3}/27\ _{1/3}=1/3$

4) $R= R_0A^{1/3} \quad R_1/R_2=A_1^{1/3}/A_2^{1/3}=(1/8)^{1/3}=1/2$

$R_1: R_2=1:2$

5) α-particles have more ionizing power than β-particles.

6) $N/N_0=(1/2)^n$

$t=2T=2*30=60$ days

7) They are neutral in nature and get absorbed by nucleus, thus distributing the neutron proton ratio.

8) The ratio of neutrons to proton ratio increases, after the emission of a ά – particle.

9) Owing to greater mass and charge, it is able to knock out/pull out electrons which colliding with atoms and molecules in its path.

10) T = 20 minutes t = 60 minutes

N/No = (1/2)n = (1/2)60/20 = (1/2) 3 =1/8

After one hour, $1/8^{th}$ of the original mass would remain.

11) The nucleus looses energy, but remains same isotope it was.

12) No a nucleus either emits a ά – particle or a β – particle and if left in the exited state, it may emit γ – ray also.

13) 1:1 (independent of A).

14) At t = T ½ N = No / 2 Using $N = No\ e^{-\lambda t}$

$No / 2 = No\ e^{-\lambda t\ ½}$

Solving we get, $T1/2 = \ln 2/\lambda = 0.693/\lambda$

15) Size of nucleus can approximately be estimated using the concept of distance of closest approach. The rebounding particle is selected and its information is substituted in the expression Ro = 1/4πEo x 2Ze2 / E for ά particle where E is its energy.

B. Using N =No (1/2)t/π/2 N =1/16No

1/16 = ½(1/2)t/π/2

T1/2 = 30/4 = 7.5 days.

17) 235 = 142+Y+3

Y = 90

And 92 = 57+Z+0

Z = 35

18) a) Yes. Since X & Y are having same atomic number.

b) $Y^4{}_3$ is likely to be more stable because for its neutron to proton ratio is smaller.

19) Disintegration constant λ =0.693/T1/2

=0.693/30x24x60x60

Therefore T avg =1.44xT1/2 = 1.44x30 = 43.2 days.

20) Remaining amount (undecayed) $=1/4N_0$

Using $N= N_0 (1/2)^{t/T1/2}$

$1/4= (1/2)^{t/60}$

Solving t=2x60=120days

21) Mass defect Δm= (22.9945-22.9898) =0.00474

Energy Q= (0.00474) (931.5)

=4.4MeV

Hence the energy of beta particle can range from 0 to 4.4MeV.

22) a) Using $R=R_0e^{-\lambda t}$

$2700=4750\ e^{-5t}$

$\lambda=0.113min^{-1}$

b) Using $T_{1/2}=0.693/\lambda =0.693/0.113 =6.132min$

23) In the process of beta decay, a neutron gets converted to proton inside the nucleus . Hence number of neutrons decreases by one whereas number of proton increases by one. Hence n/p ratio decreases.

$^{210}Bi_{83}$----------→ $^{210}Po_{84} + {}^{0}\beta_{-1} + \gamma$

Before decay =127/83

After decay=126/84

24) Let λ and λ' be the decay constant of element A and B respectively. Given is

$T_{1/2}(A) = T_{1/2}(B)$

0.693/λ=1/ λ' or λ/ λ' =0.693

Let N be the number of atoms of each of the two samples and R and R' their disintegration rate, then

R/R'= λN/ λ'N= λ/ λ'=0.693

→R' > R

25) Find Δm using

Δm= (7x1.00783+7x1.00867-14.003074) U

Calculate ΔE_b=Δmx931.5 MeV

26) a) $^{226}Ra_{88}$----------→$^{222}Rn_{86} + {}^{4}He_{2}$

b) $^{32}P_{15}$----------→$^{32}S1_{6} + {}^{0}e_{-1} + \gamma$

c) $^{32}P_{15}$----------→$^{11}B_{5} + {}^{0}e_{+1} + \gamma$

27) i) $^{6}Li_{3} + {}^{1}n_{0}$ ----------→$^{3}H_{1} + {}^{4}He_{2}$ +Q (energy)

