12th STD

PHYSICS

12th- PHYSICS STUDY MATERIAL

KRISHNAGIRI DISTRICT

2023-2024.

CHIEF

Mrs. K.P. MAGESHWARI,
CHIEF EDUCATIONAL OFFICER, KRISHNAGIRI DT

COORDINATORS

Dr. M. VENKATESAN, PA to CEO (HSS) KRISHNAGIRI DT.

Mr, S. VADIVELU, APO,CEO OFFICE ,KRISHNAGIRI.

Dr. B.J. MURALI, HEADMASTER, G.H.S. SCHOOL, BARUR.

Mr.S.JOHN PACKIAM, AHM,MMS,RAJU ST,KRISHNAGIRI.

PHYSICS-SUBJECT -COORDINATORS

Mr. R. VENDHAN, HEADMASTER, GBHSS KAVERIPATTINAM.
Mr. S. BOOPATHI, HM, GHSS MADRAHALLI.
Mr. P. SATHIYAMURTHI ,HM, GHSS PERUGOPANAPALLI.

SUBJECT TEACHERS

Mr. V. VIJAYAKUMAR, PG ASST, GHSS MORANAHALLI.
.**Mr. K. MURUGAN** PG ASST, GBHSS RAYAKOTTAI.
Mr. R. SATHIYAKUMAR PG ASST, GHSS SIGARALAPALLI.
Mr. P. MAGI PG ASST, GBHSS KRISHNAGIRI.
Mr. D. SANKAR PG ASST, GHSS ANANDUR.
Mr. N. SAKTHIKUMAR PG ASST, PDB.GHSS PANNANDUR.
Mrs. M. VIVEKANANDHINI PG ASST, GGHSS ,RAYAKOTTAI.
Mr .V.KUBENDRAN, P.G.ASST.GHSS, BARUR.

12- ஆம் வகுப்பு இயற்பியல்
ஒரு மதிப்பெண் வினாக்கள்

12-ம் வகுப்பு தமிழ் பாடப்புத்தகத்தில் உள்ள ஒரு மதிப்பெண் வினாக்கள், **GeoGebra** மென்பொருளின் உதவியோடு, ஒரு வினாவிற்கு சரியான விடையை தேர்வு செய்ய அதிகபட்சம் மூன்று வாய்ப்புகள் வழங்கி, மாணவர்களின் கற்றல், கற்பித்தல் திறன் அதிகரிக்கும் வகையில் வடிவமைக்கப்பட்டுள்ளது என்பதை தெரிவித்துக் கொள்கிறோம்.

குறிப்பு :-

Hi-Tech Lab- QR Code- ஐ செய்து அல்லது **Link- Click** செய்து மாணவர்கள் பயிற்சி செய்யும் விதமாக மென்பொருள் உருவாக்கப்பட்டுள்ளது.

இயற்பியல் ***PHYSICS***	***https://www.geogebra.org/m/pepgybhh***

PHYSICS
Unit 1. Electrostatics
Two Marks Questions:

1. Give the vector form of coulomb's law.

$$\overrightarrow{F_{21}} = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}\widehat{r_{12}}$$

$\overrightarrow{F_{21}}$ → Electrostatic force between two point charges

r → distance between two point charges

$\widehat{r_{12}}$ → Unit vector directed from q_1 to q_2

2. State electrostatic coulomb's law.

The force between two point charges is directly proportional to the product of the magnitude of the charges and inversely proportional to the square of the distance between them.

3. Define electric dipole moment. Give its unit.

The magnitude of the electric dipole moment (P) is equal to the product of the magnitude of one of the charges (q) and the distance (2a) between them. Its unit is Cm.

$\boxed{p = q2a.}$

4. Define electric flux.

The number of electric field lines crossing a given area kept normal to the electric field lines is called electric flux (Φ_E). Its SI unit is Nm^2C^{-1}

5. Define action at points or corona discharge.

Leakage of charge from the sharp edge of charged conductor is called corona discharge (or) action at points.

6. State Gauss law.

Gauss Law states that if a charge Q is enclosed by an arbitrary closed surface then the total electric flux through the closed surface is equal to $\frac{1}{\varepsilon_0}$ times the net charge enclosed by the surface.

$$\Phi_E = \oint \vec{E}.\vec{dA} = \frac{Q_{enclosed}}{\varepsilon_0}$$

7. Give the applications of capacitor.

- Flash capacitors are used in digital camera to take photographs.
- Capacitors are used in the ignition system of automobiles engines to eliminate sparking.
- Capacitors are used to reduce power fluctuations in power supplies and to increase the efficiency of power transmission.

8. What are called Non-polar and polar molecules. Give examples.

- Non-polar molecules is one in which centres of positive and negative charges coincides. E.x. O_2, N_2, H_2
- Polar molecule is one in which the centres of the positive and negative charges are separated even in the absence of an external electric field.
  They have a permanent dipole moment. Ex. H_2O, N_2O, HCl

9. State quantisation of electric charge.

The charge of any object is equal to an integral multiple of this fundamental unit of charge "e".

$\boxed{q = ne}$

10. Define capacitance. Give its Unit.

Capacitance of capacitor is the ratio between the charge given to the potential developed. Its unit is farad (F)

$\boxed{C = \frac{Q}{V}}$

11. Why is it safer to be inside a car than standing under a tree during lightning?

- The metal body of the car provides electrostatic shielding.
- Since the electric field is zero.
- During lightning the electric discharge passes through the body of the car.

12. Define electric field.

The force experienced by a unit positive charge kept at that point in an electric field. Unit is **NC^{-1}**

Three Mark Questions

1. Drive an expression for torque experienced by an electric dipole placed in the uniform electric field.

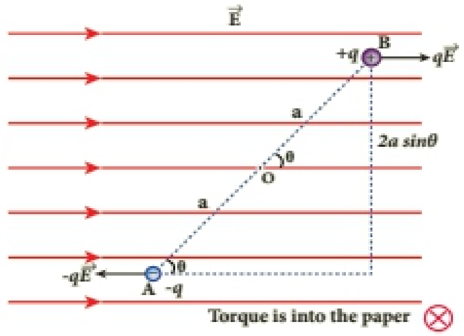
- Let a dipole AB of moment $\vec{P}$ is placed in an uniform electric field $\vec{E}$.
- The force on $+q = +q\vec{E}$
- The force on $-q = -q\vec{E}$
- Then the total force acts on the dipole is zero.
- But these two forces constitute a couple and the dipole experience a torque which tends to rotate the dipole along the field.
- The total torque on the dipole about the point "O"

$$\vec{\tau} = \overrightarrow{OA} \times (-q\vec{E}) + \overrightarrow{OB} \times (q\vec{E})$$

$$\tau = qE2asin\theta \qquad \because p = 2aq$$

$$\tau = pEsin\theta$$

$$\boxed{\vec{\tau} = \vec{p} \times \vec{E}}$$



Torque on dipole

- The torque is maximum when $\theta = 90°$

2. Drive an expression for capacitance of parallel plate capacitor?

- Consider a capacitor consists of two parallel plate each of area A separated by a distance "d".
- Let σ be the surface charge density of the plates.
- The electric field between the plates.

$$E = \frac{\sigma}{\varepsilon_0} = \frac{Q}{A\varepsilon_0}$$

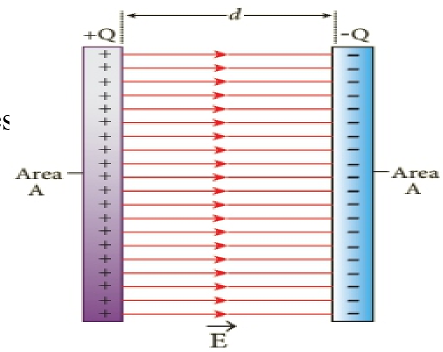
Since the field is uniform the potential difference between the plates

$$V = E.d = \left(\frac{Q}{A\varepsilon_0}\right) d$$

Then the capacitance of the capacitor.

$$C = \frac{Q}{V} = \frac{Q}{\left(Qd/A\varepsilon_0\right)} = \frac{\varepsilon_0 A}{d}$$

$$\boxed{C = \frac{\varepsilon_0 A}{d}}$$



Capacitance of a parallel plate capacitor

3. Drive the expression for resultant capacitance when capacitors are connected in series.

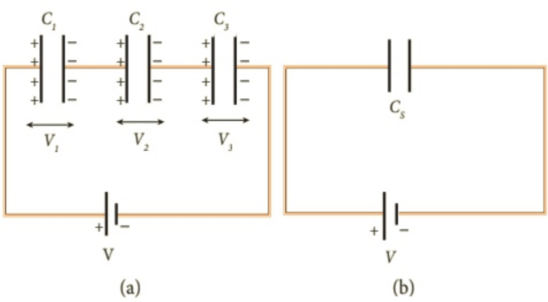
- Each capacitor has same amount of charge (Q).
- But potential difference across each capacitor will be different.
- Let C_s be the equivalent capacitance of capacitor in series connection then.

$$V = V_1 + V_2 + V_3 \qquad \therefore Q = CV$$

$$V = \frac{Q}{C_1} + \frac{Q}{C_2} + \frac{Q}{C_3}$$

$$\frac{Q}{C_s} = Q\left(\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}\right)$$

$$\boxed{\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}}$$



(a) Capacitors connected in series (b) Equivalence capacitors C_s

Thus the inverse of the equivalent capacitance of capacitors connected in series is equal to the sum of the inverses of each capacitance.

4. Drive the expression for resultant capacitance when capacitors are connected in parallel.

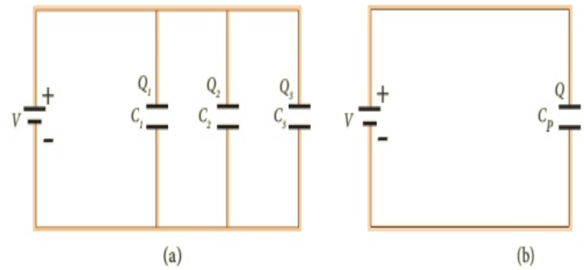
- ❖ Each capacitor has same potential difference (V)
- ❖ But charges on each capacitor will be different.
- ❖ Let C_P be the equivalent capacitance of capacitor in parallel connection then

$$Q = Q_1 + Q_2 + Q_3$$

$$Q = C_1V + C_2V + C_3V \quad \therefore Q = C_PV$$

$$C_PV = V(C_1 + C_2 + C_3)$$

$$\boxed{CP = C1 + C2 + C3}$$



(a) capacitors in parallel (b) equivalent capacitance with the same total charge

- ❖ Thus the equivalent capacitance of capacitors connected in parallel is equal to the sum of the individual capacitances.

5. Distinguish between Coulomb force and Gravitational force.

Coulomb force	Gravitational force
It acts between two charges	It acts between two masses
It can be attractive or repulsive	It is always attractive
Always greater in magnitude	Always lesser in magnitude
It depends on the nature of the medium	It is independent of the medium

6. Derive an expression for energy stored in capacitor.

- ❖ Capacitor is a device used to store charges and energy.
- ❖ For this work is done by the battery. This work done is stored as electrostatic energy in capacitor.
- ❖ To transfer charge dq for a potential difference V the work done is

$$dw = Vdq \qquad where\ V = \frac{Q}{C}$$

The total work done to charge a capacitor

$$W = \int_0^Q \frac{Q}{C}dq = \frac{Q^2}{2C}$$

This work done is stored as electrostatic potential energy of the capacitor,

$$U_E = \frac{Q^2}{2C} = \frac{1}{2}CV^2 \qquad (Q = CV)$$

7. Obtain an expression for electric potential at a point due to a point charge.

- ❖ Consider a point charge +q at origin.
- ❖ P be a point at a distance r from origin.
- ❖ By definition the electric field at P is

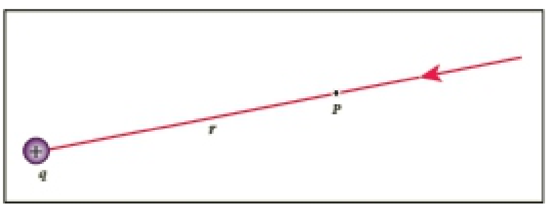
$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}\hat{r}$$

Hence electric potential at P is

$$V = -\int_\infty^r \vec{E}.\vec{dr}$$

$$V = -\int_\infty^r \frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}\hat{r}\,\vec{dr}$$

$$\boxed{V = \frac{q}{4\pi\varepsilon_0}}$$



Electrostatic potential at a point P

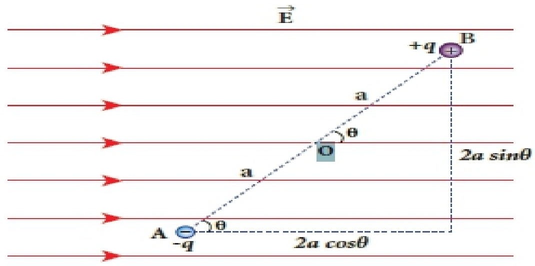
PHYSICS

8. List the properties of electric field lines.

- They starts from positive and end at negative charge or at infinity.
- The electric field vector at a point in space is tangential to the electric field line at that point.
- If E is large the electric field lines are dense
- If E is small the electric field lines are less dense
- Electric field lines never intersect each other.
- The number of electric field lines that emanate from +q or end at –q is directly proportional to the magnitude of the charges.

9. Derive an expression for electrostatic potential energy of the dipole in a uniform electric field.

- Consider an electric dipole in an electric field E.
- A dipole experiences a torque (τ) when kept in an uniform electric field.
- This torque rotates the dipole to align it with the direction of the electric field.
- Work done by external torque.



$$W = \int_{\theta'}^{\theta} \tau_{ext}\, d\theta$$

$$\vec{\tau}_E = \vec{\tau}_{ext} = \vec{p} \times \vec{E}$$

$$W = \int_{\theta'}^{\theta} pE \sin\theta \, d\theta$$

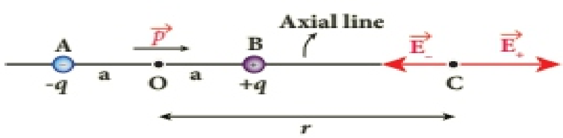
$$W = pE(\cos\theta' - \cos\theta)$$

Electrostatic potential energy $\boxed{\boldsymbol{U = -pE\cos\theta = -\vec{p}.\vec{E}}}$

Five Mark Questions:

1. Calculate the electric field due to a dipole on its axial line.

- Consider a dipole AB of dipole moment P=2qa and its direction be along –q to +q
- Let C be the point at a distance r from the midpoint O on its axial line.
- Electric field at C due to +q



Electric field of the dipole along the axial line

$$\vec{E_+} = \frac{1}{4\pi\varepsilon_0}\frac{q}{(r-a)^2}\hat{p}$$

Electric field at C due to –q

$$\vec{E_-} = \frac{1}{4\pi\varepsilon_0}\frac{q}{(r+a)^2}\hat{p}$$

The total electric field at C due to dipole is

$$\vec{E_{tot}} = \vec{E_+} + \vec{E_+}$$

$$\vec{E_{tot}} = \frac{q}{4\pi\varepsilon_0}\left(\frac{4ra}{(r^2-a^2)^2}\right)\hat{p} \qquad (\because \boldsymbol{r >> a})$$

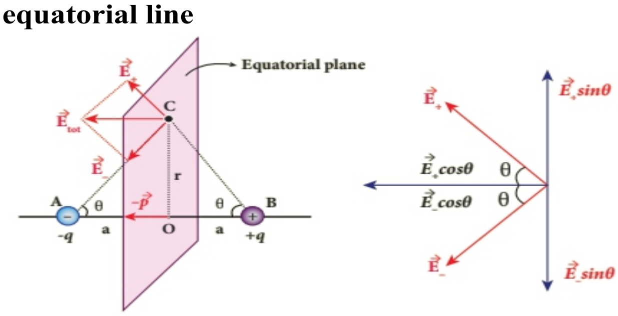
$$\vec{E_{tot}} = \frac{1}{4\pi\varepsilon_0}\frac{2\vec{p}}{r^3} \qquad (\because \vec{p} = 2qa\,\hat{p})$$

$$\boxed{\vec{E_{tot}} = \frac{1}{4\pi\varepsilon_0}\frac{2\vec{p}}{r^3}}$$

Here the direction of total electric field is along the dipole moment.

2. Calculate the electric field due to a dipole on its equatorial line

- Consider a dipole AB of dipole moment P=2qa and its direction be along –q to +q.
- Let C be the point at a distance r from the midpoint O on its equatorial plane.
- Electric field at C due to dipole.
- The magnitudes $\vec{E_+}$ and $\vec{E_-}$ are the same.



Electric field due to a dipole at a point on the equatorial plane

$$\left|\overrightarrow{E_+}\right| = \left|\overrightarrow{E_-}\right| = \frac{1}{4\pi\varepsilon_0}\frac{q}{(r^2+a^2)}$$

Resolve $\overrightarrow{E_+}$ *and* $\overrightarrow{E_-}$ in two components.

- ❖ $\left|\overrightarrow{E_+}\right| Sin\theta,\ \left|\overrightarrow{E_-}\right| sin\theta$ Perpendicular components.
- ❖ $\left|\overrightarrow{E_+}\right| cos\theta, \left|\overrightarrow{E_-}\right| cos\theta$ Parallel components.

Here perpendicular components cancel each other.
But Parallel components in same direction will added up to give total electric field.

$$\overrightarrow{E_{tot}} = -\left|\overrightarrow{E_+}\right|\cos\theta\ (\hat{P}) - \left|\overrightarrow{E_-}\right|\cos(\theta)\ (\hat{P}) \text{-----}(1)$$

From the equation (1)

$$\overrightarrow{E_{tot}} = -\frac{1}{4\pi\varepsilon_0}\frac{2q\cos\theta}{(r^2+a^2)}\hat{p}$$

$$\cos\theta = \frac{a}{\sqrt{r^2+a^2}}$$

$$\overrightarrow{E_{tot}} = -\frac{1}{4\pi\varepsilon_0}\frac{2aq\ \hat{p}}{(r^2+a^2)^{3/2}} \qquad (\because\ r >> a)$$

$$\boxed{\overrightarrow{\boldsymbol{E}_{tot}} = -\frac{\vec{\boldsymbol{p}}}{4\pi\varepsilon_0 r^3}} \qquad (\vec{p} = 2aq\ \hat{p})$$

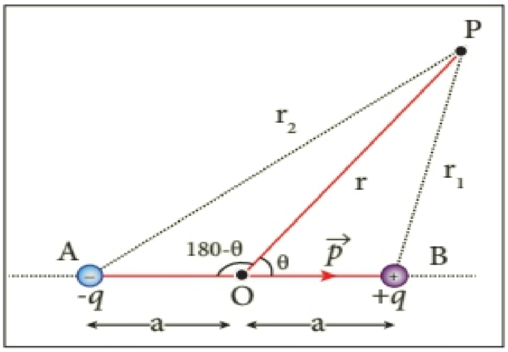
3. Derive an expression for electro static potential due to electric dipole.

- ❖ Consider a dipole AB of dipole moment P=2qa and its direction along –q to +q.
- ❖ Let P be the point at a distance r from the midpoint O.
- ❖ Electric potential at P due to +q

$$V_1 = \frac{1}{4\pi\varepsilon_0}\frac{q}{r_1}$$

- ❖ Electric potential at P due to –q

$$V_2 = \frac{1}{4\pi\varepsilon_0}\left(\frac{-q}{r_2}\right)$$



Potential due to electric dipole

Then total potential at P due to dipole is.

$$V = V_1 + V_2$$

$$V = \frac{q}{4\pi\varepsilon_0}\left(\frac{1}{r_1} - \frac{1}{r_2}\right) --- (1)$$

Apply cosine law in Δ BOP and Δ AOP we get.

$$\frac{1}{r_1} = \frac{1}{r}\left(1 + \frac{a}{r}cos\theta\right) --- (2)$$

$$\frac{1}{r_2} = \frac{1}{r}\left(1 - \frac{a}{r}cos\theta\right) --- (3)$$

Equation 2 and 3 substitute in 1 we get

$$V = \frac{q}{4\pi\varepsilon_0 r}\left(1 + \frac{a\cos\theta}{r} - 1 + \frac{a\cos\theta}{r}\right)$$

$$\boxed{V = \frac{1}{4\pi\varepsilon_0}\frac{p cos\theta}{r^2}} \qquad (\vec{P} = 2aq\ )$$

$$\boxed{\boldsymbol{V} = \frac{\boldsymbol{1}}{\boldsymbol{4\pi\varepsilon_0}}\frac{\vec{\boldsymbol{p}}}{\boldsymbol{r^2}}\hat{\boldsymbol{r}}}$$

Case (i) $\theta = 0°$ $\quad V = \frac{1}{4\pi\varepsilon_0}\frac{p}{r^2}$

PHYSICS

Case (ii) $\theta = 180°$ $V = -\frac{1}{4\pi\varepsilon_0}\frac{p}{r^2}$

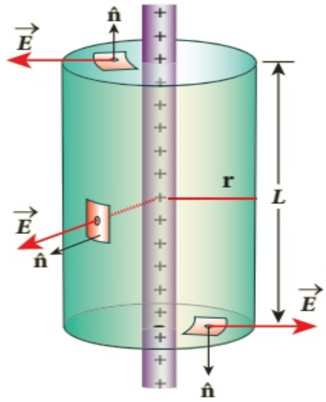
Case (iii) $\theta = 90°$ V $= 0°$

4. Obtain an expression for electric field due to an infinitely long charged wire.

- ❖ Consider an infinitely long straight wire of uniform linear charge density λ.
- ❖ Let P be a point at a distance r from the wire. Let E be the electric field at P.
- ❖ Consider a cylindrical Gaussian Surface of length L and radius r.

Total Flux

$$\phi_E = \oint \vec{E}.\vec{dA} = \int_{Curved} \vec{E}.\vec{dA} + \int_{Top} \vec{E}.\vec{dA} + \int_{Bottom} \vec{E}.\vec{dA}$$



Cylindrical Gaussian surface

- ❖ The electric flux through the top and bottom surface is zero.

The electric flux through the curved surface.

$$\phi_{Curve} = \int \vec{E}.\vec{dA} = E2\pi rL$$

$$\phi_E = E(2\pi rL)$$

By Gauss law,

$$\phi_E = \frac{Q_{enclosed}}{\varepsilon_0}$$

E $(2\pi$ r L$) = \lambda L/\varepsilon_0$ $\quad (\because Q_{\text{enclosed}} = \lambda L)$

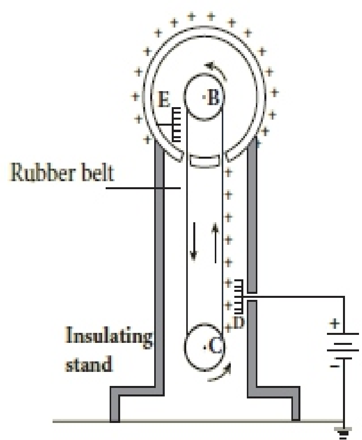
$$\boxed{E = \frac{\lambda}{2\pi\varepsilon_0 r}}$$

$$\boxed{\vec{E} = \frac{\lambda}{2\pi\varepsilon_0 r}\hat{r}}$$

5. Explain in detail the construction and working of Van de Graff generator.

- ❖ It is designed by Robert vande graff.