ii) Q=Δmx931 MeV

Where Δm=6.01512+1.0086654-4.0026044-3.0100000

UNIT-9

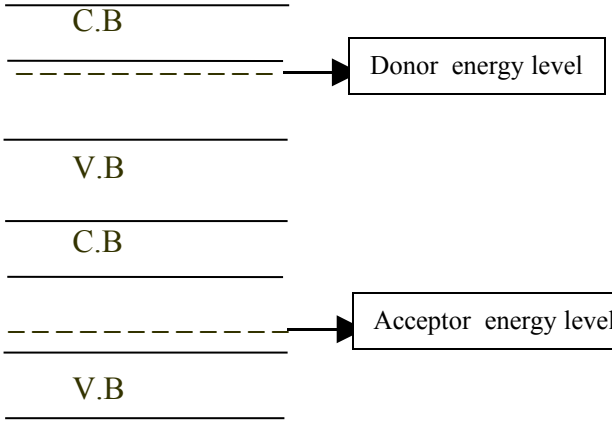
HINTS FOR ELECTRONIC DEVICES

1. Conductor - no energy gap
Semi Conductor - It is of the order of 1 ev.
Insulator - 6 ev (or) more than 6 ev.

2. When a semi conductor is heated more & more electrons get enough energy to jump across the forbidden energy gap from valence band to the conduction band, where they are free to conduct electricity. Thereby increasing the conductivity of a semi conductor.

3. In an intrinsic semi conductor the number of free electrons and holes is same.

4.



5.

6. About 0.3V germanium .About 0.67V for silicon.

7. Transistor is a current controlled devices.

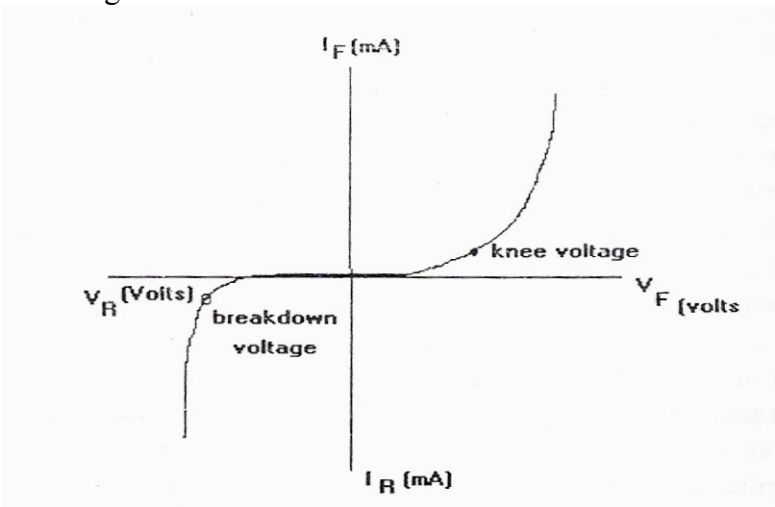
8. Reverse biased.

9.NAND GATE.

10.If $n_e/n_h = 1$. Hence A is intrinsic semi conductor.

If $n_e/n_h < 1$, $n_e < n_h$ hence B is P-type.

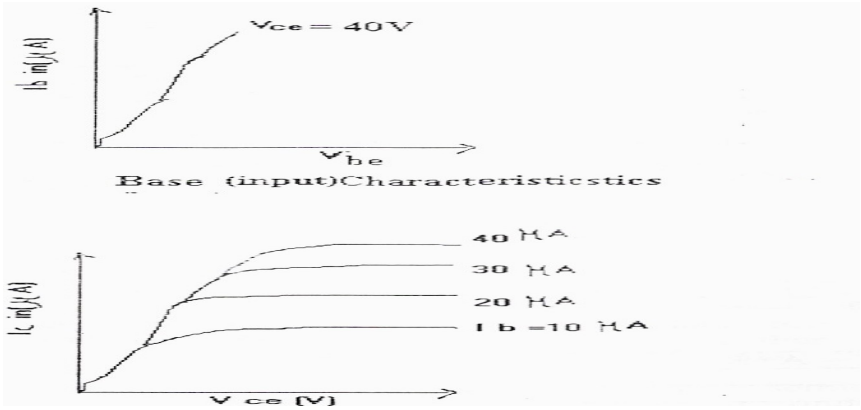
11. For half wave rectification 50 Hz.
For Full wave rectification 100Hz.
12. Mobility of an electron is defined as the drift velocity of electron per unit electric field,
i.e. $\mu_{e=} V_e/E$
Mobility of a hole is defined as the drift velocity of hole per unit electric field,
i.e. $\mu_h = V_{h/E}$
The electrical conductivity(σ) is the reciprocal of resistivity (p), therefore
Conductivity, $\sigma = 1/\rho = e(n_e \mu_e + n_h \mu_h)$ Where n_e & n_h are free electron density & hole density respectively.
13. Diagram



14. The drift velocity of a charge carrier is proportional to electric E.
Therefore V = eET/m ie. V α E
But V cannot be increased indefinitely by increasing E . At high speed relaxation time (T) begins to decrease due to increase in collision frequency. S: so drift velocity saturates at thermal velocity ($lOms^{-1}$). An electric field of 10^6 V/m causes saturation of drift velocity. Hence semi- conduction obey ohm's law for low electrical field and above this field ($E < 10^6$ V/m) current becomes independent of potential.

15. The factors upon which transconductance of a transistor depend are as follows--
i) Geometry of the transistor
ii) Doping levels.
iii) Biasing of the transistors.
16. For faster action NPN Transistor is used .In an NPN transistor, current conduction is mainly by free electron ,whereas in PNP type transistor .it is mainly holes Since electron are more mobile than holes we prefer NPN for faster action as well as high conduction current.
17. graphs:

:



18. Because the energy gap for Ge (Eg = 0.7 ev) is smaller than the energy gap for Si (Eg = 1.1ev) . Moreover, the germanium diode is much more open to the danger of high temperature affect than silicon at high voltage.

19. The output of the AND gate is Y = A.B consequently the input of the OR gate are A and A.B . Then the final Y = A + A.B

Input for AND gate		Output of AND gate	Input of OR gate		output of OR gate
A	B	Y= A.B	A	Y	Y = A + Y
0	0	0	0	0	0
0	1	0	0	0	0
1	0	0	1	0	1
1	1	1	1		1

20. The output of OR gate is A+B. Consequently, the inputs of AND gate are A+B & C
Hence the Boolean equation for the given circuit is
Y=(A+B).C