It produces large electro static potential difference of about $10^7 V$.



Van de Graaff generator

Principle:

- ❖ Electro Static induction.
- ❖ Action at points.

Construction:

- ❖ A be the large hollow spherical conductor.
- ❖ B and C be the two pulleys.
- ❖ A belt made up of insulating material like silk (or) rubber runs over the pulleys.
- ❖ The pulley C is driven by the electric motor.
- ❖ D and E are two comb shaped metallic conductor fixed near the pulleys.
- ❖ The Comb D is maintained at a positive potential of $10^4 V$ by a power supply
- ❖ The comb E is connected to the inner side of the hollow metal sphere.

Working:

- ❖ Due to the action of point air between the belt and comb D gets ionized.
- ❖ The positive charges are pushed towards the belt and stick to the belt and move up.

- When they reach the comb E a large amount of negative and positive charges are induced on either side of comb E due to electro static induction.
- These positive charges are distributed uniformly on the outer surface of the hollow sphere.
- Again due to action of points at comb E, negative charges pushed towards the belt and neutralize the positive charges in the belt.
- When the belt descends it has almost no net charge.
- This process continues until the outer surface produce the potential difference of the order of $10^7 V$ which is the limiting value.
- Beyond this the charges starts leaking to the surrounding due to ionization of air.
- It is prevented by enclosing the machine in a gas filled steel chamber at very high pressure.

Application:

The high voltage produced in this van de Graff generator is used to accelerate positive ions for nuclear disintegration.

Unit 2. Current Electricity
Two Mark Questions:

1. Define current density.

Current density defined as the current per unit area of cross section of the conductor.

unit is Am^{-2}. $J = I/A$

2. Define drift velocity and mobility.

Drift velocity	Mobility
The average velocity acquired by the free electrons inside the conductor when it is subjected to an electric field is called drift velocity	The magnitude of the drift velocity acquired by the free electrons per unit electric field is called mobility. (μ)
Its unit ms^{-1}	Its unit is $m^2v^{-1}s^{-1}$

3. State ohm's law.

The Potential difference across a given conductor is directly proportional to the current passing through it when the temperature remains constant. $\boldsymbol{V = IR}$

4. Define resistivity of the material.

The electrical resistivity of a material is defined as the resistance offered to current flow by a conductor of unit length having limit area of cross section.

Its unit ohm-metre (Ω m).

5. Define temperature co-efficient of resistivity.

It is defined as the ratio of increase in resistivity per degree rise in temperature to its resistivity at T_0. Its unit is $/°C$

6. State Kirchhoff's laws.

First Law: It states that the algebraic sum of currents at any junction in circuit is zero.

Second Law: It states that in a closed circuit the algebraic sum of the product of the current and resistance of each part of the circuit is equal to the total emf included in the circuit.

7. State joule's law of heating.

Heat develop in an electrical circuit due to the flow of current various directly as

1. The square of the current.
2. The resistance of the circuit.
3. The time flow.

$H = I^2 Rt$

8. What are the applications of seebeck effect?

- It is used in thermoelectric generators (seebeck generators)
- This effect is utilized in automobiles as automotive. Thermoelectric generators for increasing fuel efficiency.

- It is used in thermocouples and thermopiles to measure the temperature difference between the two objects.

9. Define superconductivity.

- The property of conducting current with zero resistance at very low temperature is called superconductivity.
- The material which exhibit this property are known as super conductors.

10. Define peltier's effect.

When an electric current is passed through a circuit of thermocouple heat is evolved at one junction and absorbed at the other junction. This is known as peltier's effect.

Three Marks Questions

1. Explain the resultant resistance of a series resistor network.

- When two or more resistors are connected end to end they are said to be in series.
- Current through each resistor will be same.
- But potential difference across different resistor will be different.

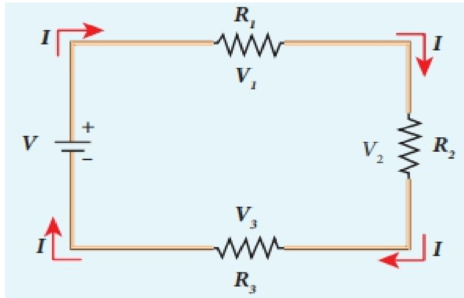
Then total potential difference.

$V = V_1 + V_2 + V_3$

$V = IR_1 + IR_2 + IR_3$

$IR_s = I(R_1 + R_2 + R_3)$ $(V_s = IR_s)$

$$\mathbf{R_s = R_1 + R_2 + R_3}$$



(a) Three resistors in series

The equivalent resistance is the sum of the individual resistances.

2. Explain the resultant resistance of parallel resistors network.

- When two or more resistors are connected across the same potential difference, they are said to be in parallel.
- Potential difference across each resistance will be the same.
- But currents flows through different resistors will be different.

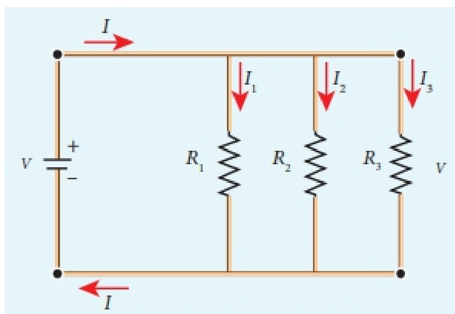
Then the total current will be

$I = I_1 + I_2 + I_3$

$I_P = \frac{V}{R_P}, \quad I_1 = \frac{V}{R_1}, \quad I_2 = \frac{V}{R_2}, \quad I_3 = \frac{V}{R_3}$

$\frac{V}{R_P} = V\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)$

$$\mathbf{\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}}$$



(a) Three resistors in parallel

The reciprocal of equivalent resistance is equal to the sum of the reciprocal of the value of resistance of the individual resistor.

3. Distinguish Peltier effect and Joules effect.

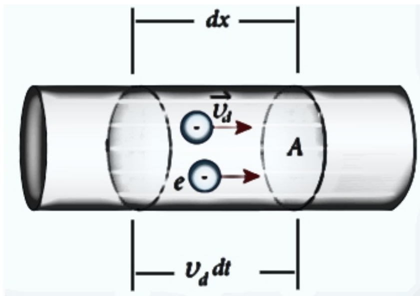
Peltier effect	Joules effect
Both liberated and absorbed occur	Heat liberated only occur
Occurs at junction	Occur all along the conductor
Reversible effect	Irreversible effect

4. Distinguish electric energy and electric power.

Electric energy	Electric power
Work done to move the charge from one end to other end of the conductor is called electric energy. $dw = VdQ$	The rate at which the electrical potential energy is delivered is called electric power. $P = VI$
Its units is Joule (J)	Its unit is Watt (W)

Five Mark Questions

1. Describe the microscopic model of current and obtain microscopic form of Ohm's law.



- ❖ Consider a conductor with area of cross section and let an electric field $\vec{E}$ be applied.
- ❖ Let n be the no. of electrons per unit volume.
- ❖ Drift velocity of electrons. $= V_d$

$$V_d = \frac{dx}{dt}$$

No. of electrons in a volume $Adx = n(AV_d dt)$

Total charge in a volume element $dQ = ne(AV_d dt)$

$$\text{Current } I = \frac{dQ}{dt} = neAV_d$$

Current density:

The current per unit area of cross section of the conductor.

$$J = \frac{I}{A} = neV_d$$

$$\boxed{\vec{J} = \sigma\vec{E}}$$

2. Explain the determination of the internal resistance of a cell using voltmeter.

- ❖ The emf of cell is measured by connecting a high resistance voltmeter across it in a open circuit.
- ❖ Voltmeter reading gives the emf of the cell.
- ❖ External resistance R is included in the circuit and curre flows in the circuit. The potential difference across R is equa to the potential difference across the cell (V)

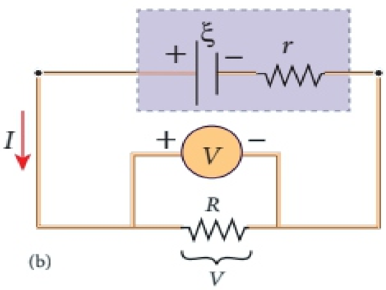
$V = I R$ ----------(1)

$V = \varepsilon - Ir$

$Ir = \varepsilon - V$ -------(2)

Dividing (2) by (1)

$$\boxed{r = \left(\frac{\varepsilon - V}{V}\right)R}$$



Internal resistance of the cell

3. How the emf of two cell's care compared using potentiometer?

- ❖ Potentiometer wire CD is connected to battery and a key is series this is primary circuit.
- ❖ The end C of the wire is connected to the terminal M of DPDT switch and the other terminal N is connected to jockey through a galvanometer G and high resistance HR.

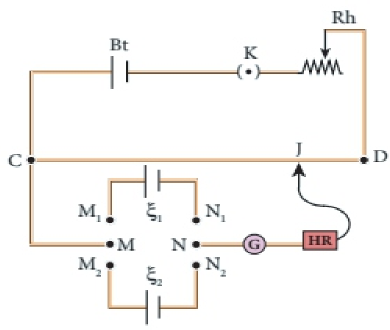
emf of the cell is directly proportional to the balancing length.

$$\varepsilon_1 = Irl_1$$

ε_1-emf of first cell

$$\varepsilon_2 = Irl_2$$

ε_2 emf of second cell



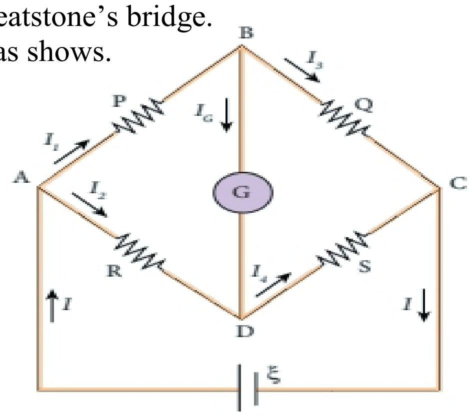
Comparison of emf of two cells

$$\boxed{\frac{\varepsilon_1}{\varepsilon_2} = \frac{l_1}{l_2}}$$

l_1 Balancing length when ε_1 included.
l_2 Balancing length when ε_2 included.

4. Obtain the condition for bridge balance in Wheatstone's bridge.

- ❖ An important application of Kirchhoff's law's is the Wheatstone's bridge.
- ❖ The bridge consists of four resistors P, Q, R, S connected as shows.



Wheatstone's bridge

Applying kirchoff's current law at B and D.

$I_1 - I_g - I_3 = 0$

$I_2 + I_g - I_4 = 0$

Applying kirchoff's voltage law ABDA and ABCDA

$I_1P + I_g G - I_2 R = 0$

$I_1P + I_3Q - I_2R - I_4 S = 0$

At balanced condition galvanometer shows zero deflection so.

$I_g = 0$

$I_1 = I_3$

$I_2 = I_4$

$I_1 P = I_2 R$ ----------(1)

$I_3Q = I_4S$-------(2)

$(1)/(2)$ $\boxed{\frac{P}{Q} = \frac{R}{S}}$

5. Explain the method of measurement of internal resistance of a cell using potentiometer.

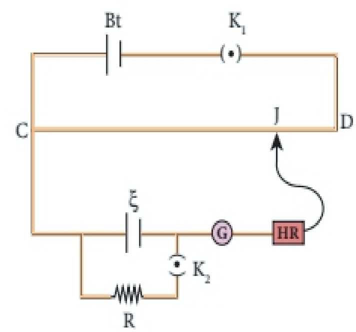
- ❖ Potentiometer wire CD is connected to battery and a key is series this is primary circuit.
- ❖ The cell ε and whose internal resistance r to be measured is connected to the secondary circuit.
- ❖ A resistance box R and a Key is connected across the cell ε
- ❖ With key K_2 open the balancing length is measured.
  By the principle

$$\varepsilon \,\alpha\, l_1 \text{ ---------(1)}$$

$$V = IR = \frac{\varepsilon R}{R + r}$$

- ❖ For this potential difference again the balancing point J is found out and the balancing length CJ=l_2 is measured.

$$\frac{\varepsilon R}{R + r} \;\alpha\; l_2 ----(2)$$



measurement of internal resistance

By simplifying the equation 1 and 2 we get.
Internal resistance

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

Unit – 3 Magnetism and Magnetic effects of electric currents

Two Mark Questions:

1. Define magnetic dipole moment. Give its unit.

The magnetic dipole moment is defined as the product of its pole strength and magnetic length. Unit is **Am^2.**

$$\boxed{P_m = 2lq_m}.$$

2. State coulomb's inverse law of magnetism?

The force of attraction or repulsion between two magnetic pole is

PHYSICS

- Directly proportional to the product of their pole strength.(q_{Am}, q_{Bm})
- Inversely proportional to the square of the distance between them.

$$F \alpha \frac{q_{Am}\, q_{Bm}}{r^2}$$

3. Define magnetic susceptibility?

The ratio of the intensity of magnetization ($\vec{M}$) induced in the material to the magnetising field ($\vec{H}$).

$$x_m = \frac{|\vec{M}|}{|\vec{H}|}$$

4. State Ampere's circuital law.

The line integral of magnetic field over a closed loop is μ_0 times net current enclosed by the loop. $\oint_c \vec{B}.\vec{dl} = \mu_\circ I_{enclosed}$

5. What is Curie temperature?

At a particular temperature, ferromagnetic material becomes paramagnetic material. This temperature is known as Curie temperature.

6. State Fleming's left-hand rule.

Stretch out forefinger, the middle finger and the thumb of the left hand such that they are in three mutually perpendicular directions.

- Forefinger - direction of magnetic field.
- Middle finger - direction of the electric current.
- Thumb – direction of the force experienced by the conductor.

7. Define one ampere.

One ampere is defined as that constant current when it is passed through each of the two infinitely long parallel straight conductors kept at a distance of one meter apart in vacuum causes each conductor to experience a force of $2 \times 10^{-7} N$ per meter length of conductor.

8. Define magnetic flux density.

The magnetic flux density is defined as the number of magnetic field lines crossing per unit area kept normal to the direction of lines of force. Its unit is Wbm^{-2} or tesla.

9. What is Hysteresis?

The phenomenon of lagging of magnetic induction B behind the magnetising field H is called hysteresis.

10. How the current sensitivity of a galvanometer can be increased?

- By increasing the number of turns (N)
- By increasing the magnetic induction (B)
- By increasing the area of the coil (A)
- By decreasing the couple per unit twist of the suspension wire.

11. What are the limitation of cyclotron?

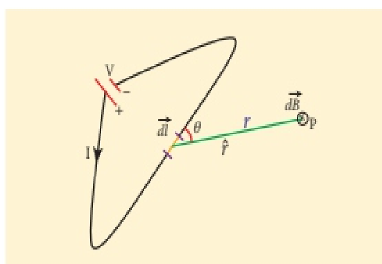
- The speed of the ion is limited.
- Electron cannot be accelerated.
- Uncharged particles cannot be accelerated.

Three Mark Questions

1. State and explain Biot savart Law.

According the Biot Savart Law, the magnitude of magnetic field $\vec{dB}$ is

- Directly proportional to the strength of the current (I).
- Directly proportional to the magnitude of the length element ($\vec{dl}$)
- Directly proportional to the sine of the angle θ between $\vec{dl}$ and $\hat{r}$.
- Inversely proportional to the square of the distance r between the point P and length element $\vec{dl}$.



Magnetic field at a point P due to current carrying conductor

$$dB \ \alpha \ \frac{Idl\sin\theta}{r^2}$$

$$\boxed{\overrightarrow{dB} = \frac{\mu_0}{4\pi}\frac{I\overrightarrow{dl} \times \hat{r}}{r^2}}$$

2. Give an account of magnetic Lorence force.

$$F_m = Bqv \sin\theta$$

- $F_m \rightarrow$ is directly proportional to the magnetic field $\vec{B}$
- $F_m \rightarrow$ is directly proportional to the velocity $\vec{v}$ of the moving charge.
- $F_m \rightarrow$ is directly proportional to sine of the angle between the velocity and magnetic field.
- $F_m \rightarrow$ is directly proportional to the magnitude of the charge q.
- The direction of $\vec{F}_m$ is always perpendicular to $\vec{v}$ and $\vec{B}$.
- If velocity $\vec{v}$ of the charge q is along magnetic field $\vec{B}$ then, $\vec{F}_m$ is zero.

3. Calculate the torque acting on a bar magnet in uniform magnetic field.

- Consider a magnet of length $2l$ of pole strength q_m kept in a uniform magnetic field B.
- The net force acting on the dipole becomes zero.
- The moment of force or torque experienced by north and South Pole about point O is.

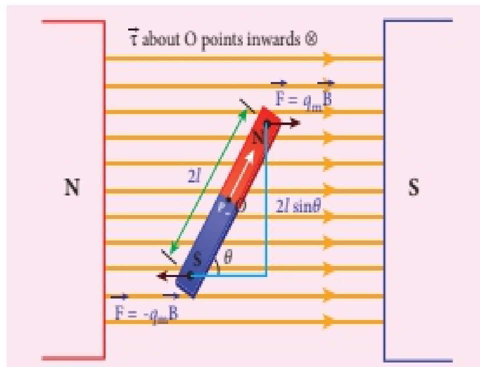
$$\vec{\tau} = \overrightarrow{ON} \times (q_m \vec{B}) + \overrightarrow{OS} \times (-q_m \vec{B})$$

$$\vec{\tau} = l \times q_m B \sin\theta + l \times q_m B \sin\theta$$

$$\vec{\tau} = 2l\, q_m B \sin\theta \qquad (\because p_m = 2l \times q_m)$$

$$\vec{\tau} = p_m B \sin\theta$$

$$\boxed{\vec{\tau} = \overrightarrow{p_m} \times \vec{B}}$$



Magnetic dipole kept in a uniform magnetic field

4. Calculate the potential energy of a bar magnet in a uniform magnetic field.

- When a bar magnet of dipole moment p_m is held at an angle with the direction of uniform magnetic field B. The work done by external torque τ_{ext}

$$W = \int_{\theta'}^{\theta} \tau_{ext}\, d\theta$$

$$\vec{\tau} = \vec{p}_m \times \vec{B}$$

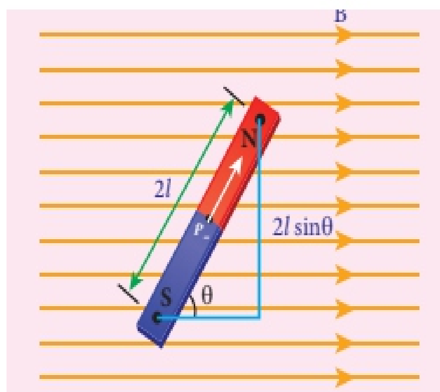
$$\tau_{ext} = \tau_B = P_m B \sin\theta$$

$$W = \int_{\theta'}^{\theta} p_m B \sin\theta\, d\theta$$

Potential Energy $U = -p_m B (\cos\theta - \cos\theta')$

$$U = -p_m B\cos\theta \qquad (\because \theta' = 90°)$$

$$\boxed{U = -\overrightarrow{p_m} \cdot \vec{B}}$$



A bar magnet (magnetic dipole) in a uniform magnetic field

5. Compare the properties of dia, para, Ferro, magnetic material.

Magnetic properties	Diamagnetic	Paramagnetic	Ferromagnetic
Magnetic susceptibility (x_m)	Negative	Positive and Small	Positive and very large
Susceptibility	Temperature independent	$x_m \propto \frac{1}{T}$	$x_m \propto \frac{1}{T}$
Relative permeability μ_r	$\mu_r < 1$	$\mu_r > 1$	$\mu_r \gg 1$
When place in external magnetic field	Magnetic field lines are expelled	Magnetic field lines attracted	Magnetic field lines strongly attracted
Example	Copper, water	Oxygen, chromium	Iron, nickel

6. What applications of hysteresis loop.

Permanent magnets:

The materials with high receptivity, high coercivity and low permeability are suitable for making permanent magnets.

Example: Carbon steel and Alnico

Electromagnets:

The materials with high initial permeability, low retentivity, low coercivity and thin hysteresis loop with smaller area are preferred to make electro magnets.

Example: Soft iron and metal.

Core of transformer:

The materials with high initial permeability, large magnetic induction and thin hysteresis loop with smaller area are needed to design transformer core.

Example: Soft iron

7. How is galvanometer converted into an ammeter?

- A Galvanometer is converted into an ammeter by **connecting a low resistance in parallel** with it.
- The potential difference across galvanometer is same as the potential difference across shunt resistance.

$$V_{galvanometer} = V_{shunt}$$

$$I_g R_g = (I - I_g) S$$

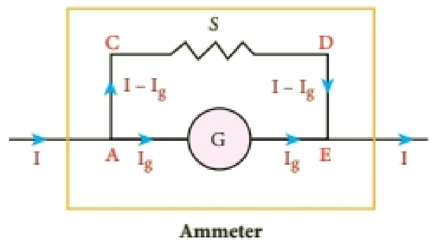
$$S = \frac{I_g}{I - I_g} R_g$$

$$I_g = \left(\frac{S}{S + R_g}\right) I$$

$$I_g \ \alpha \ I$$

$$\theta \ \alpha \ I$$

$$\boldsymbol{R_a = \frac{R_g S}{R_g + S}}$$



Shunt resistance connected in parallel

An ideal ammeter has zero resistance

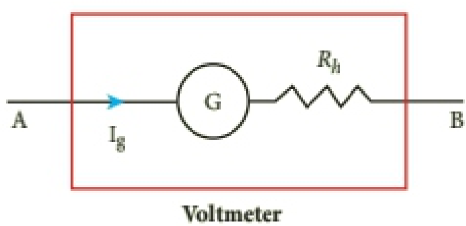
8. How is galvanometer converted into voltmeter?

- A galvanometer is converted into a voltmeter by connecting **high resistance R_h in series** with it.
- The current in the electrical circuit is same as the current passing through the galvanometer.

$$I = I_g$$

The voltmeter resistance $R_v = R_g + R_h$

$$I_g = \frac{V}{R_g + R_h}$$



High resistance connected in series

$$R_h = \frac{V}{I_g} - R_g$$

Here $I_g \, \alpha \, V$

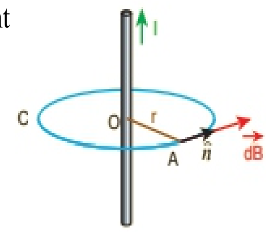
The deflection in the galvanometer is proportional to current I_g.

An **ideal voltmeter has infinite resistance**.

Five Mark Questions:

1. Obtain an expression for magnetic field due to the current carrying wire of infinite length using ampere's law.

- Let I be the current flowing through in a infinite length of current carrying wire.
- We construct an Ampere and loop in the form of a circular shape at a distance r from the centre of the conductor.



Ampèrian loop for current carrying straight wire

$$\oint_C \vec{B}.\vec{dl} = \mu_o \text{I}$$

$$\oint_C Bdl = \mu_o \text{I} \qquad \because \theta = 0$$

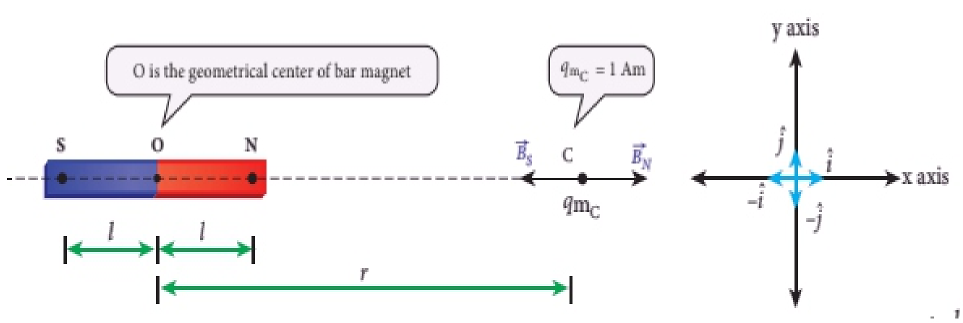
$$B\int_0^{2\pi r} dl = \mu_o \text{I} \qquad \therefore \int_0^{2\pi r} dl = 2\pi r$$

$$\text{B } 2\pi r = \mu\text{o I}$$

$$\mathbf{B} = \frac{\mu_0 I}{2\pi r}$$

In vector form $\vec{B} = \frac{\mu_0 I}{2\pi r}\hat{n}$

2. Calculate the magnetic field at a point on the axial line of a bar magnet.



Magnetic field at a point along the axial line due to magnetic dipole

Consider a bar magnet NS.C be the point on the axial line at a distance r from the centre of magnet.

$$\vec{B_N} = \frac{\mu_0}{4\pi}\frac{q_m}{(r-l)^2}\hat{\imath}$$

$$\vec{B_S} = -\frac{\mu_0}{4\pi}\frac{q_m}{(r+l)^2}\hat{\imath}$$

This net magnetic field. $\vec{B} = \overrightarrow{B_N} + \overrightarrow{B_S}$

$$\vec{B} = \frac{\mu_0 q_m}{4\pi}\left(\frac{1}{(r-l)^2} - \frac{1}{(r+l)^2}\right)\hat{\imath}$$

$$\vec{B} = \frac{\mu_0 2r}{4\pi}\left(\frac{q_m.2l}{(r^2-l^2)^2}\right)\hat{\imath} \qquad (\because r >> l)$$

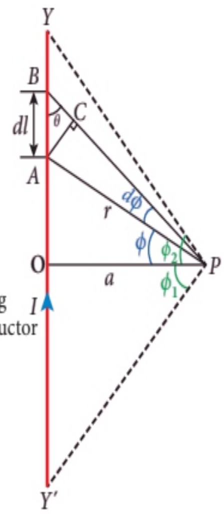
$$\vec{B} = \frac{\mu_0}{4\pi}\left(\frac{2r\,p_m}{(r^2-l^2)^2}\right)\hat{\imath} \qquad \because \left|\overrightarrow{P_m}\right| = q_m.2l$$

$$\boxed{\vec{B} = \frac{\mu_0}{4\pi}\frac{2\overrightarrow{P_m}}{r^3}}$$

3. Deduce the relation for the magnetic field at a point due to an infinitely long straight conductor carrying current using Biot-Savart Law.

- **I** be the steady current flowing through an infinitely long straight conductor of YY'
- Point P is a distance of (a) from the centre of a wire O.

The magnetic field at a point P due to current element Idl



Magnetic field due to a long straight current carrying conductor

$$\overrightarrow{dB} = \frac{\mu_0}{4\pi}\frac{Idl\,sin\theta}{r^2}\,\hat{n}$$

In Δ ABC, AC = dl Sinθ

In Δ APC, AC = rdϕ

dl Sinθ = rdϕ

$$\overrightarrow{dB} = \frac{\mu_0}{4\pi}\frac{Id\phi}{r^2}\,\hat{n}$$

$$\text{In } \Delta OPA\ cos\phi = \frac{a}{r}, r = \frac{a}{cos\phi}$$

$$\overrightarrow{dB} = \frac{\mu_0 I}{4\pi a}\,cos\phi d\phi\,\hat{n}$$

The total magnetic field at P due to the conductor YY'

$$\vec{B} = \int_{-\phi_1}^{-\phi_2} dB$$

$$\vec{B} = \frac{\mu_0 I}{4\pi a}(sin\phi_1 + sin\phi_2)\,\hat{n}$$

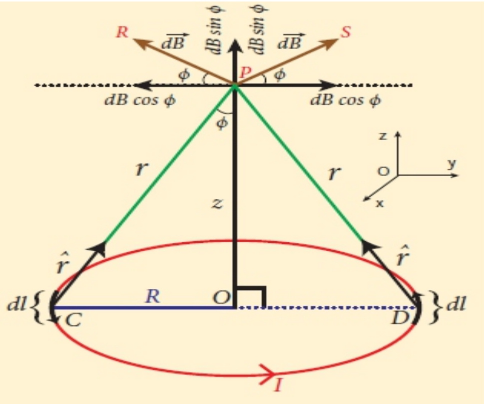
For infinitely long conductor

$\phi_1 = \phi_2 = 90°$

$$\boxed{\vec{B} = \frac{\mu_0 I}{2\pi a}\,\hat{n}}$$

4. Obtain a relation for the magnetic field at a point along the axis of a circular coil carrying current.

- Consider a current carrying circular loop of radius R and I be the current flowing through the wire.
- The magnetic field at a point on the axis of the circular coil at a distance Z form its center of the coil O.
- According to the Biot-Sakart's law the magnetic field at P due to the current elements are equal in magnitude.
- The magnitude of $\overrightarrow{dB}$ is



$$\overrightarrow{dB} = \frac{\mu_0}{4\pi}\frac{I\vec{dl}\times\hat{r}}{r^2}$$

$$dB = \frac{\mu_0}{4\pi}\frac{Idl\,sin\theta}{r^2} \qquad (\therefore \theta = 90°)$$

$$dB = \frac{\mu_0}{4\pi}\frac{Idl}{r^2}$$

- ❖ The magnetic field $\overrightarrow{dB}$ due to each current element is resolved into two components.
- ❖ The horizontal components cancel out while the vertical components $dB \sin\emptyset\hat{k}$ along contribute to the net magnetic field at the point P.

$\vec{B} = \int \overrightarrow{dB} = \int dB\sin\emptyset\hat{k}$

$$\vec{B} = \frac{\mu_0 I}{4\pi}\int\frac{dl\sin\phi\,\hat{k}}{r^2} \;---\;(1)$$

$$\therefore \sin\phi = \frac{R}{\sqrt{R^2+Z^2}}$$

$$r^2 = R^2 + z^2 \qquad \therefore \int dl = 2\pi R$$

$$(1) \Rightarrow \vec{B} = \frac{\mu_0 IR^2}{2(R^2+Z^2)^{3/2}}\hat{k}$$

If coils contain N terms $\vec{B} = \dfrac{\mu_0 NIR^2}{2(R^2+Z^2)^{3/2}}\hat{k}$

Magnetic field at centre of the coil $\boxed{\vec{B} = \dfrac{\mu_0 NI}{2R}\hat{k}}$ $\quad \therefore z = 0$

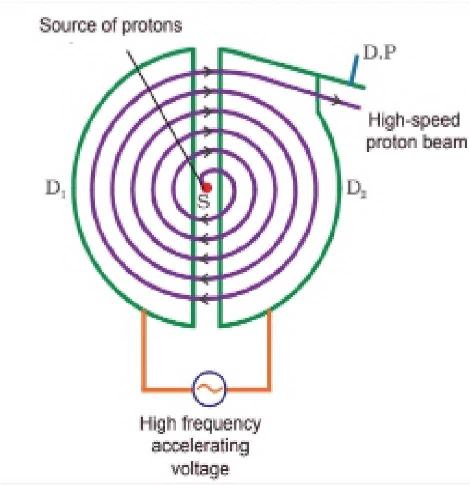
5. Discuss the working of cyclotron in detail.

Principle:

When a charged particle moves perpendicular to the magnetic field, it experiences magnetic Lorentz force.

Construction:

- ❖ D_1 and D_2 are two Semi-Circular metal containers called dees. The two dees are separated with a gap.
- ❖ The Source S is placed at the centre in the gap between the dees.
- ❖ The direction of magnetic field is normal to the plane of the dees.
- ❖ Dees are connected to high frequency alternating potential difference.



Working of cyclotron

Working:

The ion ejected from source S is positively charged is accelerated towards a Dee(D_1) which has negative potential at that time.

Since the magnetic field is normal to the plane of the dees, the ion moves in a circular path.

After one Semi-Circular path inside D_1, the ion reaches the gap between dees.

At this time, the polarities of the dees are reversed. So, that the ion is now accelerated towards D_2, with a greater velocity.

For this circular motion, the centripetal force on the charged particle q is provided by Lorentz force.

$$\frac{mv^2}{r} = qvB$$

$$r = \frac{mv}{qB}$$

$$r \,\alpha\, v$$

Resonance condition:

The frequency of the positive ion circulates in the magnetic field must be equal to the constant frequency of the electrical oscillator f_{osc}.

$$f_{osc} = \frac{Bq}{2\pi m}$$

Time Period of oscillation $\boxed{T = \frac{2\pi m}{Bq}}$

$$\boxed{KE = \frac{1}{2}mv^2 = \frac{B^2q^2r^2}{2m}}$$

6. Derive the expression for the force on a current-carrying conductor in a magnetic field.

- When a current carrying conductor is placed in a magnetic field, the force experienced by the conductor is equal to the sum of Lorentz force on the individual charge carries in the conductor.
- Consider a small segment of conductor of length dl, with cross-sectional area A placed in a magnetic field B.

$$I = neAV_d$$

Current element $I\vec{dl} = -neA\vec{V_d}dl$ --------(1)

Force on a electron $\vec{f} = -e(\vec{V}_d \times \vec{B})$

$$n = \frac{N}{V}$$

$$N = nAdl$$

The force on small element $\vec{dF} = N\vec{f}$

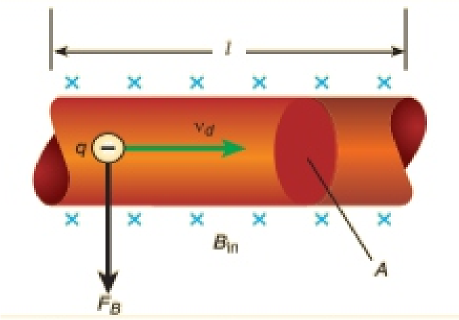
$\vec{dF} = -neAdl(\vec{V}_d \times \vec{B})$ -----------(2)

From the equation 1 and 2 we get.

$$\vec{dF} = I\vec{dl} \times \vec{B}$$

Total force $\vec{F} = I\vec{l} \times \vec{B}$

Magnitude $\boxed{F = BIl\sin\theta}$



Current carrying conductor in a magnetic field

Special case:

$\theta = 0$; F = 0

$\theta = 90°$; F = BIl

7. Derive the expression for the force between two parallel, current-carrying conductors.

- Two long straight parallel current carrying conductors A and B separated by a distance r are kept in air.
- The net magnetic field at a distance r due to current I_1 in conductor A,

$$\vec{B_1} = -\frac{\mu_0 I_1}{2\pi r}\hat{\imath}$$

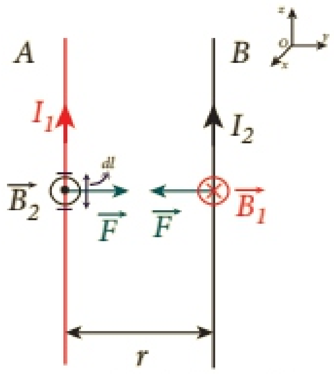
Lorentz force on the element dl of conductor B is.

$$\vec{dF} = (I\vec{dl} \times \vec{B}_1)$$

$$\vec{dF} = -\frac{\mu_0 I_1 I_2}{2\pi r} dl\,.\hat{\jmath}$$

Force per unit length of the conductor B due to current in conductor A is

$$\frac{\vec{F}}{l} = -\frac{\mu_0 I_1 I_2}{2\pi r}\,.\hat{\jmath}$$



Current in both the conductors are in the same direction attracts each other

The net magnetic field at a distance r due to current I_2 in conducto B,

$$\vec{B}_2 = \frac{\mu_0 I_2}{2\pi r}\,.i$$

Lorentz force on the element dl of conductor A is.

$$\vec{dF} = (I_1\vec{dl} \times \vec{B_2})$$

$$\overrightarrow{dF} = \frac{\mu_0 I_1 I_2 dl}{2\pi r} \cdot \hat{j}$$

The force per unit length of the conductor A due to the current in conductor B is.

$$\boxed{\frac{\vec{F}}{l} = \frac{\mu_0 I_1 I_2}{2\pi r}\hat{j}}$$

- ❖ The force between two parallel current carrying conductors is attractive if they carry current in the same direction.
- ❖ The force between two parallel current carrying conductors is repulsive if they carry current in the opposite direction.

Unit-4 Electromagnetic Induction and Alternating Current
Two Mark Questions

1. What is electromagnetic induction?

Whenever the magnetic flux linked with a closed coil changes, an emf (electromagnetic force) is induced in the circuit.

2. Write Faraday's laws of electromagnetic induction?

First Law: Whenever the magnetic flux linked with a closed-circuit change, an emf is induced in the circuit.

Second Law: The magnitude of induced emf in a closed circuit is equal to the time rate of change of magnetic flux linked with circuit.

$$\boxed{\varepsilon = \frac{d\Phi_B}{dt}}$$

3. State Lenz's law.

The direction of the induced current always opposes the cause responsible for its production.

$$\varepsilon = -\frac{d\Phi_B}{dt}$$

4. State Fleming's right hand rule.

The thumb, index finger and middle mutually perpendicular direction.

- ❖ The index finger – The direction of magnetic field.
- ❖ The thumb – The direction of motion of the conductor.
- ❖ The middle finger – The direction of the induced current.

5. Mention the ways of producing induced emf.

- ❖ By changing the magnetic field (B)
- ❖ By changing the area (A) of the coil.
- ❖ By changing the relative orientation (θ) of the coil with magnetic field.

6. What is meant by mutual induction?

When an electric current passing through a coil changes with time, an emf is induced in the neighbouring coil. Unit. Henry.

7. Define the unit of self-induction (or) define one henry.

The induction of the coil is said to be one henry if a current changing at the rate $1AS^{-1}$ of induce an opposing emf of 1V in it.

8. How will you define RMS value of an alternating current?

The square root of the mean of the squares of all currents over one cycle.

9. Define Q factor or Quality factor.

It is defined as the ratio of voltage across L (or) C at resonance to the applied voltage.

$$\text{Q factor } = \frac{Voltage\ across\ L\ or\ \ C\ at\ resonance}{Applied\ voltage}$$

10. What is mean by wattles current?

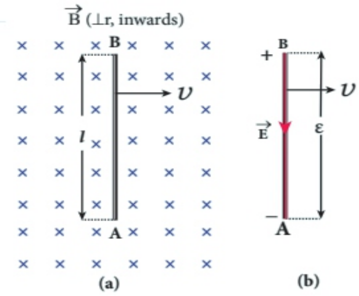
The current is an AC circuit is said to be wattles current. If the power consumed by it is zero.

Three Mark Questions

1. Obtain an expression for motional emf from Lorentz force.

Consider a straight conducting rod AB of length l in a uniform magnetic field B which is directed perpendicularly into the plane of the paper.

Let the rod move with a constant velocity $\vec{v}$ towards right side.



Motional emf from Lorentz force

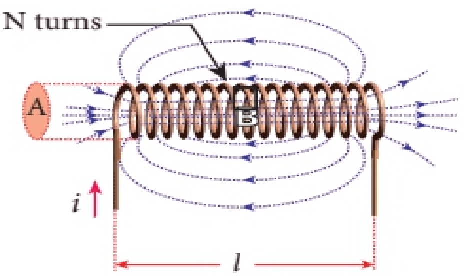
$$\vec{F}_B = -e(\vec{v}\times\vec{B})$$
$$\vec{F}_E = -e\vec{E}$$
$$|\vec{F_B}| = |\vec{F_E}|$$
$$-e(\vec{v}\times\vec{B}) = -e\vec{E} \qquad (\because \theta = 90^\circ)$$
$$vB = E$$

The potential difference across the rod $V = El$

$$V = Bvl$$

Therefore emf $\boxed{\varepsilon = Blv}$

2. Obtain the expression for self-inductance of a long solenoid.



Self-inductance of a long solenoid

- Consider a long solenoid of length l and cross-sectional area A. Let n be the number of turns per unit length of the solenoid.
- When an electric current (i) is passed through the solenoid, magnetic induction inside solenoid.

$$B = \mu_o ni$$
$$\Phi_B = BA$$
$$\Phi_B = (\mu_o ni)A$$
$$N = nl$$
$$N\Phi_B = (\mu_o n^2 Al)\, i$$

Total flux, $N\Phi_B = LI$

In air medium $\boxed{\mathbf{L = \mu_o n^2 A l}}$

In dielectric Medium $\mathbf{L = \mu n^2 A l}$

3. An inductor of inductance L carries an electric current i. How much energy is stored while establishing the current in it?

Whenever a current is established in the circuit, the inductance oppose the growth of the current. In order to establish a current in the circuit work is done against this opposition by some external agency. This work done is stored an magnetic potential energy.

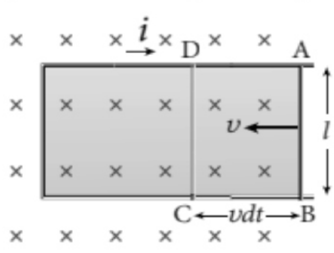
Induced emf $\qquad \varepsilon = -L\dfrac{di}{dt}$

$$\text{Work done } dW = -\varepsilon dq$$
$$dW = -\varepsilon i dt$$
$$dW = Lidi$$
$$W = \int dW = L\int_o^i idi$$
$$W = \frac{1}{2}Li^2$$

Magnetic potential energy $\mathbf{U_B} = \frac{1}{2}\mathbf{Li^2}$

4. How will you induce an emf by changing the area enclosed by the coil?

- Consider a conducting rod of length l moving with a velocity v towards left on a rectangular fixed metallic frame work as shown in figure.



- This arrangement is placed perpendicular in uniform magnetic field B.

Changing area enclosed by loop $dA = ldx$

$$dA = lvdt$$

Changing magnetic flux link with loop $d\Phi_B = B \times dA$

$$d\Phi_B = Blvdt$$

$$\text{Emf } \varepsilon = \frac{d\Phi_B}{dt}$$

$$\boxed{\varepsilon = Blv}$$

5. Mention the various energy losses in a transformer. How it is minimized?

1.Iron loss

(i)Hysteresis loss:

Source: Transformer core is magnetized and demagnetized repeatedly.

Minimize: Using steel of high silicon content in making transformer core.

(ii)Eddy loss:

Source: Alternating magnetic flux in the core induced eddy current in it.

Minimize: Using very thin laminations of transformer core.

2.Copper loss:

Source: When an electric current flows through winding some amount of energy is dissipated due to joule heating.

Minimize: Using wires of larger diameter.

3.Flux leakage loss:

Source: The magnetic lines of primary coil are not completely lined with secondary coil.

Minimize: Winding coils one over the other.

6. What are advantage and disadvantage of AC over DC?

Advantages:

- The generation of AC is cheaper than that of DC.
- The transmission losses are small compared to DC transmission.
- AC can easily be converted in the DC with help of rectifier.

Disadvantages:

- Alternating voltage cannot be used for certain applications.
- At high voltages, it is more dangerous to work with AC than DC.

7. Find out the phase relationship between voltage and current in a pure resistor circuit.

Consider a circuit containing a pure resistor of resistance R connected across an alternating voltage source.

$$v = V_m \sin \omega t \text{ ---- (1)}$$

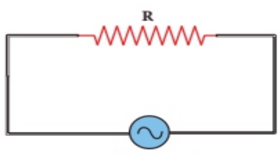
$$v_R = iR$$

$$v - V_R = 0$$

$$v_m \sin \omega t = iR$$

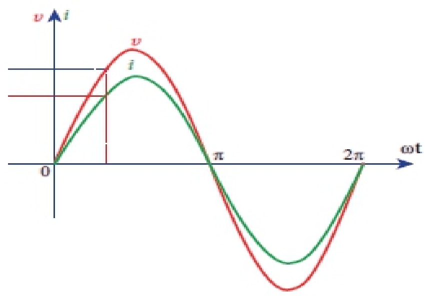
$$i = \frac{V_m}{R} \sin \omega t$$

$$\boxed{I = I_m \sin \omega t}$$



$v = V_m \sin \omega t$

AC circuit with resistor

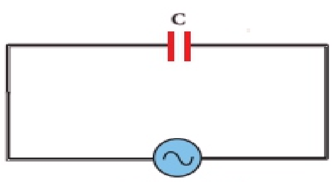


Current is in phase with the applied voltage.