A	B	C	Y'=A+B	Y=(A+B).C=Y'.C
0	0	0	0	0
0	0	1	0	0
0	1	0	1	0
0	1	1	1	1
1	0	0	1	0
1	0	1	1	1
1	1	0	1	0
1	1	1	1	1

21) AND Gate using NAND GATE:-

A	B	Y= A.B

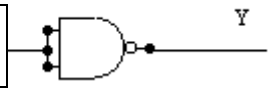
0	0	0
0	1	0
1	0	0
1	1	1

22. NOT gate using NAND gate:-

Truth Table:-

A	$Y=\overline{A}$
0	1
1	0

NAND acts as NOT gate



23. Here $\beta=50$

$I_e=6.6mA$

$\beta=I_c/I_b$

$I_c=\beta I_b = 50I_b$

$I_e=I_c + I_b$

$I_b=0.129mA$

Hence,

$I_c = 50 \times 6.6/51 = 6.47mA$

$\beta = \alpha / (1 - \alpha)$

$\alpha = \beta / (1 + \beta)$

$\alpha = 0.98$

24. Here

$I_b = 100\mu A = 0.1mA$

$I_c = 3mA$

a) $\beta=I_c / I_b = 30$

$\beta = \alpha / (1- \alpha)$

$\therefore \alpha = 0.97$

$\alpha = I_c / I_e$

$\therefore Ie = 3.1$ mA

b) $\Delta Ib = 20\mu A$ 0.02 mA

$\beta a.c. = \Delta I_c / \Delta I_b$

$\beta a.c. = 25$

25. Here

I_c=95% of Ie = (95 / 100) I_e

$I_e = (100 / 95) \times 5$ mA = 5.26mA

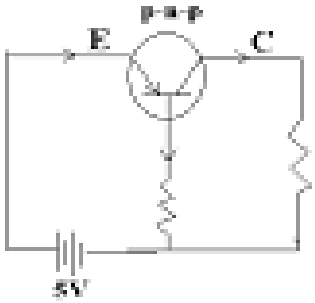
$I_e = I_c + I_b$

$I_b = 0.25$ mA

26. **Here**

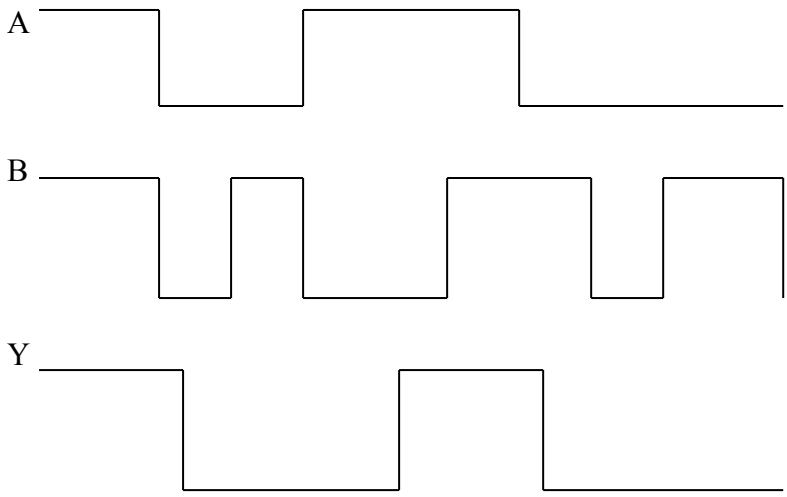
Ie = 5mA

Ic = 4.75 mA

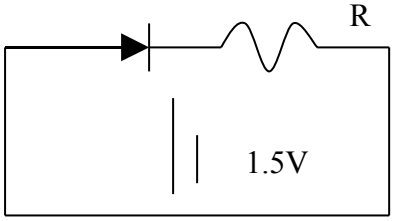


$Ie = Ic + Ib$
$Ib = 75 \times 10^{-5}$ A
$V = Ib\ Rb$
$V = 5V$
$Rb = V / Ib$
$Rb = 6.67\ k\Omega$

27. This is AND logic gate
Output wave form



28.



Here e.m.f of the source, $E = 1.5V$
Voltage drop across the diode , $V_d = 0.5V$
Maximum power rating of the diode
$I = (P / V_d)$
$I = 0.2A$
Potential drop across resistance R
$V = E - V_d$
$= 1V$
$R = V / I = 1 / 0.2 = 5\Omega$

29. $\alpha = 0.96$, $I_e = 7.2mA$
$\alpha = I_c / I_e$
$\therefore I_c = \alpha I_e = 6.91$ mA
$I_b = I_e - I_c$
$I_b = 0.29$ mA.

30. **$\beta = 70$**
$I_e = 8.8mA$
$I_e = I_c + I_b$
$\therefore I_b = 8.8 / 71$
$I_b = 0.124$ mA

31. **$I_b = 105 \times 10^{-6}$ A $I_c = 2.05 \times 10^{-3}$A**

$\beta = I_c / I_b = 19.5$

Also,

$I_e = I_b + I_c = 2.155 \times 10^{-3}$ A

$\alpha = I_c / I_e = 0.95$

$\triangle I_b = 27\mu A = 27 \times 10^{-6}$ A

$\beta = \triangle I_c / \triangle I_b = 24.1$

32. $\triangle I_e = 7.89 \times 10^{-3}$ A

$\triangle I_c = 7.8 \times 10^{-3}$ A

Now $\alpha_{a.c.} = \triangle I_c / \triangle I_e = 0.9886$

We have, $\beta_{ac} = \alpha_{ac} / (1-\alpha_{ac}) = 86.72$

Also,

$\beta_{ac} = \triangle I_c / \triangle I_b$

$\therefore \triangle I_b = \triangle I_c / \beta_{ac}$

$\triangle I_b = (7.8 \times 10^{-3}) / (86.72)$

$\triangle I_b = 89.94 \times 10^{-6}$A

UNIT-10
HINTS FOR COMMUNICATION SYSTEMS

1) In a radar, a beam signal is needed in particular direction which is possible if wavelength of signal waves is very small. Since the wavelength of microwave is a few millimeter, hence they are used in radar.

2 The television signals have frequencies in 100-200 MHz range. As ionosphere cannot reflect radio waves of frequency greater than 40 M back to earth, the sky waves cannot be used in the transmission of TV signals.

3) A diode detector should have the following characteristic for proper detection a) high rectification efficiency.

b) negligible loading effect on previous stage

c) low distortion.