8. Find out the phase relationship between voltage and current in a pure capacitor.

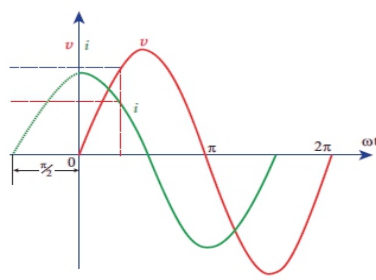
Consider a circuit containing a capacitor of capacitance C connected across an alternating voltage source.

$$v = V_m \sin \omega t \text{ ------- (1)}$$



$v = V_m \sin \omega t$

AC circuit with capacitor



$$v - \frac{q}{c} = 0$$

$q = CV_m \text{ Sin } \omega t$

$i = \frac{dq}{dt} = \frac{d}{dt} \quad (CV_m \text{ Sin}\omega t)$

$i = CV_m\omega \text{ Cos}\omega t$

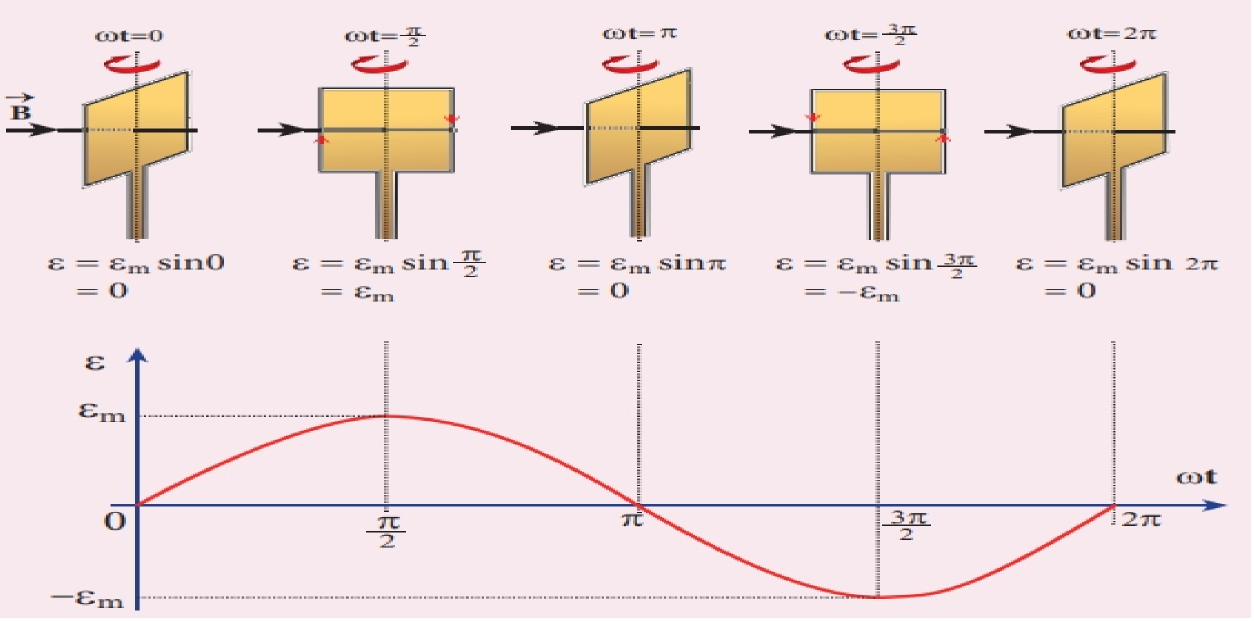
$$\boxed{i = I_m \text{ Sin } (\omega t + \pi/2)}$$

It is clear that current leads the applied voltage by $\frac{\pi}{2}$ in capacitance circuit.

Five Mark Questions

1. Show mathematically that the rotation of a coil in a magnetic field over one rotation induce an alternating emf of one cycle.

Consider a rectangular coil of N turns kept in a uniform magnetic field B. The coil rotates with an angular velocity ω about axis perpendicular to the field.



The flux linkage with a coil

$N\Phi_B = NBAcos\omega t \qquad (\therefore \Phi_B = BAcos\omega t)$

According to Faraday's low, the induced emf

$$\varepsilon = -\frac{d(N\Phi_B)}{dt}$$

$$\boxed{\boldsymbol{\varepsilon = NBA\omega sin\omega t}}$$

When the coil is rotated through 90° from initial position $sin\omega t = 1$

Maximum value of emf $\boxed{\varepsilon_m = NBA\omega}$

The value of induced emf at any instant is then given by $\boldsymbol{\varepsilon = \varepsilon_m \text{ sin } \omega t}$

The alternating current $\boldsymbol{i = I_m \, sin\omega t}$

2. Explain the construction and working of a transformer.

Principle:

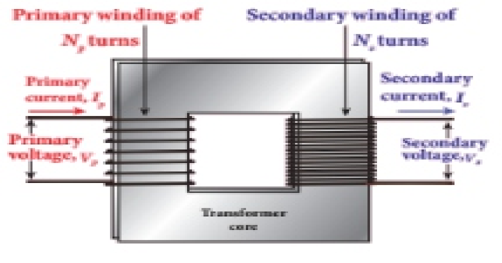
The mutual induction between two coils.

Construction:

- There are two coils of high mutual inductance wound over the same transformer core.
- The laminated core made up of silicon steel.
- The coil across which voltage is applied is known as primary coil.
- The coil from which output power is drawn is known as secondary coil.

Working:

- If the primary coil is connected to a source of alternating voltage, an alternating magnetic flux is set up in the laminated core.
- All the magnetic flux linked with primary coil is also linked with the secondary coil. As a result of flux change, emf is induced in both primary and secondary coils.



Construction of transformer

V_p, ε_p, N_p are the voltage across the primary coil. Induced back emf and number of turns of primary coil then.

$$v_p = \varepsilon_p = -N_p \frac{d\Phi_B}{dt}$$

$$v_s = \varepsilon_s = -N_s \frac{d\Phi_B}{dt}$$

For an ideal transformer Input power = Output power

$$V_p i_p = V_s i_s$$

$$\boxed{\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s} = K}$$

Step-up transformer	Step-down transformer
$N_s > N_p$	$N_s < N_p$
$K > 1$	$K < 1$
$V_s > V_p$	$V_s < V_p$
$I_p > I_s$	$I_p < I_s$

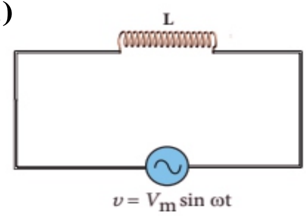
Efficiency of a transformer:

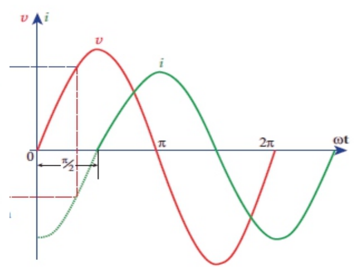
$$\eta = \frac{Output\ power}{Input\ power} \times 100\%$$

3.Find out the phase relationship between voltage and current in pure inductive circuit.

- Consider a circuit containing a pure induction of inductance L connected across an alternating voltage source.

$$\boldsymbol{v = V_m \sin \omega t \quad \text{-- (1)}}$$





$$\text{Back emf } \varepsilon = -L\frac{di}{dt}$$

$$v + \varepsilon = 0$$

$$V_m \sin \omega t = L\frac{di}{dt}$$

$$di = \frac{V_m}{L}\sin \omega t \; dt$$

$$i = \frac{V_m}{L}\int \sin \omega t \, dt$$

$$i = \frac{V_m}{L\omega}(-\cos \omega t)$$

$$\boldsymbol{i = I_m \sin(\omega t - \pi/2) \text{------------ (2)}}$$

From equation 1 and 2 It is clear, that current lags behind the applied voltage by $\frac{\pi}{2}$.

4. Drive an expression for phase angle between the applied voltage and current in a series RLC circuit.

- Consider a circuit containing a resister of resistance R, an inductor of inductance L and a capacitance of capacitance C connected across an alternating voltage source.

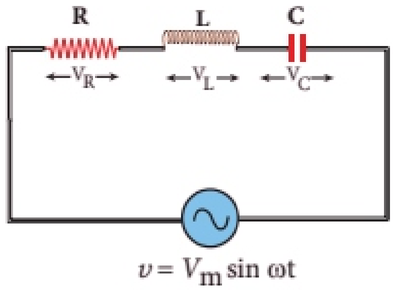
$$v = V_m \ \text{Sin}\ \omega t$$

Let i be the current in the circuit at that instant.
Hence the voltage developed across R, L and C

$$V_R = iR\ (V_R \text{ is in phase with } i)$$

$$V_L = iX_L\ (V_L \text{ leads } i \text{ by } \frac{\pi}{2})$$

$$V_c = iX_C\ (V_c \text{ lags } i \text{ by } \frac{\pi}{2})$$



AC circuit containing R, L and C

If $V_L > V_C$
The resultant voltage V_m

$$V_m^2 = V_R^2 + (V_L - V_C)^2$$

$$V_m = I_m\sqrt{R^2 + (X_L - X_C)^2}$$

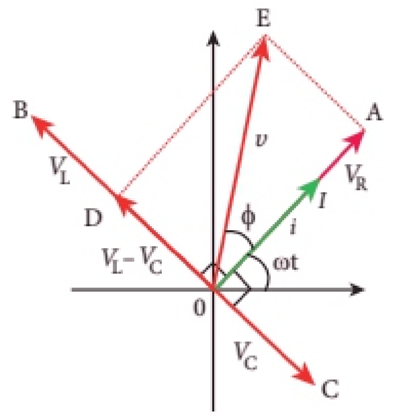
$$I_m = \frac{V_m}{\sqrt{R^2 + (X_L - X_C)^2}}$$

$$I_m = \frac{V_m}{Z}$$

Where $\boldsymbol{Z} = \sqrt{\boldsymbol{R^2 + (X_L - X_C)^2}}$ is called impedance of the circuit.

The phase angle

$$\tan\phi = \frac{V_L - V_C}{V_R} = \frac{X_L - X_C}{R}$$



Phasor diagram for a series RLC – circuit when $V_L > V_C$

Special cases:

1. $X_L > X_C, X_L - X_C$ and ϕ are positive

$$v = V_m sin\omega t, i = I_m Sin(\omega t + \phi)$$

This circuit is inductive

2. $X_L < X_C$ phase angle ϕ is negative

$$v = V_m sin\omega t, i = I_m Sin(\omega t - \phi)$$

This circuit is capacitive.

3. when $X_L = X_C$, phase angle $\phi = 0$

$$v = V_m sin\omega t, i = I_m Sin\omega t$$

This circuit is resistive.

5. What are eddy (Foucault) currents? Explain the application of eddy currents.

- When magnetic flux linked with a sheet or plate changes, electric currents are induced. As these electric current resembles eddies of water, these are known as eddy currents.

Applications:

(i). Induction Stove:

- It is used to cook the food quickly and safely with less energy consumption. Below the cooking zone, there is a tightly wound coil of insulated wire.
- A suitable cooking pan is placed over the cooking zone.
- When the stove is switched on an AC flowing in the coil produce high frequency alternating magnetic field which induce very strong eddy currents in the cooking pan.
- The eddy currents in the pan produce so much of heat due to Joule heating which is used to cook the food.

(ii). Eddy current brake:

- ❖ Strong electromagnets are fixed just above the rails. To stop the train, electromagnets are switched on.
- ❖ The magnetic field of these magnets induces eddy currents in the rails which oppose or resist the movement of the train.

(iii). Eddy current testing:

- ❖ Find defects like surface cracks, air bubbles present in a specimen. A coil of insulated wire is given an alternating electric current.
- ❖ When this coil is brought near the test surface, eddy current is induced in the test surface defects causes the change in phase and amplitude of the eddy current.

(iv). Electromagnetic damping:

- ❖ The armature of the galvanometer coil is wound on a soft iron cylinder.
- ❖ Relative motion between the soft iron cylinder and the radial magnetic field induces eddy current in the cylinder. The damping force due to eddy current bring the armature to rest immediately.

Unit 5. Electromagnetic Waves
Two Mark Questions

1. What is displacement current?

The current present in the region in which the electric field or the electric flux are changing with time.

2. What are electromagnetic waves?

Electromagnetic waves are non-mechanical waves which move with speed equals to the speed of light in vacuum. It is a transverse wave.

3. Write down the integral form of modified ampere's circuital law?

Maxwell modified ampere's law as,

Here where, $i -$ Total current: $i_c -$ Conduction current: $i_d -$ Displacement current.

$$\int_l \vec{B}.\vec{dl} = \mu_0 i = \mu_0(i_c + i_d)$$

4. Write notes on Gauss' law in magnetism.

$$\oint_s \vec{B}.\vec{dA} = 0$$

The surface integral of magnetic field over a closed surface is zero.

This equation implies that the magnetic lines of force form a continuous closed path It mean that no isolated magnetic monopole exists in nature.

5. Why are electromagnetic waves non – mechanical.

Electromagnetic waves do not require any medium for propagation.

6. Write notes on Ampere – Maxwell law?

$$\oint_l \vec{B}.\vec{dl} = \mu_0 i_c + \mu_0 \varepsilon_0 \frac{d}{dt} \oint \vec{E}.\vec{dA}$$

This law relates the magnetic field around any closed path to the conduction current and displacement current through that path.

7. Give any two uses of i) IR Radiation, ii) Microwaves and iii) UV radiation.

i) IR Radiation:

It is used to provide electrical energy to satellite.

It is used to produce dehydrate fruits.

ii) Microwaves:

It is used in microwave oven for cooking.

It is used in very long-distance wireless communication through satellites.

iii) UV Radiation:

It is used in the study of molecular structure.

It is used to destroy bacteria and sterilizing the surgical instruments.

Three Mark Questions

1. What are the fraunhofer lines how are they useful in identification of elements in the sun.

- These dark lines in solar spectrum are known as fraunhofer lines.
- The absorption spectra for various materials are compared with the fraunohofer lines in the solar. Its helps identify the elements.

2. Write short notes on i) Microwaves and ii) X-rays.

i) Microwaves:

- It is produced by special vacuum tubes.
- It undergoes reflection and polarization.

ii) X-ray:

- It is produced when there is a sudden stopping of high speed electrons by high atomic number target and also by electronic transition among innermost orbitals of atoms.
- X-rays have more penetrating power than ultraviolet radiation.

3. Write short notes on i) Radio waves, ii) Visible light.

i) Radio Waves:

- It is produced by accelerating charges in conducting wire.
- It undergoes reflection and diffraction.
- It is used in radio and television communication systems.

ii) Visible light.

- It is produced by incandescent bodies and also it is radiated by excited atoms in gases.
- It obeys the laws of reflection and refraction.
- It undergoes interference, diffraction, polarized and photo-electric effect.

4. Write a uses on i) X-rays, ii) Gamma rays.

i) X-rays

- It is used in detecting fractures, diseased organs, formation of bones and stones. Observing the progress of healing bones.
- It is used to detect faults, cracks. Flaws and holes.

ii) Gamma rays.

- It is used in radio therapy for the treatment of cancer and tumour.
- It is used in food industry to kill pathogenic microorganism.
- It is used in the structure of atomic nuclei.

5. Write down the properties of electromagnetic waves.

- Electromagnetic waves are produced by any accelerated charges.
- Electromagnetic waves do not require any medium for propagation.
- Electromagnetic waves travel with the speed of light in vacuum or free space.
- Electromagnetic waves are not deflected by electric field or magnetic field.
- Electromagnetic waves can exhibit interference, diffraction and Polarisation.
- Electromagnetic waves carry energy, linear momentum and angular momentum.

Five mark Questions

1. What is emission spectra? Explain their types?

When the spectrum of self-luminous source is taken, we get emission spectrum. Each source has its own characteristic emission spectrum.

Types of emission spectrum:

a) continuous emission spectrum.

b) Line emission spectrum.

c) Band emission spectrum

a) Continuous emission spectrum:

If the light from incandescent lamp is allowed to pass through prism, it splits into seven colours. It consists of wavelengths containing all the visible colours ranging from violet to red.

Example: Spectrum obtained from carbon arc and incandescent solids.

b) Line emission spectrum:

Light from hot gas is allowed to pass through prism, line spectrum is observed.The line spectra are sharp lines of definite wavelengths or frequencies.It arises due to excited atoms of the elements.These lines are the characterisics of the element.

Example: Spectra of atomic hydrogen, helium.

c) Band emission spectrum:

Band spectrum consists of several number of very closely spaced spectral lines which overlapped to gather forming specific bands which are separated by dark spaces.This spectrum has a sharp edge at one and fades out at the other end.

Example: Spector of ammonia gas in the discharge tube.

2. What is absorption spectra? Explain their types?

When light is allowed to pass through a medium or an absorbing substance then the spectrum obtained is known as absorption spectrum. It is the characteristic of absorbing substance.

Types of absorption spectrum:

i) Continuous absorption spectrum.
ii) Line absorption spectrum.
iii) Band absorption spectrum.

i) Continuous absorption spectrum:

When we pass white light through a blue glass plate, it absorbs all the colours except blue and give continuous absorption spectrum.

ii) Line absorption spectrum:

When light from the incandescent lamp is passed through cold gas, the spectrum obtained through the dispersion due to prism is line absorption spectrum.

Example: If the light from the carbon arc is made to pass through sodium vapour, a continuous spectrum of carbon are with two dark lines in the yellow region are obtained.

iii) Band absorption spectrum:

When the white light is passed through the iodine vapour, dark bands on continuous bright background is obtained.

Example: When white light is passed through diluted solution of blood or chlorophyll, band absorption spectrum is obtained.

3. Write down Maxwell equation in integral form.

a) Maxwell's 1st equation:

It relates the net electric flux to net electric charge enclosed in a surface.

$$\oint_S \vec{E}.\overrightarrow{dA} = \frac{Q_{\text{closed}}}{\epsilon_o} \qquad (Gauss's\ Law\ for\ electricity)$$

Where is $\vec{E}$ the electric field and $Q_{enclosed}$ is the net charge enclosed.

b) Maxwell's 2nd equation:

The surface integral of magnetic field over a closed surface is zero.

$$\oint_S \vec{B}.\overrightarrow{dA} = 0 \qquad (Gauss's\ Law\ for\ magnetism)$$

Where $\vec{B}$ is the magnetic field.

c) Maxwell's 3rd equation:

This law relates electric field with the changing magnetic flux.

$$\oint_l \vec{E}.\overrightarrow{dl} = -\frac{d\emptyset_B}{dt} \qquad (faraday's\ Law)$$

Where $\vec{E}$ is the electric field.

d) Maxwell's 4th equation:

This law relates the magnetic field around any closed path to the conduction current and displacement current through that path.

$$\oint_l \vec{B}.\overrightarrow{dl} = \mu_o i_c + \mu_o \epsilon_o \frac{d}{dt}\oint_S \vec{E}.\overrightarrow{dA} \qquad (Ampere - Maxwell\ Law)$$

Unit 6. Ray Optics
Two Mark Questions:

1. Laws of reflection.

- ❖ The incident ray, reflected ray and normal to the reflecting surface are all coplanar.
- ❖ Angle of incidence = angle of reflection.

2. What is principle of reversibility?

The principle of reversibility states that light will follow exactly the same path if its direction of travel is reversed.

3. What is Rayleigh's scattering?

- ❖ The scattering of light by particles of size less than that of the wavelength of light is called Rayleigh's scattering.
- ❖ The intensity of light scattered is inversely proportional to fourth power of wavelength.

$$\boxed{I\ \alpha\ \frac{1}{\lambda^4}}$$

4. Why does sky appear blue?

According to Rayleigh's scattering

- ❖ Shortest wavelength gets much scattered during day time.
- ❖ As our eyes are more sensitive to blue colour then violet colour, sky appears blue during day time.

5. What is the reason for reddish appearance of sky during sunset and sunrise?

According to Rayleigh's scattering during sunrise and sunset, the light from sun travels a greater distance. So blue light which has shorter wavelength scattered away and red light of longer wavelength manages to reach our eyes.

6. Why does rain cloud appear dark?

Rain clouds appear dark because of the condensation of water droplets on dust particles that makes cloud opaque.

7. How are rainbows formed?

- ❖ Dispersion of sunlight through droplets of water during rainy days.
- ❖ When sunlight falls on the water drop suspended in air. It splits into its constituent seven colours.

8. Why do stars twinkle?

- ❖ Actualy stars do not twinkle.
- ❖ They appear twinkling because of the movement of the atmospheric layers with varying refractive index which is clearly seen in the sky.

9. What is optical path?

Optical path of a medium is defined as the distance d' light travels in vacuum in the same time it travels a distance d in the medium. $d' = nd$

10. Why the diamond glittering.

- ❖ Diamond appears dazzling because of the total internal reflection of light that happens inside the diamond. The refractive index of diamond is about 2.417.
- ❖ The critical angle of diamond is about 24.4^0.

11. What is power of a lens?

The power of a lens P is defined as the reciprocal of its focal length.

$$P = \frac{1}{f} \qquad \text{Its unit is dioptre}$$

12. Define critical angle.

The angle of incidence in the denser medium for which the angle of refraction is 90^o or The refracted ray graces the boundary between the two media is called critical angle.

Three Mark Question

1. What is mirage?

- ❖ In hot places air near the ground is hotter than air at a height.
- ❖ Refractive index of air increases with height.
- ❖ The ray of light successively deviates away from the normal at different layers of air and undergoes total internal reflection when the angle of incidence near the ground exceeds the critical angle this gives an illusion as if the light comes from somewhere below the ground.

2. What is looming?

- ❖ The temperature of air close to the ground is lesser than the temperature.
- ❖ In the cold places the refractive index increases towards the ground.
- ❖ In the cold places the reverse effect of mirage will happen. Hence an inverted image is formed little above the surface.

3. What is total internal reflection? Write the two conditions for total internal reflection.

For any angle of incidence greater than the critical angle, the entire light is reflected back into the denser medium it self. This phenomenon is called total internal reflection.

Conditions:

- ❖ Light must travel from denser to rarer medium.
- ❖ Angle of incidence in the denser medium must be greater than critical angle $(i > i_c)$

4. Obtain the equation for apparent depth.

- ❖ It is a common observation that bottom of a tank filled with water appears to be raised.

In figure.

$d \rightarrow Real\ depth$

$d' \rightarrow Apparent\ depth$

From figure. Snell's law

$n_1 \sin i = n_2 Sin\, r$

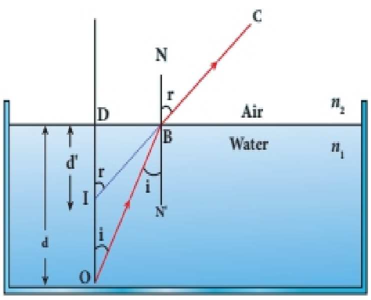
$n_1 \tan i = n_2 tan\, r$ (for small angle, $sin\theta = tan\theta$)

$$\frac{n_1}{d} = \frac{n_2}{d'}$$

Substitute, $n_1 = n$, $n_2 = 1$ (air medium)

Apparent depth $d' = \frac{d}{n}$

(or) $\boxed{d - d' = d(1 - \frac{1}{n})}$



Apparent depth

5. Derive the relation between f and R for spherical mirror.

C-Centre of curvature of mirror, i-angle of incidence and F-principal focus.

From figure,

$$\tan i = \frac{PM}{PC} = i$$

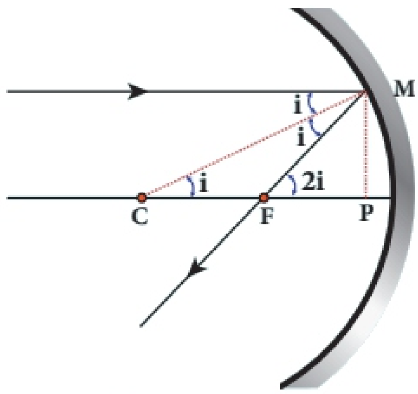
$$\Delta MFB, tan2i = \frac{PM}{PF} = 2i$$

So, $$\frac{PM}{PF} = \frac{2PM}{PC} \rightarrow \frac{1}{PF} = \frac{2}{PC}$$

Substitute, $PF = f, PC = R$

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

$R - Radius\ of\ curvature \quad f - focal\ length$



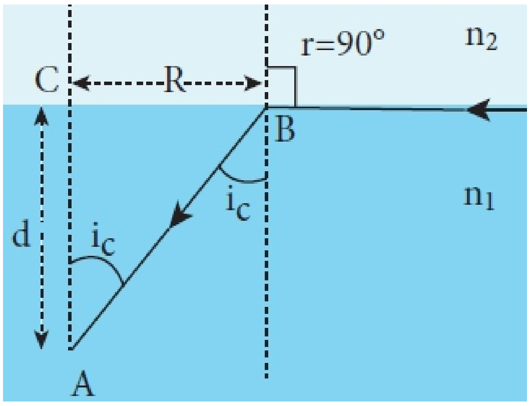
Concave mirror

6. Why do clouds appear white?

- Clouds contain large size of dust and water droplets.
- In clouds all the colours get equally scattered irrespective of wavelength. So it appears white.

7. Sneel window or derive radius of illumination of equation.

When the light entering the water from outside is seen from inside of the water the view is restricted to a particular angle equal to the critical angle.



$$n_1 \sin i_c = n_2 \sin 90^\circ$$

$$\sin i_c = \frac{n_2}{n_1} - - - (1) \qquad (\therefore \sin 90^\circ = 1)$$

$$\Delta ABC \ \sin i_c = \frac{R}{\sqrt{d^2 + R^2}} - - - (2)$$

$$(1) = (2), \ \frac{n_2}{n_1} = \frac{R}{\sqrt{d^2 + R^2}}$$

$$R \ = d\left(\sqrt{\frac{{n_2}^2}{{n_1}^2 - {n_2}^2}}\right)$$

$n_2 = 1$ and $n_1 = n$ sub.

$$\boldsymbol{R \ = d\left(\sqrt{\frac{1}{{n_1}^2 - 1}}\right)}$$

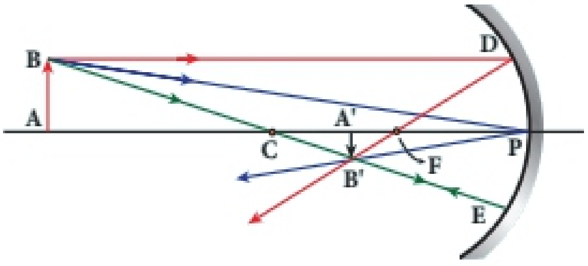
Five Mark Questions

1. Drive the mirror equation and the equation for lateral magnification.

$AB \rightarrow object$

$A'B' \rightarrow image$

From figure, ΔABP & $\Delta A'B'P$ are similar triangles.



Mirror equation

$$\frac{A'B'}{AB} = \frac{PA'}{PA} \rightarrow \boxed{1}$$

Similarly ΔDPE & $\Delta A'B'F$ are similar triangles.

$$\frac{A'B'}{PD} = \frac{A'F}{PF} \rightarrow \boxed{2}$$

As

$$PD = AB, \quad \frac{A'B'}{AB} = \frac{A'F}{PF} \rightarrow \boxed{3}$$

Compare 1 & 3 we can write,

$$\frac{PA'}{PA} = \frac{PA' - PF}{PF} \rightarrow \boxed{4}$$

$$(\because A'F = PA' - PF)$$

Substitute $PA = -u, \ PA' = -V, \ PF = -f$ in equation no.4

We can arrive , $\frac{1}{f} = \frac{1}{u} + \frac{1}{V}$ This equation is mirror equation.

Lateral Magnification $\boldsymbol{m = -\frac{V}{u} = \frac{f}{f-u}}$

$$\text{Magnification} = \frac{height\ of\ the\ image}{height\ of\ the\ object}$$

2. Obtain lens maker's formula.

R_1 , R_2 → Radii of curvature of two spherical 1 & 2

n_2 → refractive index of the lens.

For the refracting surface 1, the light goes from n_1 *to* n_2

$$\frac{n_2}{V'} - \frac{n_1}{u} = \frac{(n_2 - n_1)}{R_1} --- (1)$$

For the refracting surface 2, the light goes from n_2 *to* n_1

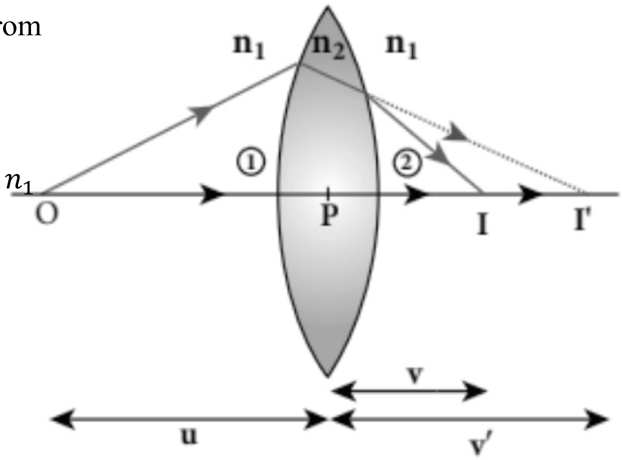
$$\frac{n_1}{V} - \frac{n_2}{V'} = \frac{(n_1 - n_2)}{R_2} --- (2)$$

Dividing by n_1 we get

$$\frac{1}{v} - \frac{1}{u} = \left(\frac{n_2}{n_1} - 1\right)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

Substitute $n_2 = n$ and n=1 (air medium)

$$\frac{1}{v} - \frac{1}{u} = (n - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right) --- (3)$$



Refraction through thin lens

If the object is at infinity, image is formed at the focus of the lens. Then substitute $u = \infty, V = f$ in equation 3

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

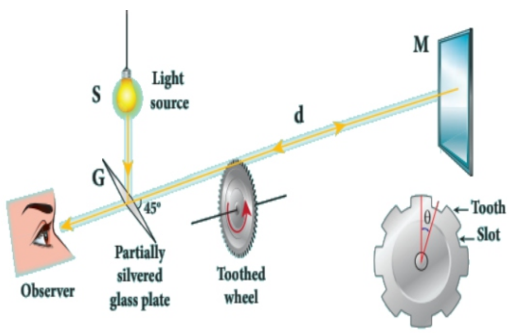
This equation is called as lens maker's formula.

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

This equation is lens equation

3. Describe the Fizeau's method to determine speed light.

- ❖ Light from the source S was first allowed to fall on a partially silvered glass plate G kept at an angle of 45°.
- ❖ Light was then allowed to pass through a rotating toothed wheel. Light passing through one cut in the wheel, will get reflected by a mirror M kept at long distance "d".
- ❖ Angular speed of wheel as increased until light passing through one cut would completely be blocked by the adjacent tooth.
- ❖ This is ensured by the disappearance of light while looking through the partially silvered glass plate.
- ❖ Toothed wheel has N teeth and N cuts of equal width.



Speed of light by Fizeau's method

2d is the distance travelled by the light during the time t.

Angular speed of wheel is

$$\omega = \frac{\theta}{t} = \frac{\pi}{Nt}\left(\because \theta = \frac{\pi}{N}\right) --- (1)$$

Time taken for the angular displacement θ is t from equation-1,

$$t = \frac{\pi}{N\omega}$$

$$\text{Speed of light} = \frac{distance\ travelled\ by\ light}{Time\ taken}$$

Speed of light $V = \frac{2d}{t} = \frac{2dN\omega}{\pi}$

$$\boldsymbol{v = 2.99792 \times 10^{8} ms^{-1}}$$

Unit 7. Wave Optics
Two Mark Questions

1.What is wavefornt?

The locus of point which are in same phase of vibration is called wave front.

2. What is interference of light?

The superposition of nodes and antinodes from the coherent sources is called interference of light.

3. What is the relation between phase difference and path difference?

$$\phi = \frac{2\pi}{\lambda}\delta$$

$\lambda - Wave\ length$
$\phi - Phase\ difference$
$\delta - path\ difference$

4. What are coherent sources?

Two light sources are said to be coherent if they produce waves which same phase difference, same frequency and same wave length.

5. What is diffraction?

Diffraction is bending of waves around sharp edges into the geometrically shadowed region.

6. Define Fresnel distance.

Fresnel distance is the distance up to which the ray optics is valid.

$$\boldsymbol{Z = \frac{a^2}{2\lambda}}$$

7. What is double refraction?

When unpolarised light is incident on a calcite crystal two refracted rays are produced. this phenomenon is called double refraction.

8. What are presbyopia and astigmatism?

Presbyopia: the inefficiency defect of vision apart 25 cm from old aged people is called presbyopia.

Astigmatism: Astigmatism is the defect arising due to different curvature along different planes in the eye lens.

9. What are myopia and hypermetropia? How can they reduced?

a) Myopia is the defect in which a person suffering cannot see distant objects. It can be reduced using concave lens.

b) Hypermetropia is the defect in which person suffering to cannot see nearest objects. It can be reduced by convex lens.

10. Define Malus law.

The intensity of light transmitter from the analyser is proportional to the square of the component of the amplitude transmitted by the analyser. $\boldsymbol{I \propto (a\cos\theta)^2}$

11. Define Huygens's principal.

- ❖ Each point on the wave front behaves has the source of secondary wavelets spreading out in the all directions with the speed of wave.
- ❖ The envelop to all these wavelets gives the position and shape of the new wavefront at a later time.

PHYSICS

Three Marks Questions

1. Distinguish between Fresnel and Fraunofer diffraction.

Fresnel Diffraction	Fraunofer Diffraction
Light source is at finite distance	Light source is at infinite distance
Spherical or cylindrical wavefront.	Plane wave front.
Does not using convex lens.	Using convex lens.
Difficult to examine / analyse	Easily examined/ analysed.

2. Distinguish between interference and Diffraction.

Interference	Diffraction
Equally spaced fringes	Unequally spaced fringes.
Intensity of all fringes almost same	Intensity falls rapidly for higher order
Large number of fringes are obtained	Less number of fringes are obtained.

3. Uses (application) of Polaroid's.

- ❖ They are used in goggles and cameras to avoid glare of light.
- ❖ They are useful in three-dimensional motion (holography) pictures.
- ❖ They are used in liquid crystal display (LCD).
- ❖ They are used to write in CDs.
- ❖ They are used to improve contrast in old oil paintings.

4. State and explain the Brewster law.

- ❖ Consider XY is a plane, in which incident ray, reflected ray, refracted ray are shown in the figure.
- ❖ "At a particular incident angle, the reflected ray is completely polarised, this incident angle is called angle of polarisation".

From the figure

$i_p + r_p + 90° = 180°$

$i_p + r_p = 90°$

$r_p = 90° - i_p$

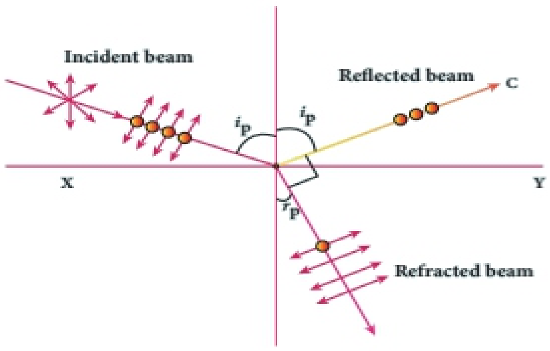
From snells law,

$$\frac{\sin i_p}{\sin r} = n$$

$$\frac{\sin i_p}{\sin(90^\circ - i_p)} = n$$

$$\frac{\sin i_p}{\cos i_p} = n$$

$$\boxed{\tan i_P = n}$$



Polarisation by reflection

Brewster's law:

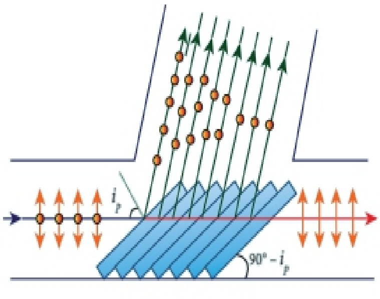
"Brewster's law states that the tangent of the polarizing angle is numerically equal to the refractive index of the medium"

5. Write short note about pile of plates.

Principle: Polarisation by reflection.

Construction: It consists number of glass plates placed one over the other in a tube inclined at an angle of $90° - i_p$ as shown.

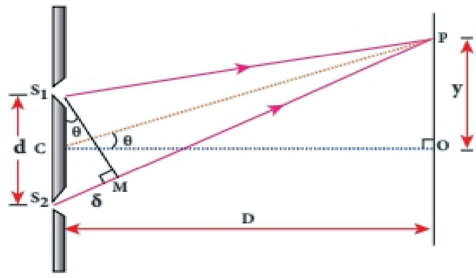
A beam of unpolarised light is allowed to fall on the pile of plates, the surface which may present in the refracted light get a chance for further reflection at the succeeding plates. (Polarising angle of glass)



Pile of plates

Five Mark Questions

1. Explain the young's double slit experiment and derive.
1) Path difference and ii) Band width using that experiments.



Young's double slit arrangement to find path difference

Structure: Consider a light of wavelength λ is illuminated two coherent sources S_1 and S_2 of distance d.
D be the distance between coherent sources and screen.
The path difference. $\delta = S_2P - S_1P$

$\delta = S_2P - MP \qquad (\because S_1P = MP)$

$\delta = S_2M$

In ΔS_1S_2M

$dsin\theta = s_2M$

$When\ \theta\ is\ too\ small$

$d\theta = s_2M$

$\delta = d\theta$

In ΔCOP

$$tan\theta = \frac{y}{D}$$

When θ is too small

$$\theta = \frac{y}{D}$$

The path difference $\delta = d\theta$

$$\boxed{\boldsymbol{\delta = \frac{dy}{D}}}$$

The condition for (maximum) bright bands:

The condition for constructive interference, the path difference $\delta = n\lambda$

$$\frac{dy}{D} = n\lambda$$

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

The condition for (minimum) dark bands:

The condition for destructive interference, the path difference $\delta = (2n - 1)\frac{\lambda}{2}$

$$\frac{dy}{D} = (2n - 1)\frac{\lambda}{2}$$

$$y = \frac{D}{d}(2n - 1)\frac{\lambda}{2}$$

Band width:

"Band width is defined as the distance between two consecutive bright bands or dark bands."

$$\boxed{\boldsymbol{\beta = \frac{\lambda D}{d}}}$$

The conditions for obtaining clear and bright interference bands are,
i) The screen should be for away from the coherent sources.
ii) The wavelength of light λ is maximum.
iii) The coherent sources must be as close as possible.

2. Explain the simple microscope and obtain the equation for magnification.

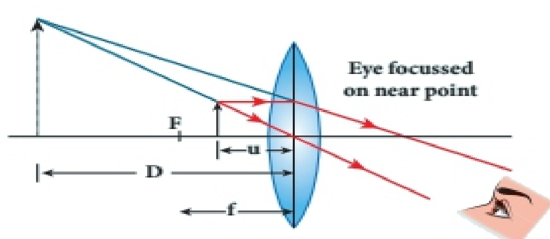
- ❖ In a simple microscope low focal length of convex lens used.
- ❖ The image is to get an erect, magnified virtual image.
- ❖ The image obtained at 25cm is called near point focusing or least distance.

a) Magnification in near point focussing:

Magnification

$$m = \frac{v}{u} = \frac{Image\ distance}{Object\ distance}$$

From lens equation,



Near point focusing

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

Magnification

$$m = 1 - \frac{v}{f} = 1 + \frac{D}{f}$$

b) Magnification in normal focussing:

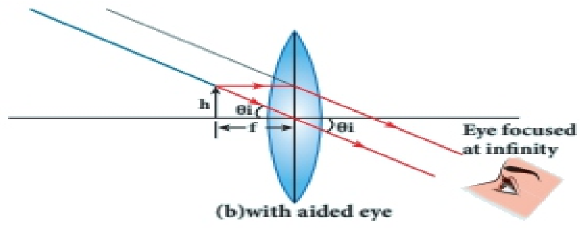
Magnification $m = \frac{h'}{h}$

$$m = \frac{\theta_i}{\theta_0} ---(1)$$

$$\tan\theta_o \approx \theta_o = \frac{h}{D}$$

$$\tan\theta_i \approx \theta_i = \frac{h}{f}$$

Subs θ_i and θ_0, in 1 we get $m = \frac{D}{f}$



Normal focusing

3. Explain compound microscope and obtain the equation for magnification and resolving power.

- ❖ It is used to see the plant cells and animal cells.
- ❖ It contains low focal length of objective lens and high focal length of eyepiece.
- ❖ Objective lens gives real, inverted large image and it is used an object of eyepiece convex lens.
- ❖ Eyepiece produced enlarged and virtual image.

From figure.

$m_o = \frac{L}{f_0}$

For eye piece (near point focusing)

$$m_e = 1 + \frac{D}{f_e}$$

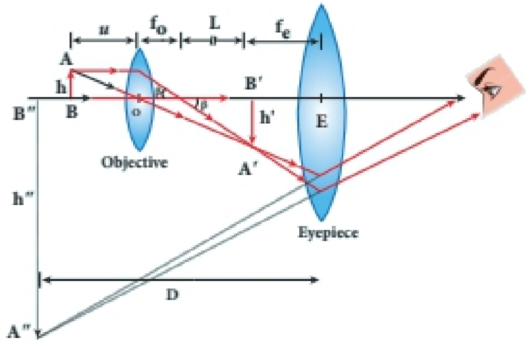
Total Magnification $m = m_0 m_e$

$$=\left(\frac{L}{f_0}\right)\left(1 + \frac{D}{f_e}\right)$$

If the image is at infinite distance normal focusing)

Total Magnification $m = m_o m_e$

$$m = \left(\frac{L}{f_0}\right)\left(\frac{D}{f_e}\right)$$



Compound microscope

Unit 8.Dual Nature of Radiation and Matter
Two Mark Questions

1. Why do metals have a large number of free electrons?

- ❖ Weak bonds between free electrons and nucleus.
- ❖ Free electrons move all directions at room temperature.

2. Define work function of a metal. Give its units.

The minimum energy required to remove free electron from the metal surface is called work function. Its unit. eV

$$\boxed{\phi_0 = h\gamma_0}$$

3. What is photo electric effect?

The emission of photo electron when UV rays incident on metal surface is called photo electric effect.

4. How does photo current vary with the intensity of light?

Photo current is directly proportional to the intensity of light.

5. Define the intensity of light, write its units.

It is defined as the number of photo electrons incident on unit area in unit time.
Its unit is Wm^{-2}

6. Define stopping potential or cut off potential.

It is defined as the minimum negative retarding potential given to anode in which photo current becomes zero.

7. Define threshold frequency.

It is defined as the minimum frequency below which no photo electrons emitted and photoelectric emission is impossible.

8. What is a photo cell? And calssify.

The device which convert light energy to current energy is called photo cells.

a) Photo emissive cell

b) Photo voltaic cell

c) Photo conductive cells.

9. State de-Broglie hypothesis.

" The particles like the electrons, protons and all other particles in the dynamical state having wave nature. Such waves are called matter waves".

10. Why we do not see the wave properties of a base ball?

According to de-Broglie wave equation.

$$\boxed{\lambda = \frac{h}{mv}}$$

and $\lambda \ \alpha \ \frac{1}{m}$ When mass increasing, the wavelength is decreasing. Hence it does not measured.

Three Mark Questions:

1. What are electron emission? Explain its various method.

Electron emission:

The liberation of electrons from any surface is called electron emission.

a) **Thermionic emission:**

When a metal is heated at high temperature. The free electrons get emitted in the form of thermal energy. Example. cathode ray tube, X-ray tube.

b**) Field emission:**

Field emission occurs when a metal placed between strong electric field.

E.g.Field emission display

c) **Photo electric emission:**

when electromagnetic radiation incident on a metal surface, photo electrons are emitted. E.g. photo diode, photo electric cells.

d) **Secondary emission:**

When a beam of fast moving electrons strike the surface of the metal, the kinetic energy is transferred to the free electrons on the metal surface.Thus free electrons get sufficient kinetic energy and emitted from the surface.

E.g.photo multiplier tube.

2. List out the laws of photo electric effect.

- ❖ For a given surface, the emission of photoelectrons takes place only if its frequency is greater than certain minimum frequency is called threshold frequency.
- ❖ The number of photo electrons is directly proportional to intensity of light
- ❖ The maximum kinetic energy of photo electrons is directly proportional to the frequency of incident light.
- ❖ Photo electric emission is an instantaneous process.
- ❖ The maximum kinetic energy of photo electrons does not depend the intensity of light.

3. Write the characteristic of photons.

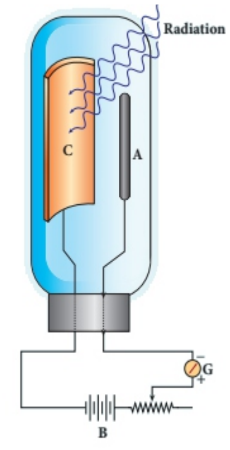
- ❖ If λ be wavelength, ν be frequency of photons then its energy is $E = h\nu$
- ❖ Photons travelled by velocity of light.

- ❖ Photon is electrically neutral. Hence it does not deflect by both electric and magnetic fields.
- ❖ No relation between energy of photon and intensity of photon.
- ❖ When photon's interact with matter, The linear momentum, angular momentum and total energy are conserved.

4. Give the construction, working and application of photo emissive cell.

It is a device which converts light energy into electric energy.

- ❖ It consists an evacuated glass or quartz bulb. It contains a semi cylindric shaped cathode and a thin wire called anode.
- ❖ A Galvanometer and a battery are connected as shown in figure.
- ❖ When exposure of UV radiation on cathode. Photo electrons are emitted attract by anode.
- ❖ Hence photo electric current flows through the galvanometer.



Construction of photo cell

The photo current depends:

1. The intensity of incident light.
2. The potential difference between anode and cathode.

5. Application of photo cells:

- ❖ Used in photo sensors.
- ❖ Used in automatic on off switches.
- ❖ Used in street light as automatic switches.
- ❖ Used in cinematography for echo sound producing.
- ❖ Used to measures the speed of athletes during running race.

6. Write the uses of X-rays.

a) <u>Medical diagnosis:</u>

X-rays photography containing a deep shadow of the bones.

X-rays are used to detect bone fracture, find foreign bodies in human body.

b) **<u>Industry</u>**:

X-ray cure skin diseases, tumours etc.

X-ray are used to find (check) flaws in welding joints motor tyres.

c) <u>Scientific research:</u>

X-rays are used to study the crystal structure and molecules in crystals.

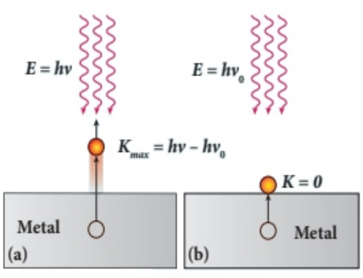
<u>Five mark Questions:</u>

1. Explain experimentally observes the photo electric effect. Write the help of Einstein's explanation.

Consider a photon of energy $E = h\gamma$ is incident on metal surface.

Its energy used in two ways.