4) Velocity factor (VF) of a cable is the ratio of reduction speed of light in the dielectric of the cable.

Velocity of light in vacuum is 3 x10^8 m/sec. It reduces when light passes through a medium. Velocity of light in a medium is given by

$v=c / \sqrt{k}$ & where, c-velocity of light in vacuum and

k- is the dielectric constant of the medium

Vf. $=v/c=1/\sqrt{k}$

For a line velocity factor is generally of the order of 0.6 to 0.9.

5) Delta modulation involves simple pulse coding and decoding methods. A simple delta modulation uses just one bit per sample i.e. a 'non-zero' sample or one per sample. Thus, this method is convenient to use.

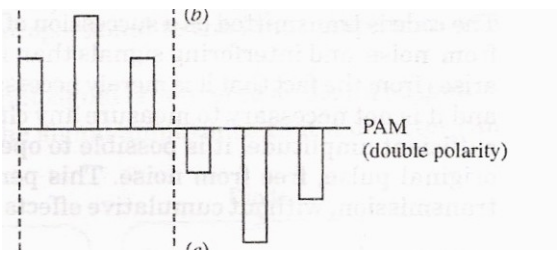
6) Two wire transmission line and coaxial cable are employed for AF and UHF region. For optical fiber is employed for optical frequency.

7). Mixing two frequencies across nonlinear impedance.

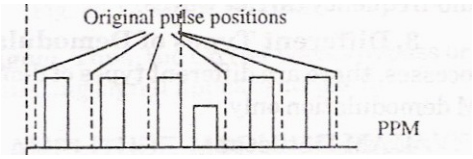
8). When light strikeds the atoms of the Laser medium, it must stimulate emission rather than be absorbed. This means that more atoms must be in an excited state than in the ground state. This is an unnatural condition and is known as population inversion.
9). Solid Lasers, Semi conductor Laser, Liquid laser, Gas Laser.
10) Laser surgery ,Laser printing, Optical communication .
11) 1)Transmission System, 2) Switching Systems and 3) Signaling Systems.
12) 1 .The length of the antenna required is so large (L = 5000m) that is practically impossible
to set up it.
2 The energy radiated from the antenna in audio frequency range is Practically zero
3 The audio signals transmitted from the different broadcasting stations will get inseparably mixed.
13) Pulse modulation is a system in which continuous wave forms are sampled at regular intervals. Information regarding the signal is transmitted only at the sampling times together with any synchronizing pulses that maybe required. Pulse modulation is the process of transmitting signals in the form of pulses (dis continuous signals) by using special techniques.
14) The term channel is commonly used to special the frequency range allotted to a particular transmission from a broadcast station or a transmitter eg a telephone channel is also used for a link in a transmitter and receiver.
15) Atmospheric pressure decreases with in crease in altitude. The high energy particles (ie & rays and cosmic rays) coming from outer space and entering our earths atmosphere cause ionization of the atoms of the gases present there . The ionizing power of these radiation decreases rapidly as they approach the earth. due to decrease in number of collision with the gas atoms . It is due to this reason that the electrical conductivity of earths atmosphere increases with altitude
receives
the signal
16) Refractive index p of core of core of optical fibre is slightly higher than glass cladding . Light propagates through and along the fibre by the series of bounces caused by internal reflection at the interface of the core and cladding. For total internal reflection the light should enter the fibre at an angle θ in accordance with core of acceptance angle θ_c

$$NA = \sin\theta_c = \sqrt{(\mu_1^2 - \mu_2^2)}$$

Numerical aperature depends upon diameter of the core It decreases as the diameter of core decreases vice versa
17) i) Pulse Amplitude Modulation : Amplitude of the pulse varies in accordance with the modulating signal.



(ii) Pulse Position Modulation. : Pulse position (ie) time of rise or fall of the pulse) changes with the modulating signal.



.

18)Dielectric loss increase beyond this frequency.

19)How does the effective power radiated by the antenna vary with wavelength?

Power is inversely proportional to wave length

20)what should be the length of the dipole antenna for a carrier wave of 5 X 10^8hz ?

$L = c/2\nu$.

21) four times.