- ❖ The minimum energy called photo work function (ϕ_0) is used to liberate photo electrons from metal surface.
- ❖ The remaining energy used as the kinetic energy of ejected photo electrons.



Emission of photoelectrons

$$\therefore\ h\gamma = \phi_0 + \frac{1}{2}mv^2 \ --- (1)$$

Where m= Mass of electron, v=Velocity of electron.

At threshold frequency (γ_0), kinetic energy of photo electron is zero.

$$\phi_0 = h\gamma_0 \ --- (2)$$

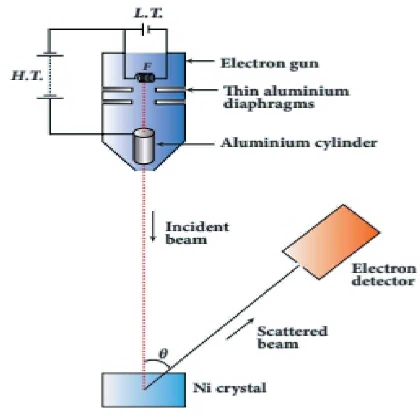
$$h\gamma = h\gamma_0 + \frac{1}{2}mv^2{}_{max} \ --- (3)$$

Equation 3 is known as Einstein's photo electric equation. If the electron does not lose energy by internal collision, then the kinetic energy of electrons is maximum.

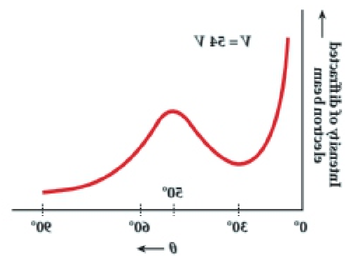
$$K_{\text{Max}} = \frac{1}{2}mv^2{}_{max}$$

$$\boxed{\boldsymbol{K_{\text{max}} = hv - \emptyset_o}}$$

2. Explain the davison – Germer experiment.



Davisson – Germer experiment


Variation of intensity of diffracted electron beam with the angle θ

- ❖ The filament F is heated by low tension battery (LT).
- ❖ The high tension battery (HT) accelerate the emitting electrons from F.
- ❖ Electron beam is collimated by using thin Aluminium diaphragms and they allowed to strike a single nickel crystal.
- ❖ They scattered in different directions and found by detector as shown in the figure.
- ❖ The angle of scattering θ and changing intensities are found and plot a graph against θ, I
- ❖ At 50° angle a peak or maximum obtained corresponding voltage 54 V .
- ❖ Experimentally the wavelength of electron is calculated as 1.65A°
- ❖ using de-broglie wavelength equation.

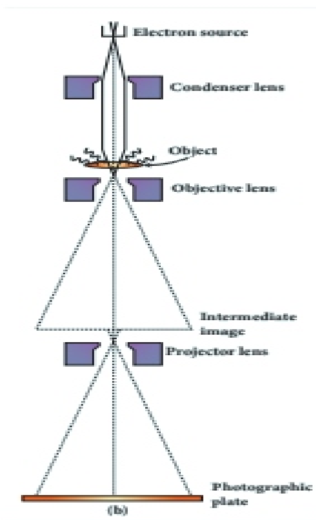
$$\lambda = \frac{12.27}{\sqrt{V}} A^0 = \frac{12.27}{\sqrt{54}} A^0 = 1.67\, A^0$$

can be calculated.

- ❖ This values agree with experimental value $1.65A^0$
- ❖ Thus this experiment directly verifies de-broglie's hypothesis.

3. Explain electron microscope.

<u>Principle</u>:



Electron microscope

- ❖ Wave nature of electron.
- ❖ The electron microscope structure is similar to the optical microscope.
- ❖ In the electron microscope, electric field or magnetic field lenses are used.
- ❖ The resolving power of electron microscope is 2,00,000 times greater than optical microscope.

Working:

- ❖ The electrons emitted from electron source (gun) are accelerated and then collimated by magnetic convex lens.
- ❖ The beam incident on object and magnified by objective magnetic lens and projector magnetic lens are shown in figure.
- ❖ The final magnified image is obtained on the screen.

Use: The electron microscope are being used in almost all branches of science.

4. Drive de-Broglie wavelength of matter waves and electron.

de-Broglie wavelength of matter waves:

$$P = \frac{hv}{C} = \frac{h}{\lambda}$$

$$\boldsymbol{\lambda = \frac{h}{mv} = \frac{h}{P}}$$

de-Broglie wavelength of electrons:

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

$$v^2 = \frac{2eV}{m}$$

$$v = \sqrt{\frac{2eV}{m}}$$

$$\lambda = \frac{h}{mv}$$

$$\lambda = \frac{h}{m\sqrt{\frac{2eV}{m}}}$$

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

The kinetic energy of electron $K = eV$, then the equation 3 becomes

$$\lambda = \frac{\mathrm{h}}{\sqrt{2\mathrm{mk}}}$$

Using known values

$$\lambda = \frac{12.27}{\sqrt{\mathrm{V}}}\mathrm{A}^{\circ}$$

If potential difference is 100 Volt,

$$\lambda = \frac{12.27}{\sqrt{100}}\mathrm{A}^{\circ} = 1.227\mathrm{A}^{\circ}$$

Unit 9. Atomic and Nuclear Physics

Two Mark Questions

1. Give the results of Ruther ford alpha scattering experiment.

- Most of the alpha particles are undeflected through the gold foil and went straight.
- Some of the alpha particles are deflected through a small angle.
- A Few alpha particles deflected through the angle more than 90^{o}.
- A very few alpha particles deflected back by 180^{o}.

2. Define ionization energy.

- The minimum energy required to remove an electron from an atom in the ground state is known as ionization energy.
- Ionization energy of hydrogen is 13.6 eV.

3. Define ionization potential.

- Ionization potential is defined as ionization energy per unit charge.
- Ionization potential of Hydrogen is 13.6 V.

4. What are the drawbacks in Bohr atom model?

- Bohr atom model is valid only for hydrogen like atoms but not for complex atoms.
- The fine structure of hydrogen is not explained.
- The intensity of spectral lines is not explained.
- The distribution of electrons is not explained.

5. Define impact parameter.

Impact parameter is defined as the perpendicular distance between the center of the nucleus and the direction of velocity vector of alpha particle when it is at a large distance.

$$\boxed{b = k \cot\left(\frac{\theta}{2}\right)}$$

6. Give the properties of nuclear forces?

- The nuclear force is of very short-range.
- The nuclear force is the strongest force.
- The nuclear force is attractive force.
- The nuclear force does not act on the electrons.

7.Define radioactivity.

The phenomenon of spontaneous emission of highly penetrating radiations such as α, β *and* γ rays by an element is called radioactivity.

8. Define one curie.

One Curie was defined as number of decays per second in 1gram of radium.

$1\ curie = 3.7 \times 10^{10}$ decays / second

9. What are the constituent particles of neutron and proton?

- Proton = 2 up quarks + 1 down quark.
- Neutron = 1 up quark + 2 down quarks.

10. Calculate the radius of $^{197}_{79}Au$ nucleus

Solution:

$$R = R_0 A^{1/3}$$
$$R = 1.2 \times 10^{-15} \times (197)^{1/3}$$
$$R = 6.97 \times 10^{-15} m$$

Three Mark Questions:

1. Write the properties of cathode rays.

- Cathode rays travel in a straight line.
- Cathode rays posses energy and momentum.
- Cathode rays affect the photographic plates.
- Cathode rays ionize the gas.
- Cathode rays can be deflected by magnetic and electric fields.
- Cathode rays produce fluorescence when they fall on certain minerals.

2. Give the symbolic representation of alpha, beta and gamma decay.

1. Alpha Decay:

When a nuclei decay by emitting an $\propto$ particle, its atomic number decreases by 2, the mass number decrease by 4.

$$^{A}_{Z}X \rightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}He$$

2. Beta Decay:

There are two types of Beta decay.

i). β^- decay

When a nuclei decay by emitting a β^- particle (electron), its atomic number increases by one but the mass number remains the same.

$^{A}_{Z}X \rightarrow {}_{Z+1}^{A}Y + e^- + \overline{\gamma}$

ii). β^+ decay

When a nuclei decay by emitting a β^+ particle (positron), its atomic number decreases by one but the mass number remains the same.

$$^{A}_{Z}X \rightarrow {}_{Z-1}^{A}Y + e^+ + \gamma$$

3. Gamma decay:

When a nuclei decay by emitting gamma ray, there is no change in atomic number and mass number. The energy level of nuclei only changed. ${}_Z^AX^* \rightarrow {}_Z^AX + gamma\ ray$

3. Write the properties of Neutrino.

- It has zero charge.
- It has anti particles called Anti neutrino.
- It has very small mass
- It interacts very weakly with the matter.

4. What is half-life and mean life?

Half-life:

The half-life is the time required to decay for the number of atoms initially present to reduce to one half of the initial amount.

$$\boxed{T_{\frac{1}{2}} = \frac{0.6931}{\lambda}}$$

Mean Life:

$$Mean\ life = \frac{Sum\ of\ life\ times\ of\ all\ nuclei}{Total\ number\ of\ nuclei\ present\ initially}$$

$$\boxed{\tau = \frac{1}{\lambda}}$$

(Relation between half-life and mean life $T_{\frac{1}{2}} = 0.6931\ \tau$)

5. State the postulates of Bohr atom model.

- The electron moves around the nucleus in circular orbits under the influence of coulomb electrostatic force of attraction.
- Electrons revolve around the nucleus only certain discrete orbits called stationary orbits where it does not radiate electromagnetic energy.
- The angular momentum of the electron in these stationary orbits are integral multiple of $\frac{h}{2\pi}$
- An electron can jump from one orbit to another orbit by absorbing or emitting a photon

$$\boldsymbol{E_f - E_i = h\nu}$$

6.what are the properties of neutrons?

- Neutrons have high penetrating power.
- Neutrons unaffected by electric and magnetic fields.
- Outside the nucleus they are unstable.
- According to kinetic energy, they are classified as slow neutrons and fast neutrons.

7. What is meant by nuclear fission and nuclear fusion?

Nuclear Fission:

The process of breaking up of the nucleus of a heavier atom into two smaller nuclei with the release of a large amount of energy is called nuclear fission.

Example: ${}_{92}^{235}U + {}_0^1n \rightarrow {}_{56}^{141}Ba + {}_{36}^{92}Kr + 3{}_0^1n + Q$

Nuclear Fusion:

When two or more light nuclei combine to form a heavier nucleus, then it is called nuclear fusion. A lot of energy generated during this nuclear fusion. Most of the stars including our sun generate energy by this way.

$${}_1^1H + {}_1^2H \rightarrow {}_2^3He + \gamma$$

Five Mark Questions

1. Explain the spectral series of hydrogen atom.

When an electron jumps from mth orbit to nth orbit a spectral line was obtained whose wave number is

$$\overline{\gamma} = R\left(\frac{1}{n^2} - \frac{1}{m^2}\right)$$

n	m	Series Name	Region	Wave number
1	2,3, 4….	Lyman	UV	$\bar{\gamma} = R\left(\frac{1}{1^2} - \frac{1}{m^2}\right)$
2	3,4, 5….	Balmer	Visible	$\bar{\gamma} = R\left(\frac{1}{2^2} - \frac{1}{m^2}\right)$
3	4,5, 6….	Paschen	IR	$\bar{\gamma} = R\left(\frac{1}{3^2} - \frac{1}{m^2}\right)$
4	5,6, 7….	Brackett	IR	$\bar{\gamma} = R\left(\frac{1}{4^2} - \frac{1}{m^2}\right)$
5	6,7, 8….	Pfund	IR	$\bar{\gamma} = R\left(\frac{1}{5^2} - \frac{1}{m^2}\right)$

2. Describe the working of nuclear reactor.

Nuclear Reactor:

- Nuclear reactor is a device in which the nuclear fission takes place in a self-sustained controlled manner.
- The energy produced is used for research purpose or power generation.

Important Parts:

1. **Fuel**:
   - The fuel is fissionable material.
   - Usually uranium or plutonium used.

2. **Moderators**:
   - The moderator is a material used to convert fast neutrons into slow neutrons.
   - Most of the reactors use heavy water and graphite as moderators.

3. Control rods:
- The control rods used to adjust the reaction rate.
- Cadmium or boron act as control rod material.

4. Cooling system:
- The cooling system removes the heat generated in the reactor core.
- Ordinary water, heavy water and liquid sodium are used as coolant.

5. Neutron source:
- A neutron source is required to initiate the chain reaction for the first time.
- A mixture of beryllium with plutonium or polonium is used as the neuron source.

6. Shielding:

For a protection against harmful radiations, the nuclear reactor is surrounded by a concrete wall of thickness about 2.5m.

3. Obtain the law of radioactivity.

Law of radioactivity:

At any instant t, rate of decay $\left(\frac{dN}{dt}\right)$is proportional to the number of nuclei (N) at the same instant.

$$\frac{dN}{dt} \propto N$$

$$\frac{dN}{dt} = -\lambda N - - - (1)$$

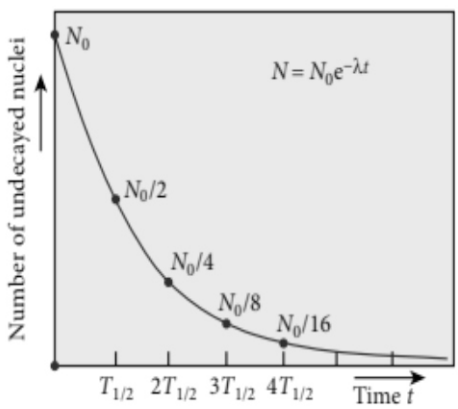
Here λ is the decay constant. The negative sign implies that N is decreasing with time.

By rewriting the equation 1.

$$\frac{dN}{N} = -\lambda dt - - - (2)$$

Let N_0 be the number of nuclei present at time t=0

Let N be the number of nuclei present at any time t.



Law of radioactive decay

Integrate the equation (2)

$$\int_{N_0}^{N}\frac{dN}{N} = -\int_0^t \lambda dt$$

$$[lnN]_{N_0}^{N} = -\lambda t$$

$$ln\left(\frac{N}{N_0}\right) = -\lambda t$$

Taking exponential on both sides

$$\boxed{\boldsymbol{N = N_0 e^{-\lambda t}}}$$

This equation is called the law of radioactive decay.

Note that the number of atoms is decreasing exponentially over the length of time.

4.Derive the energy expression for an electron in the hydrogen atom using Bohr atom model.

Since the electro static force is a conservative force, the potential energy for the nth orbit is

$$U_n = \frac{1}{4\pi\varepsilon_o}\frac{(+Ze)(-e)}{r_n}$$

$$U_n = -\frac{1}{4\pi\varepsilon_o}\frac{Ze^2}{r_n}$$

$$U_n = -\frac{1}{4{\varepsilon_o}^2}\frac{me^4Z^2}{h^2\ {}_n^{\ 2}} - - - (1) \qquad \left(\because r_n = \frac{\varepsilon_o h^2 n^2}{\pi me^2 Z}\right)$$

The kinetic energy of the electron in nth orbit is

$$KE_n = \frac{1}{2}mV_n^2$$

$$KE_n = \frac{me^4}{8{\varepsilon_o}^2h^2}\frac{Z^2}{n^2} - - - (2)$$

From equation 1,2 $\qquad U_n = -2KE_n$

Total Energy $\qquad E_n = KE_n + U_n$

$$E_n = KE_n - 2KE_n$$

$$E_n = -KE_n$$

$$E_n = -\frac{me^4}{8\varepsilon_\circ^2h^2}\frac{Z^2}{n^2}$$

For Hydrogen atom (Z=1)

$$E_n = -\frac{me^4}{8\varepsilon_\circ^2h^2}\frac{1}{n^2}$$

$$\boxed{\boldsymbol{E_n = \frac{-13.6}{n^2}\ eV}}$$

Unit 10. Electronics and Communication

Two Mark Questions

1. What do you mean by doping?

The process of adding impurities to the intrinsic Semiconductor is called doping.
(It is in the order of 100ppm)

2. Why is temperature co-efficient of resistance negative for semiconductor?

When the temperature of the semiconductor increase, its resistance decreases. Hence the semiconductor are said to have negative temperature coefficient of resistance.

3. Distinguish between intrinsic semiconductor and extrinsic semiconductor

Intrinsic Semiconductor	Extrinsic Semiconductor
A semiconductor in its pure form without impurity	The semiconductor obtained by dropping impurities
Number of electrons and number of holes are same	Number of electrons and number of holes are different
Its conduction is low	Its conduction is more

4. What is meant by biasing? Mention its types.

Biasing is the process of giving external energy to charge carriers to overcome the barrier potential and make them to move in a particular direction.

1.Forward bias

2.Reverse bias

5. Give the applications of zener diode.

It is used

- ❖ As voltage regulators.
- ❖ For calibrating voltages
- ❖ To protect gadget against damage from excessive voltage.

6. What is rectification?

The process of converting alternating current into direct current is called rectification.

7. List the application of light emitting diode.

The light emitting diodes are used in

- ❖ Indicators lamp on the front panel of the lab equipments.
- ❖ Seven-Segment displays.
- ❖ Remote control of TV, air conditioner Etc.

8. Give the Barkhausen conditions for sustained oscillators?

- ❖ There should be positive feedback
- ❖ The loop gain must be unity ($A\beta = 1$)
- ❖ The loop phase shift must be 0° or integral multiples of 2π

9. What is modulation?

For long distance transmission, the low frequency baseband signal is superimposed onto a high frequency radio signal by a process called modulation.

10. What do you mean by skip distance?

The shortest distance between the transmitter and the point of reception of the sky wave along the surface is called skip distance.

11. What are the advantages of amplitude modulation?

- ❖ Easy transmission and reception
- ❖ Lesser bandwidth requirements.
- ❖ Low cost.

<u>Three Mark Questions</u>

1.Distinguish between avalanche breakdown and Zener breakdown.

Avalanche breakdown	Zener breakdown.
Lightly doped PN junction.	heavily doped PN junction.
Depletion region is very thick.	Depletion region is very thin.
The electric field is not strong enough to produce breakdown. But the minority charges carriers accelerated by the electric field gains sufficient kinetic energy, this leads to the breaking of covalent bonds and it turn generate electron -hole pair. This is known as avalanche breakdown.	This electric field is strong enough to break or rupture the covalent bonds in the lattice and thereby generating electron-hole pairs. This effect is called Zener effect.

2. Transistor function as a switch. Explain.

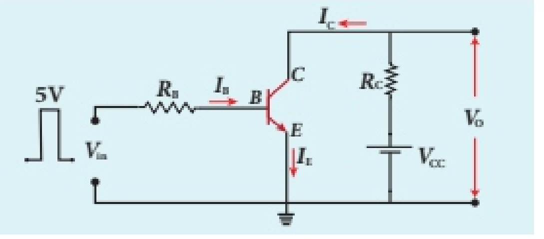
- ❖ A transistor in saturation region acts as a closed switch while in cut-off region it acts as on open switch.

<u>When the input is low:</u>

- ❖ When the input is low (0V), the base current is zero and the transistor is in cut-off region.
- ❖ The collector current is zero and no current flows through the transistor. So the transistor acts as a open switch(OFF).

<u>When the input is high:</u>

- ❖ When the input is high (+5V), the base current is high and the transistor is in saturation region.
- ❖ The collector current is high and maximum current flows through the transistor. So the transistor acts as a closed switch (ON).



Transistor as a switch

3. What does RADAR stand for? Give applications of RADAR.

- ❖ RADAR basically stands for Radio Detection And Ranging.

<u>Applications:</u>

- ❖ In military, it is used for detecting the targets.
- ❖ It is used in navigation systems such as ship, missile etc.
- ❖ It is used in meteorological observations.
- ❖ It is used to locate and rescue people in emergency situations.

4. State and prove Demogran's first and Second theorem.

<u>First Theorem:</u>

The complement of the sum of two inputs is equal to the product of its complements.

$$\overline{A+B} = \bar{A}.\bar{B}$$

A	B	A+B	$\overline{A + B}$	$\bar{A}$	$\bar{B}$	$\bar{A}.\bar{B}$
0	0	0	1	1	1	1
0	1	1	0	1	0	0
1	0	1	0	0	1	0
1	1	1	0	0	0	0

<u>Second Theorem:</u>

The complement of the product of two inputs is equal to the sum of its complements.

$$\overline{A.B} = \bar{A} + \bar{B}$$

A	B	A . B	$\overline{A.B}$	$\bar{A}$	$\bar{B}$	$\bar{A}+\bar{B}$
0	0	0	1	1	1	1
0	1	0	1	1	0	1
1	0	0	1	0	1	1
1	1	1	0	0	0	0

5. List out the advantages and limitations of frequency modulation.

<u>Advantages:</u>

- ❖ A large decrease in noise.
- ❖ The operating range is quite large.
- ❖ The transmission efficiency is very high.
- ❖ FM radio has better quality compared to AM radio.

<u>Limitations:</u>

- ❖ FM requires a much wider channel.
- ❖ FM transmitters and receivers are more complex and costly.
- ❖ In FM reception, less area is covered compared to AM.

6. Fiber optic communication is gaining popularity among other various transmissions – justify.

Fiber optic communication:

- ❖ The method of transmitting information from one place to another place through optical fiber is called fiber optic communication.
- ❖ It works on the principle of total internal reflection.

Merits:

- ❖ Fiber cables are very thin and less weight.
- ❖ This system has much larger band width.
- ❖ This system is immune to electrical interferences.
- ❖ Fiber cables are cheaper than copper cables.

7. What is meant by satellite communication? Give its applications.

- ❖ The satellite communication is a mode of transmission of the signal between transmitter and receiver via satellite.

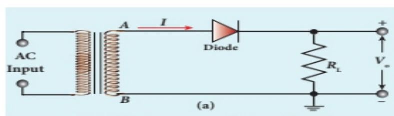
Applications:

- ❖ **Weather satellite:** They are used to monitor the weather and climate of earth.
- ❖ **Communication satellite:** They are used to transmit television, radio, internet signals.
- ❖ **Navigation satellite:** They are used to locate the ship, aircrafts or any other object and to navigate them.

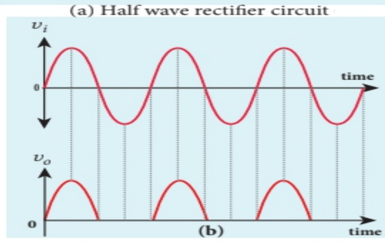
Five Mark Questions

1. Draw the circuit diagram of a half wave rectifier and explain its working.

- ❖ The half wave rectifier circuit consists of a transformer, a p-n junction diode and a load resister R_L.
- ❖ Only one half of the input wave is rectified, so it is called half wave rectifier.



(a) Half wave rectifier circuit



(b) Input and output waveforms

During the positive half cycle:

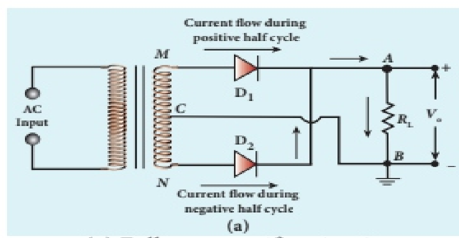
- ❖ When the positive half cycle passes through the circuit, terminal A becomes positive with respect terminal B.
- ❖ The diode is forward biased and hence it conducts. Hence, current flows through load resister R_L and there is an output voltage. This is shown in the wave form diagram.

During the negative half cycle:

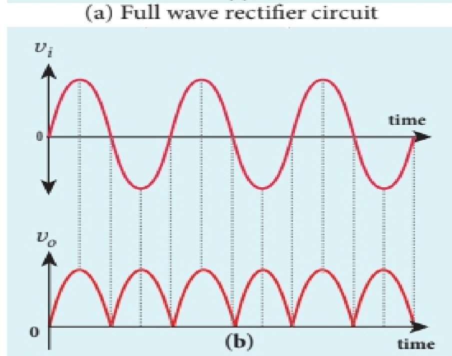
- ❖ When the negative half cycle passes through the circuit, terminal A becomes negative with respect terminal B.
- ❖ The diode is reverse biased and hence it does not conduct. Hence no current flows through load resister R_L and there is no output voltage. This is shown is waveform diagram.

$$\boldsymbol{Efficiency} = \frac{Output\ DC\ power}{Input\ AC\ power}$$

- ❖ Efficiency of half wave rectifier is 40.6%



(a) Full wave rectifier circuit



(b) Input and output waveforms

2. Explain the construction and working of full wave rectifier.

The full wave rectifier circuit consists of a transformer, two p-n junction diodes and a load resister RL.

The positive and negative half cycle of AC input are rectified, hence it is called full wave rectifier.

During positive half cycle:

- ❖ When the positive half cycle passes through the circuit terminal M becomes positives with respect terminal N.
- ❖ So the diode D_1 is forward biased and D_2 is reverse biased, hence diode D_1 conducts and current flows along the path MD_1ABC.

During Negative half cycle:

- ❖ When the negative half cycle passes through the circuit terminal N becomes positive with respect to terminal M.
- ❖ So the diode D_1 is reverse biased and D_2 is forward biased, hence diode D_2 conducts and current flows along the path ND_2ABC.
- ❖ During both positive and negative half cycles of the input, the current flows through the load resister in the same direction. The input and output wave forms is shown in the figure.
- ❖ Efficiency of full wave rectifier is 81.2%

11. Recent Development in Physics

Two Mark Questions

1. Distinguish Between Nano science and Nanotechnology.

Nano science:

It is the science of objects with typical size 1-100 nm

Nano means one – billionth of a meter (i.e.) 10^{-9}m

Nanotechnology:

It is a technology involving the design, production, characterization and application of nano structured materials.

2. Write a note on black holes.

Black holes :

- ❖ Black holes are end stage of stars which are highly dense massive object.
- ❖ Its mass ranges 20 times mass of the sun to 1 million times mass of the sun.
- ❖ It has very strong gravitational force such that no particle or even light can escape from it.
- ❖ The existence of black hole is studied when the stars orbiting the black hole

3. Mention the advantages and disadvantages of Robotics.

Advantages of robotics:

- ❖ The robots are much cheaper than humans.
- ❖ Stronger and faster than humans.
- ❖ In warfare, robots can save human lives.

Disadvantages of robotics:

- ❖ Robots have no sense of emotions or conscience.
- ❖ They lack empathy and hence create an emotionless workplace.
- ❖ Robots can perform defined tasks and cannot handle unexpected situations

4. List the applications of Nano technology.

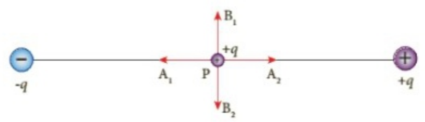
- ❖ Energy storage
- ❖ Defence and security
- ❖ Electronics
- ❖ Bio-technology
- ❖ Textiles

5. Give any two examples for Nano in Nature.

- ❖ Morpho Butterfly
- ❖ Peacock feathers
- ❖ Parrot fish.

Unit: I

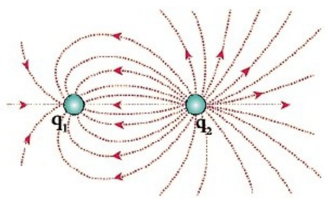
1. Two identical point charges of magnitude –q are fixed as shown in the figure below. A third charge +q is placed midway between the two charges at the point P. Suppose this charge +q is displaced a small distance from the point P in the directions indicated by the arrows, in which direction(s) will +q be stable with respect to the displacement?



(a) A_1 and A_2 (b) B_1 and B_2
(c) both directions (d) No stable

2. Which charge configuration produces a uniform electric field?
(a) point Charge
(b) infinite uniform line charge
(c) uniformly charged infinite plane
(d) uniformly charged spherical shell

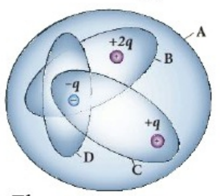
3. What is the ratio of the charges $\left|\frac{q_1}{q_2}\right|$ for the following electric field line pattern?



(a) $\frac{1}{5}$ (b) $\frac{25}{11}$ (c) 5 (d) $\frac{11}{25}$

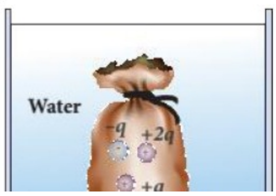
4. An electric dipole is placed at an alignment angle of 30° with an electric field of 2×10^5 N C^{-1}. It experiences a torque equal to 8 N m. The charge on the dipole if the dipole length is 1 cm is
(a) 4 mC (b) 8 mC (c) 5 mC (d) 7 mC

5. Four Gaussian surfaces are given below with charges inside each Gaussian surface. Rank the electric flux through each Gaussian surface in increasing order.



(a) D < C < B < A
(b) A < B = C < D
(c) C < A = B < D
(d) D > C > B > A

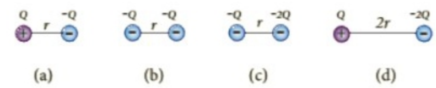
6. The total electric flux for the following closed surface which is kept inside water



(a) $\frac{80\,q}{\varepsilon_0}$ (b) $\frac{q}{40\varepsilon_0}$ (c) $\frac{q}{80\varepsilon_0}$ (d) $\frac{q}{160\varepsilon_0}$

7. Two identical conducting balls having positive charges q_1 and q_2 are separated by a center to center distance r. If they are made to touch each other and then separated to the same distance, the force between them will be
(a) less than before (b) same as before
(c) more than before (d) zero

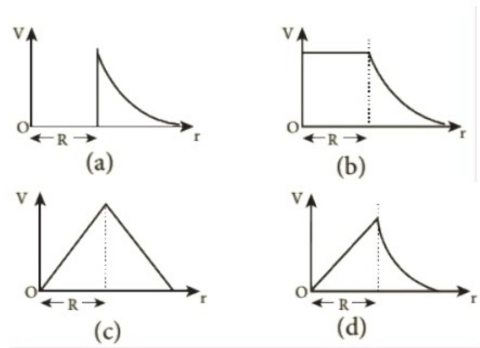
8. Rank the electrostatic potential energies for the given system of charges in increasing order.



(a) 1 = 4 < 2 < 3 (b) 2 = 4 < 3 < 1
(c) 2 = 3 < 1 < 4 (d) 3 < 1 < 2 < 4

9. An electric field $\vec{E} = 10\,x\,\hat{\imath}$ exists in a certain region of space. Then the potential difference $V = V_o - V_A$, where V_o is the potential at the origin and V_A is the potential at x = 2 m is:
(a) 10 J (b) – 20 J (c) +20 J (d) -10J

10. A thin conducting spherical shell of radius R has a charge Q which is uniformly distributed on its surface. The correct plot for electrostatic potential due to this spherical shell is



11. Two points A and B are maintained at a potential of 7 V and –4 V respectively. The work done in moving 50 electrons from A to B is
(a) 8.80×10^{-17}J (b) -8.80×10^{-17}J
(c) 4.40×10^{-17}J (d) 5.80×10^{-17}J

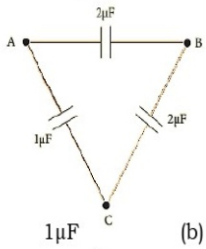
12. If voltage applied on a capacitor is increased from V to 2V, choose the correct conclusion.
(a) Q remains the same, C is doubled
(b) Q is doubled, C doubled
(c) C remains same, Q doubled
(d) Both Q and C remain same

13. A parallel plate capacitor stores a charge Q at a voltage V. Suppose the area of the parallel plate capacitor and the distance between the plates

are each doubled then which is the quantity that will change?

(a) Capacitance (b) Charge
(c) Voltage (d) Energy density

14. Three capacitors are connected in triangle as shown in the figure. The equivalent capacitance between the points A and C is



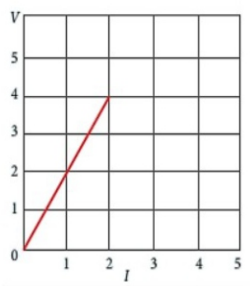
(a) 1μF (b) 2μF (c) 3μF (d) $\frac{1}{4}$ μF

15. Two metallic spheres of radii 1 cm and 3 cm are given charges of -1×10^{-2} C and 5×10^{-2} C respectively. If these are connected by a conducting wire, the final charge on the bigger sphere is

(a) 3×10^{-2} C (b) 4×10^{-2} C
(c) 1×10^{-2} C (d) 2×10^{-2} C

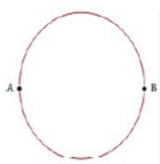
UNIT – 2

16. The following graph shows current versus voltage values of some unknown conductor. What is the resistance of this conductor?



(a) 2 ohm (b) 4 ohm (c) 8 ohm (d) 1 ohm

17. A wire of resistance 2 ohms per meter is bent to form a circle of radius 1m. The equivalent resistance between its two diametrically opposite points, A and B as shown in the figure is



(a) π Ω (b) $\frac{\pi}{2}$ Ω (c) 2π Ω (d) $\frac{\pi}{4}$ Ω

18. A toaster operating at 240 V has a resistance of 120 Ω. The power is

a) 400 W b) 2 W c) 480 W d) 240 W

19. A carbon resistor of (47 ± 4.7) k Ω to be marked with rings of different colours for its identification. The colour code sequence will be

a) Yellow – Green – Violet – Gold
b) Yellow – Violet – Orange – Silver
c) Violet – Yellow – Orange – Silver
d) Green – Orange – Violet - Gold

20. What is the value of resistance of the following resistor?

(a)100 k Ω (b)10 k Ω (c) 1k Ω (d)1000 k Ω

21. Two wires of A and B with circular cross section made up of the same material with equal lengths. Suppose $R_A = 3 R_B$, then what is the ratio of radius of wire A to that of B?

(a) 3 (b) $\sqrt{3}$ (c) $\frac{1}{\sqrt{3}}$ (d) $\frac{1}{3}$

22. A wire connected to a power supply of 230 V has power dissipation P_1. Suppose the wire is cut into two equal pieces and connected parallel to the same power supply. In this case power dissipation is P_2. The ratio $\frac{P_2}{P_1}$

(a)1 (b) 2 (c) 3 (d) 4

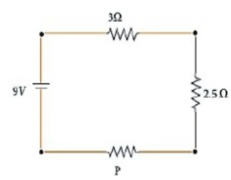
23. In India electricity is supplied for domestic use at 220 V. It is supplied at 110 V in USA. If the resistance of a 60W bulb for use in India is R, the resistance of a 60W bulb for use in USA will be

(a) R (b) 2R (c) $\frac{R}{4}$ (d) $\frac{R}{2}$

24. In a large building, there are 15 bulbs of 40W, 5 bulbs of 100W, 5 fans of 80W and 1 heater of 1kW are connected. The voltage of electric mains is 220V. The minimum capacity of the main fuse of the building will be

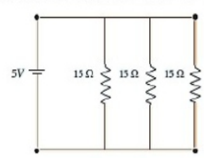
(a) 14 A (b) 8 A (c) 10 A (d) 12 A

25. There is a current of 1.0 A in the circuit shown below. What is the resistance of P?



a) 1.5 Ω b) 2.5 Ω c) 3.5 Ω d) 4.5 Ω

26. What is the current out of the battery?



a) 1A b) 2A c) 3A d) 4A

27. The temperature coefficient of resistance of a wire is 0.00125 per °C. At 300 K, its resistance is 1 Ω. The resistance of the wire will be 2 Ω at
a) 1154 K b) 1100 K c) 1400 K d) 1127 K

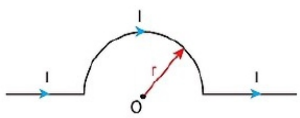
28. The internal resistance of a 2.1 V cell which gives a current of 0.2 A through a resistance of 10 Ω is
a) 0.2 Ω b) 0.5 Ω c) 0.8 Ω d) 1.0 Ω

29. A piece of copper and another of germanium are cooled from room temperature to 80 K. The resistance of
a) each of them increases
b) each of them decreases
c) copper increases and germanium decreases
d) copper decreases and germanium increases

30. In Joule's heating law, when I and t are constant, if the His taken along the *y* axis and I^2 along the *x* axis, the graph is
a) straight line b) parabola
c) circle d) ellipse

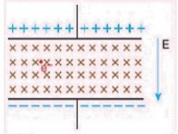
UNIT – 3

31. The magnetic field at the center O of the following current loop is



(a) $\frac{\mu_o I}{4r}\otimes$ (b) $\frac{\mu_o I}{4r}\odot$
(c) $\frac{\mu_o I}{2r}\otimes$ (d) $\frac{\mu_o I}{2r}\odot$

32. An electron moves straight inside a charged parallel plate capacitor of uniform charge density σ. The time taken by the electron to cross the parallel plate capacitor when the plates of the capacitor are kept under constant magnetic field of induction $\vec{B}$ is



(a) $\varepsilon_o \frac{elB}{\sigma}$ (b) $\varepsilon_o \frac{lB}{\sigma l}$
(c) $\varepsilon_o \frac{lB}{e\sigma}$ (d) $\varepsilon_o \frac{lB}{\sigma}$

33. The force experienced by a particle having mass m and charge q accelerated through a potential difference V when it is kept under perpendicular magnetic field $\vec{B}$ is

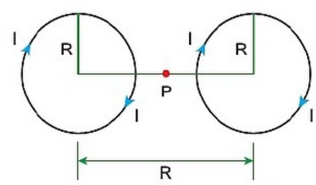
(a) $\sqrt{\frac{2q^3BV}{m}}$ (b) $\sqrt{\frac{q^3B^2V}{2m}}$
(c) $\sqrt{\frac{2q^3B^2V}{m}}$ (d) $\sqrt{\frac{2q^3BV}{m^3}}$

34. A circular coil of radius 5 cm and 50 turns carries a current of 3 ampere. The magnetic dipole moment of the coil is
(a) 1.0 amp – m^2 (b) 1.2 amp – m^2
(c) 0.5 amp – m^2 (d) 0.8 amp – m^2

35. A thin insulated wire forms a plane spiral of N = 100 tight turns carrying a current I = 8 m A (milli ampere). The radii of inside and outside turns are a = 50 mm and b = 100 mm respectively. The magnetic induction at the center of the spiral is
(a) 5 μT (b) 7 μT (c) 8 μT (d) 10 μT

36. Three wires of equal lengths are bent in the form of loops. One of the loops is circle, another is a semi-circle and the third one is a square. They are placed in a uniform magnetic field and same electric current is passed through them. Which of the following loop configuration will experience greater torque ?
(a) circle (b) semi-circle
(c) square (d) all of them

37. Two identical coils, each with N turns and radius R are placed coaxially at a distance R as shown in the figure. If I is the current passing through the loops in the same direction, then the magnetic field at a point P which is at exactly at $\frac{R}{2}$ distance between two coils is

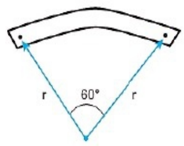


(a) $\frac{8N\mu_o I}{\sqrt{5}R}$ (b) $\frac{8N\mu_o I}{5^{3/2}R}$
(c) $\frac{8N\mu_o I}{5R}$ (d) $\frac{4N\mu_o I}{\sqrt{5}R}$

38. A wire of length ℓ carries a current I along the Y direction and magnetic field is given by $\vec{B} = \frac{\beta}{\sqrt{3}}(\hat{i} + \hat{j} + \hat{k})T$.
The magnitude of Lorentz force acting on the wire is

(a) $\sqrt{\frac{2}{\sqrt{3}}}\beta Il$ (b) $\sqrt{\frac{1}{\sqrt{3}}}\beta Il$
(c) $\sqrt{2}\beta Il$ (d) $\sqrt{\frac{1}{2}}\beta Il$

39. A bar magnet of length l and magnetic moment M is bent in the form of an arc as shown in figure. The new magnetic dipole moment will be

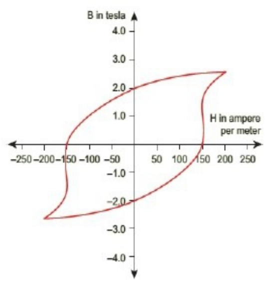


(a) M (b) $\frac{3}{\pi}$ M (c) $\frac{2}{\pi}$ M (d) $\frac{1}{2}$ M

40. A non-conducting charged ring of charge q, mass m and radius r is rotated with constant angular speed ω. Find the ratio of its magnetic moment with angular momentum is

(a) $\frac{q}{m}$ (b) $\frac{2q}{m}$ (c) $\frac{q}{2m}$ (d) $\frac{q}{4m}$

41. The B_H curve for a ferromagnetic material is shown in the figure. The material is placed inside a long solenoid which contains 1000 turns/cm. The current that should be passed in the solenoid to demagnetize the ferromagnetic completely is



(a) 1.00 m A (milli ampere) (b) 1.25 mA
(c) 1.50 mA (d) 1.75 mA

42. Two short bar magnets have magnetic moments 1.20 Am2and 1.00 Am^2 respectively. They are kept on a horizontal table parallel to each other with their north poles pointing towards the south. They have a common magnetic equator and are separated by a distance of 20.0 cm. The value of the resultant horizontal magnetic induction at the mid-point O of the line joining their centers is (Horizontal components of Earth's magnetic induction is 3.6×10^{-5} Wb m^{-2})

(a) 3.60 ×10 Wb m^{-2} (b) 3.5×10^{-5} Wb m^{-2}
(c) 2.56×10^{-4} Wb m^{-2} (d) 2.2×10^{-4} Wb m^{-2}

43. The vertical component of Earth's magnetic field at a place is equal to the horizontal component. What is the value of angle of dip at this place?

(a) 30° (b) 45° (c) 60° (d) 90°

44. A flat dielectric disc of radius R carries an excess charge on its surface. The surface charge density is σ. The disc rotates about an axis perpendicular to its plane passing through the center with angular velocity ω. Find the magnitude of the torque on the disc if it is placed in a uniform magnetic field whose strength is B which is directed perpendicular to the axis of rotation

(a) $\frac{1}{4}\sigma\omega\pi BR$ (b) $\frac{1}{4}\sigma\omega\pi BR^2$

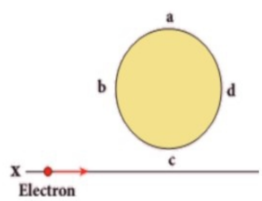
(c) $\frac{1}{4}\sigma\omega\pi BR^3$ (d) $\frac{1}{4}\sigma\omega\pi BR^4$

45. A simple pendulum with charged bob is oscillating with time period T and let θ be the angular displacement. If the uniform magnetic field is switched ON in a direction perpendicular to the plane of oscillation then

(a) time period will decrease but θ will remain constant
(b) time period remain constant but θ will decrease
(c) both T and θ will remain the same
(d) both T and θ will decrease

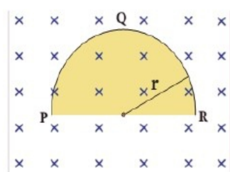
UNIT – 4

46. An electron moves on a straight line path XY as shown in the figure. The coil *abcd* is adjacent to the path of the electron. What will be the direction of current, if any, induced in the coil?



(a) The current will reverse its direction as the electron goes past the coil
(b) No current will be induced
(c) *abcd*
(d) *adcb*

47. A thin semi-circular conducting ring (PQR) of radius r is falling with its plane vertical in a horizontal magnetic field B, as shown in the figure.