22) $d = \sqrt{2hR}$

$d = \sqrt{2} \times 0.1 \times 6400$

$= \sqrt{1280}$ km

Area covered by broadcaste, $A = \pi d^2 = 3.14 \times 1280$

$= 3919.2$ km^2

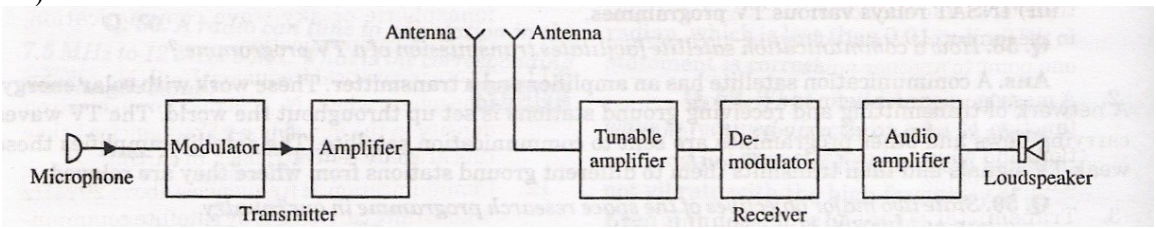
population covered = Area x population density

$= 3919.2 \times 1000 = 3919200$

23) (i) 5 MHz <fc sky wave propagation (ionospheric propagation).

(ii) 100 MHz > fc satellite mode of communication.

24)



25) Maximum voltage of AM wave,

$$V_{max} = \frac{16}{2} = 8\text{mV}$$

Minimum voltage of AM wave,

$$V_{min} = \frac{4}{2} = 2\text{mV}$$

$$m_a = \frac{V_{max} - V_{min}}{V_{max} + V_{min}}$$

$$= \frac{8-2}{8+2} = \frac{6}{10} = 0.6$$

26) The AM wave equation is given by ;

$v = 5(1+0.6\cos 6280t) \sin 221 \times 10^4 t$ volts ……(i)

(i) Maximum amplitude of AM wave

$= E_C + m_a E_C = 5 + 0.6 \times 5 = 8$V

Minimum amplitude of AM wave

$= E_C - m_a E_C = 5 - 0.6 \times 5 = 2$V

(ii) The AM wave will contain three frequency viz

f_c-f_s,	f_c,	f_c+f_s
336-1	336	336+1
335kHz	336kHz	337kHz

27) (i) The AM wave has sideband frequency of ($f_c + f_s$) and ($f_c - f_s$).

Sideband frequency = (500+1) kHz and (500-1) kHz

501 kHz and 499 kHz

(ii) Bandwidth required = 499 kHz to 501 kHz = 2 kHz

28) $P_S = ½ m_a^2 P_C$

$1.246 = 1 + \frac{m_a^2}{2}$

$m_a^2/2 = 0.246$

$m_a = (2 \text{ X } 0.246)^{1/2} = 0.701 = 70.1\%$

29) Modulation index ,

$m_f = \frac{\text{Maximum frequency deviation}}{\text{Minimum signal frequency}}$

30) $d = (2 \times 6400 \text{ X} 10^3 \times 160)^{1/2} = 45255\text{m}$

Coverage range, $d = (2Rh)^{1/2}$

$h_2 = 4h_1 = 4 \times 160 = 640\text{m}$

31) Radius of the area covered by TV broadcast is

$d = (2Rh)^{1/2}$

$= 37500\text{m} = 37.5 \text{ km}$

$= 4.4 \times 10^6$

32) Microwave communication channel width =

$\frac{2}{100} \text{ X } 10GHz$ =0.2 GHz

band width of channel = 8 KHz

$= 2.5 \text{ X } 10^4$

33) Energy corresponding to $\lambda = 1400\text{nm} = 1400 \times 10^{-9}$ m is

$E = \frac{hc}{\lambda} = \frac{1.42 \text{ X } 10^{-19}}{1.6 \text{ X } 10^{-19}} eV = 1\text{eV}$

For detection E must be equal to greater then Eg. Hence only suitable semiconductor is C.

34) Critical frequency fc and maximum electron density nmax are related as

$fc = 9(nmax)^{1/2}$

Squaring we get $nmax = \frac{fc^2}{81}$

Given fc = 10MHz = $10 \text{ X } 10^6 = 10^7$ Hz

ie, nmax = $\frac{(10^{7})^{2}}{81} = 1.23 \times 10^{12} m^{-3}$