The potential difference developed across the ring when its speed v, is

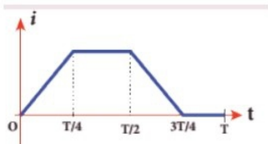
(a) Zero

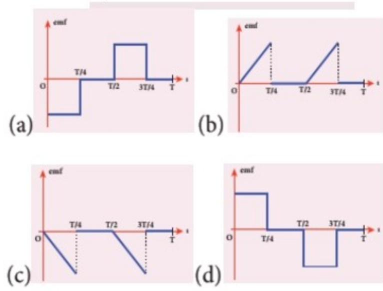
(b) $\frac{Bv\pi r^2}{2}$ and P is at higher potential
(c) πrBv and R is at higher potential
(d) $2rBv$ and R is at higher potential

48. The flux linked with a coil at any instant t is given by $\Phi_B = 10t^2 - 50t + 250$. The induced emf at $t = 3s$ is
(a) −190 V (b) −10 V
(c) 10 V (d) 190 V

49. When the current changes from +2A to −2A in 0.05 s, an emf of 8 V is induced in a coil. The co-efficient of self-induction of the coil is
(a) 0.2 H (b) 0.4 H (c) 0.8 H (d) 0.1 H

50. The current I flowing in a coil varies with time as shown in the figure. The variation of induced emf with time would be





51. A circular coil with a cross-sectional area of 4 cm² has 10 turns. It is placed at the centre of a long solenoid that has 15 turns/cm and a cross-sectional area of 10 cm². The axis of the coil coincides with the axis of the solenoid. What is their mutual inductance?
(a) 7.54 µH (b) 8.54 µH
(c) 9.54 µH (d) 10.54 µH

52. In a transformer, the number of turns in the primary and the secondary are 410 and 1230 respectively. If the current in primary is 6A, then that in the secondary coil is
(a) 2 A (b) 18 A (c) 12 A (d) 1 A

53. A step-down transformer reduces the supply voltage from 220 V to 11 V and increase the current from 6 A to 100 A. Then its efficiency is
(a) 1.2 (b) 0.83 (c) 0.12 (d) 0.9

54. In an electrical circuit, R, L, C and AC voltage source are all connected in series. When L is removed from the circuit, the phase difference between the voltage and current in the circuit is $\frac{\pi}{3}$. Instead, if C is removed from the circuit, the phase difference is again $\frac{\pi}{3}$. The power factor of the circuit is
(a) $\frac{1}{2}$ (b) $\frac{1}{\sqrt{2}}$ (c) 1 (d) $\frac{\sqrt{3}}{2}$

55. In a series RL circuit, the resistance and inductive reactance are the same. Then the phase difference between the voltage and current in the circuit is
(a) $\frac{\pi}{4}$ (b) $\frac{\pi}{2}$ (c) $\frac{\pi}{6}$ (d) *zero*

56. In a series resonant RLC circuit, the voltage across 100 Ω resistor is 40 V.
The resonant frequency ω is 250 rad/s. If the value of C is 4 µF, then the voltage across L is
(a) 600 V (b) 4000 V
(c) 400V (d) 1 V

57. An inductor 20 mH, a capacitor 50 µF and a resistor 40 Ω are connected in series across a source of emf v = 10 sin 340t. The power loss in AC circuit is
(a) 0.76 W (b) 0.89 W
(c) 0.46 W (d) 0.67 W

58. The instantaneous values of alternating current and voltage in a circuit are
$i = \frac{1}{\sqrt{2}} \sin(100\pi t)$ A and
$v = \frac{1}{\sqrt{2}} \sin\left(100\pi t + \frac{\pi}{3}\right)$ V
The average power in watts consumed in the circuit is
(a) $\frac{1}{4}$ (b) $\frac{\sqrt{3}}{4}$ (c) $\frac{1}{2}$ (b) $\frac{1}{6}$

59. In an oscillating LC circuit, the maximum charge on the capacitor is Q. The charge on the capacitor when the energy is stored equally between the electric and magnetic fields is
(a) $\frac{Q}{2}$ (b) $\frac{Q}{\sqrt{3}}$ (c) $\frac{Q}{\sqrt{2}}$ (b) Q

60. $\frac{20}{\pi^2}$ H inductor is connected to a capacitor of capacitance. The value of inductor is connected to a capacitor of capacitance C. The value of C in order to impart maximum power at 50 Hz is
(a) 50 µF (b) 0.5 µF (c) 500 µF (d) 5 µF

UNIT – 5

61. The dimension of $\frac{1}{\mu_0 \varepsilon_0}$ is
(a) [L T⁻¹] (b) [L² T⁻²]
(c) [L⁻¹ T] (d) [L⁻² T²]

2. If the amplitude of the magnetic field is 3×10^{-6} T, then amplitude of the electric field for a electromagnetic waves is
(a) 100 V m⁻¹ (b) 300 V m⁻¹
(c) 600 V m⁻¹ (d) 900 V m⁻¹

PHYSICS

63. Which of the following electromagnetic radiation is used for viewing objects through fog
(a) microwave (b) gamma rays
(c) X- rays (d) infrared
64. Which of the following are false for electromagnetic waves
(a) transverse (b) mechanical waves
(c) longitudinal
(d) produced by accelerating charges
65. Consider an oscillator which has a charged particle and oscillates about its mean position with a frequency of 300 MHz. The wavelength of electromagnetic waves produced by this oscillator is
(a) 1 m (b) 10 m (c) 100 m (d) 1000 m
66. The electric and the magnetic field, associated with an electromagnetic wave, propagating along X axis can be represented by

(a) $\vec{E} = E_o\hat{j}$ and $\vec{B} = B_o\hat{k}$

(b) $\vec{E} = E_o\hat{k}$ and $\vec{B} = B_o\hat{j}$

(c) $\vec{E} = E_o\hat{i}$ and $\vec{B} = B_o\hat{j}$

(d) $\vec{E} = E_o\hat{j}$ and $\vec{B} = B_o\hat{i}$

67. In an electromagnetic wave in free space the rms value of the electric field is 3 V m^{-1}. The peak value of the magnetic field is
(a) 1.414×10^{-8} T (b) 1.0×10^{-8} T
(c) 2.828×10^{-8} T (d) 2.0×10^{-8} T
68. During the propagation of electromagnetic waves in a medium:
(a) electric energy density is double of the magnetic energy density
(b) electric energy density is half of the magnetic energy density
(c) electric energy density is equal to the magnetic energy density
(d) both electric and magnetic energy densities are zero
69. If the magnetic monopole exists, then which of the Maxwell's equation to be modified?.

(a) $\oint \vec{E}\cdot d\vec{A} = \frac{Q_{enclosed}}{\epsilon_o}$

(b) $\oint \vec{E}\cdot d\vec{A} = 0$

(c) $\oint \vec{E}\cdot d\vec{A} = \mu_o I_{enclosed} + \mu_o \epsilon_o \frac{d}{dt}\int \vec{E}\cdot d\vec{A}$

(d) $\oint \vec{E}\cdot d\vec{l} = -\frac{d}{dt}\Phi_B$

70. A radiation of energy E falls normally on a perfectly reflecting surface. The momentum transferred to the surface is
(a) $\frac{E}{c}$ (b) $2\frac{E}{c}$ (c) Ec (d) $\frac{E}{c^2}$
71. Which of the following is an electromagnetic wave?
(a) $\propto$ - rays (b) β – rays (c) γ – rays (d) all of them
72. Which one of them is used to produce a propagating electromagnetic wave?.
(a) an accelerating charge
(b) a charge moving at constant velocity
(c) a stationary charge
(d) an uncharged particle
73. Let $E = E_o \sin[10^6 x - \omega t]$ be the electric field of plane electromagnetic wave, the value of ω is
(a) 0.3×10^{-14} rad s^{-1} (b) 3×10^{-14} rad s^{-1}
(c) 0.3×10^{14} rad s^{-1} (d) 3×10^{14} rad s^{-1}
74. Which of the following is NOT true for electromagnetic waves?.
(a) it transport energy
(b) it transport momentum
(c) it transport angular momentum
(d) in vacuum, it travels with different speeds which depend on their frequency

75. The electric and magnetic fields of an electromagnetic wave are
(a) in phase and perpendicular to each other
(b) out of phase and not perpendicular to each other
(c) in phase and not perpendicular to each other
(d) out of phase and perpendicular to each Other

Unit: VI

76. The speed of light in an isotropic medium depends on,
(a) its intensity (b)its wavelength
(c) the nature of propagation
(d) the motion of the source w.r.t. medium
77. A rod of length 10 cm lies along the principal axis of a concave mirror of focal length 10 cm in such a way that its end closer to the pole is 20 cm away from the mirror. The length of the image is, (AIPMT Main 2012)
(a) 2.5 cm (b) 5cm (c) 10 cm (d) 15cm
78. An object is placed in front of a convex mirror of focal length of f and the maximum and minimum distance of an object from the mirror such that the image formed is real and magnified.
(a) 2f and C (b) C and ∞
(c) f and O (d) None of these
79. For light incident from air on a slab of refractive index 2, the maximum possible angle of refraction is,

(a) 30° (b) 45° (c) 60° (d) 90°

80. If the velocity and wavelength of light in air is V_a and λ_a and that in water is V_w and λ_w, then the refractive index of water is

(a) $\frac{V_w}{V_a}$ (b) $\frac{V_a}{V_w}$ (c) $\frac{\lambda_w}{\lambda_a}$ (d) $\frac{V_a \lambda_a}{V_a \lambda_w}$

81. Stars twinkle due to,

(a) reflection (b) total internal reflection
(c) refraction (d) polarisation

82. When a biconvex lens of glass having refractive index 1.47 is dipped in a liquid, it acts as a plane sheet of glass. This implies that the liquid must have refractive index,

(a) less than one (b) less than that of glass
(c) greater than that of glass
(d) equal to that of glass

83. The radius of curvature of curved surface at a thin plano-convex lens is 10 cm and the refractive index is 1.5. If the plane surface is silvered, then the focal length will be,

(a) 5 cm (b) 10 cm (c) 15 cm (d) 20 cm

84. An air bubble in glass slab of refractive index 1.5 (near normal incidence) is 5 cm deep when viewed from one surface and 3 cm deep when viewed from the opposite face. The thickness of the slab is,

(a) 8 cm (b)10 cm (c) 12 cm (d)16 cm

85. A ray of light travelling in a transparent medium of refractive index n falls, on a surface separating the medium from air at an angle of incidents of 45°. The ray can undergo total internal reflection for the following n,

(a) n = 1.25 (b) n = 1.33 (c) n = 1.4 (d) n = 1.5

86. A plane glass is placed over various coloured letters (violet, green, yellow, red). The letter which appears to be raised more is,

(a) red (b) yellow (c) green (d) violet

87. Two point white dots are 1 mm apart on a black paper. They are viewed by eye of pupil diameter 3 mm approximately. The maximum distance at which these dots can be resolved by the eye is, [take wavelength of light, λ= 500 nm]

(a) 1 m (b) 5 m (c) 3 m (d) 6m

88. In a Young's double-slit experiment, the slit separation is doubled. To maintain the same fringe spacing on the screen, the screen-to-slit distance D must be changed to,

(a) $2D$ (b) $\frac{D}{2}$ (c) $\sqrt{2}\,D$ (d) $\frac{D}{\sqrt{2}}$

89. Two coherent monochromatic light beams of intensities I and 4I are superposed. The maximum and minimum possible intensities in the resulting beam are

(a) 5I and I (b) 5Iand 3I (c) 9I and I (d) 9I and 3I

90. When light is incident on a soap film of thickness 5×10^{-5}cm, the wavelength of light reflected maximum in the visible region is 5320 Å. Refractive index of the film will be,

(a) 1.22 (b) 1.33 (c) 1.51 (d) 1.83.

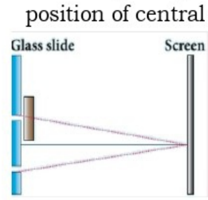
91. First diffraction minimum due to a single slit of width 1.0×10^{-5} cm is at 30°. Then wavelength of light used is,

(a) 400 Å (b) 500 Å (c) 600 Å (d) 700 Å

92. A ray of light strikes a glass plate at an angle 60°. If the reflected and refracted rays are perpendicular to each other, the refractive index of the glass is,

(a) 3 (b) 32 (c) 32 (d) 2

93. One of the of Young's double slits is covered with a glass plate as shown in figure. The position of central maximum will,



(a) get shifted downwards
(b) get shifted upwards
(c) will remain the same
(d) data insufficient to conclude

94. Light transmitted by Nicol prism is,

(a) partially polarised (b) unpolarised
(c) plane polarised (d) elliptically polarised

95. The transverse nature of light is shown in,

(a) interference (b) diffraction
(c) scattering (d) polarisation

UNIT – 7

96. The wavelength λ_e of an electron and λ_p of a photon of same energy E are related by

(a) $\lambda_p \propto \lambda_e$ (b) $\lambda_p \propto \sqrt{\lambda_e}$ (c) $\lambda_p \propto \frac{1}{\sqrt{\lambda_e}}$ (d) $\lambda_p \propto \lambda_e^2$

97. In an electron microscope, the electrons are accelerated by a voltage of 14 kV. If the voltage is changed to 224 k V, then the de Broglie wavelength associated with the electrons would

a. increase by 2 times b. decrease by 2 times
c. decrease by 4 times d. increase by 4 times

98. A particle of mass 3×10^{-6} g has the same wavelength as an electron moving with a velocity 6×10^6 m s^{-1} . The velocity of the particle is

a. 1.82×10^{-18} m s^{-1} b. 9×10^{-2} m s^{-1}
c. 3×10^{-31} m s^{-1} d. 1.82×10^{-15} m s^{-1}

99. When a metallic surface is illuminated with radiation of wavelength λ, the stopping potential is V. If the same surface is illuminated with radiation of wavelength 2λ, the stopping potential is $\frac{V}{4}$. The threshold wavelength for the metallic surface is

PHYSICS

a. 4λ b. 5λ c. $\frac{5}{2}$λ d. 3λ

100. If a light of wavelength 330 nm is incident on a metal with work function 3.55 eV, the electrons are emitted. Then the wavelength of the emitted electron is (Take h = 6.6 ×10^{-34} Js)
a. < 2.75 ×10^{-9} m b. ≥ 2.75 ×10^{-9} m
c. ≤ 2.75 ×10^{-12} m d. < 2.5 ×10^{-10} m

101. A photoelectric surface is illuminated successively by monochromatic light of wavelength λ and λ/2 . If the maximum kinetic energy of the emitted photoelectrons in the second case is 3 times that in the first case, the work function at the surface of material is
(a) $\frac{hC}{\lambda}$ (b) $\frac{2hC}{\lambda}$ (c) $\frac{hC}{3\lambda}$ (d) $\frac{hC}{2\lambda}$

102. In photoelectric emission, a radiation whose frequency is 4 times threshold frequency of a certain metal is incident on the metal. Th en the maximum possible velocity of the emitted electron will be
(a) $\sqrt{\frac{2\nu_0}{m}}$ (b) $\sqrt{\frac{6h\nu_0}{m}}$ (c) $2\sqrt{\frac{h\nu_0}{m}}$ (d) $\sqrt{\frac{h\nu_0}{2m}}$

103. Two radiations with photon energies 0.9 eV and 3.3 eV respectively are falling on a metallic surface successively. If the work function of the metal is 0.6 eV, then the ratio of maximum speeds of emitted electrons will be
a) 1:4 b) 1:3 c) 1:1 d)1:9

104. A light source of wavelength 520 nm emits 1.04 × 10^{15} photons per second while the second source of 460 nm produces 1.38 × 10^{15} photons per second. Then the ratio of power of second source to that of first source is
a) 1.00 b) 1.02 c) 1.5 d) 0.98

105. The mean wavelength of light from sun is taken to be 550 nm and its mean power is 3.8 × 10^{26} W. The number of photons received by the human eye per second on the average from sunlight is of the order of
a) 10^{45} b) 10^{42} c) 10^{54} d) 10^{51}

106. The threshold wavelength for a metal surface whose photoelectric work function is 3.313 eV is
a) 4125 Å b) 375 Å c) 6000 Å d) 20625 Å

107. A light of wavelength 500 nm is incident on a sensitive plate of photoelectric work function 1.235 eV. The kinetic energy of the photo electrons emitted is be (Take h = 6.6 × 10^{-34} Js)
a) 0.58 eV b) 2.48 eV c) 1.24 eV d) 1.16 eV

108. Photons of wavelength λ are incident on a metal. The most energetic electrons ejected from the metal are bent into a circular arc of radius R by a perpendicular magnetic field having magnitude B. The work function of the metal is
(a) $\frac{hC}{\lambda} - m_e + \frac{e^2B^2R^2}{2m_e}$ (b) $\frac{hC}{\lambda} + 2m_e\left[\frac{eBR}{2m_e}\right]^2$
(c) $\frac{hC}{\lambda} - m_ec^2 - \frac{e^2B^2R^2}{2m_e}$ (d) $\frac{hC}{\lambda} - 2m_e\left[\frac{eBR}{2m_e}\right]^2$

109. The work functions for metals A,B and C are 1.92 eV, 2.0 eV and 5.0 eV respectively. The metals which will emit photoelectrons for a radiation of wavelength 4100Å is/are
a. A only b. both A and B
c. all these metals d. none

110. Emission of electrons by the absorption of heat energy is called.........emission.
a. photoelectric b. field
c. thermionic d. secondary

UNIT – 8

111. Suppose an alpha particle accelerated by a potential of V volt is allowed to collide with a nucleus whose atomic number is Z, then the distance of closest approach of alpha particle to the nucleus is
(a) 14.4 $\frac{Z}{V}$ Å (b) 14.4 $\frac{V}{Z}$ Å
(c) 1.44 $\frac{Z}{V}$ Å (d) 1.44 $\frac{V}{Z}$ Å

112. In a hydrogen atom, the electron revolving in the fourth orbit, has angular momentum equal to
a) h b) $\frac{h}{\pi}$ c) $\frac{h}{4\pi}$ d) $\frac{2h}{\pi}$

113. Atomic number of H-like atom with ionization potential 122.4 V for n = 1 is
a) 1 b) 2 c) 3 d) 4

114. The ratio between the first three orbits of hydrogen atom is
a) 1:2:3 b) 2:4:6 c) 1:4:9 d) 1:3:5

115. The charge of cathode rays is
a) positive b) negative
c) neutral d) not defined

116. In J.J. Thomson e/m experiment, a beam of electron is replaced by that of muons (particle with same charge as that of electrons but mass 208 times that of electrons). No deflection condition is achieved only if
(a) B is increased by 208 times
(c) B is increased by 14.4 times
(d) B is decreased by 14.4 times

117. The ratio of the wavelengths for the transition from n = 2 to n = 1 in Li^{++}, He^{+} and H is
(a) 1:2:3 (b) 1:4:9 (c) 3:2:1 (d) 4:9:36

118. The electric potential between a proton and an electron is given by V = $V_0 \ln\left(\frac{r}{r_0}\right)$, where r_0 is a constant. Assume that Bohr atom model is applicable to potential, then variation of radius of n^{th} orbit r_n with the principle quantum number n is

PHYSICS

(a) $r_n \propto \frac{1}{n}$ (b) $r_n \propto n$ (c) $r_n \propto \frac{1}{n^2}$ (d) $r_n \propto n^2$

119. If the nuclear radius of ^{27}Al is 3.6 fermi, the approximate nuclear radius of ^{64}Cu is
(a) 2.4 (b) 1.2 (c) 4.8 (d) 3.6

120. The nucleus is approximately spherical in shape. Then the surface area of nucleus having mass number A varies as
(a) $A^{2/3}$ (b) $A^{4/3}$ (c) $A^{1/3}$ (d) $A^{5/3}$

121. The mass of a $^{7}_{3}Li$ nucleus is 0.042 u less than the sum of the masses of all its nucleons. The binding energy per nucleon of $^{7}_{3}Li$ nucleus is nearly
(a) 46 MeV (b) 5.6 MeV (c) 3.9 MeV (d) 23 MeV

122. M_p denotes the mass of the proton and M_n denotes mass of a neutron. A given nucleus of binding energy B, contains Z protons and N neutrons. The mass M(N,Z) of the nucleus is given by(where c is the speed of light)
(a) $M(N,Z) = NM_n + ZM_p - Bc^2$
(b) $M(N,Z) = NM_n + ZM_p + Bc^2$
(c) $M(N,Z) = NM_n + ZM_p - B/c^2$
(d) $M(N,Z) = NM_n + ZM_p + B/c^2$

123. A radioactive nucleus (initial mass number A and atomic number Z) emits 2αand 2 positrons. The ratio of number of neutrons to that of proton in the final nucleus will be
(a) $\frac{A-Z-4}{Z-2}$ (b) $\frac{A-Z-2}{Z-6}$ (c) $\frac{A-Z-4}{Z-6}$ (d) $\frac{A-Z-12}{Z-4}$

124. The half-life period of a radioactive element A is same as the mean life time of another radioactive element B. Initially both have the same number of atoms. Then
(a) A and B have the same decay rate initially
(b) A and B decay at the same rate always
(c) B will decay at faster rate than A
(d) A will decay at faster rate than B.

125. A system consists of N_0 nucleus at t = 0. The number of nuclei remaining after half of a half-life (that is, at time t = $\frac{1}{2}T_{1/2}$)
(a) $\frac{N_0}{2}$ (b) $\frac{N_0}{\sqrt{2}}$ (c) $\frac{N_0}{4}$ (d) $\frac{N_0}{8}$

UNIT – 9

126. The barrier potential of a silicon diode is approximately,
a. 0.7 V b. 0.3V c. 2.0 V d. 2.2V

127. Doping a semiconductor results in
a. The decrease in mobile charge carriers
b. The change in chemical properties
c. The change in the crystal structure
d. The breaking of the covalent bond

128. A forward biased diode is treated as
a. An open switch with infinite resistance
b. A closed switch with a voltage drop of 0 V
c. A closed switch in series with a battery voltage of 0.7V
d. A closed switch in series with a small resistance and a battery.

129. If a half –wave rectified voltage is fed to a load resistor, which part of a cycle the load current will flow?
(a) 0°– 90° (b) 90°–180° (c) 0°–180° (d) 0°– 360°

130. The primary use of a zener diode is
a. Rectifier b. Amplifier
c. Oscillator d. Voltage regulator

131. The principle in which a solar cell operates
a. Diffusion b. Recombination
c. Photovoltaic action d. Carrier flow

132. The light emitted in an LED is due to
a. Recombination of charge carriers
b. Reflection of light due to lens action
c. Amplification of light falling at the junction
d. Large current capacity.

133. When a transistor is fully switched on, it is said to be
a. Shorted b. Saturated c. Cut-off d. Open

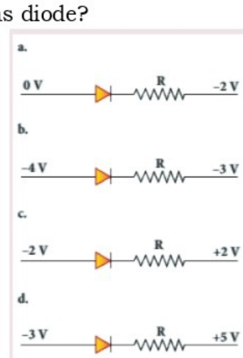
134. The specific characteristic of a common emitter amplifier is
a. High input resistance b. Low power gain
c. Signal phase reversal d. Low current gain

135. To obtain sustained oscillation in an oscillator,
a. Feedback should be positive
b. Feedback factor must be unity
c. Phase shift must be 0 or 2π
d. All the above

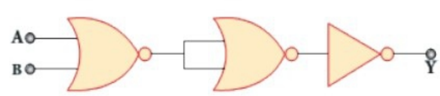
136. If the input to the NOT gate is A = 1011, its output is
a. 0100 b. 1000 c. 1100 d. 0011

137. The electrical series circuit in digital form is
a. AND b. OR c. NOR d. NAND

138. Which one of the following represents forward bias diode?

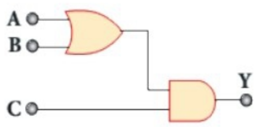


139. The given electrical network is equivalent to



a. AND gate b. OR gate
c. NOR gate d. NOT gate

140. The output of the following circuit is 1 when the input ABC is



a. 101 b. 100 c. 110 d. 010

UNIT – 10

141. The output transducer of the communication system converts the radio signal into -------------
(a) Sound (b) Mechanical energy
(c) Kinetic energy (d) None of the above

142. The signal is affected by noise in a communication system
(a) At the transmitter (b) At the modulator
(c) In the channel (d) At the receiver

143. The variation of frequency of carrier wave with respect to the amplitude of the modulating signal is called -----------------
(a) Amplitude modulation
(b) Frequency modulation
(c) Phase modulation
(d) Pulse width modulation

144. The internationally accepted frequency deviation for the purpose of FM broadcasts.
(a) 75 kHz (b) 68 kHz (c) 80 kHz (d) 70 kHz

145. The frequency range of 3 MHz to 30 MHz is used for
(a) Ground wave propagation
(b) Space wave propagation
(c) Sky wave propagation
(d) Satellite communication

UNIT – 11

146. The particle size of ZnO material is 30 nm. Based on the dimension it is classified as
a) Bulk material b) Nanomaterial
c) Soft material d) Magnetic material

147. Which one of the following is the natural nanomaterial?
a) Peacock feather b) Peacock beak
c) Grain of sand d) Skin of the Whale

148. The blue print for making ultra-durable synthetic material is mimicked from
a) Lotus leaf b) Morpho butterfly
c) Parrot fish d) Peacock feather

149. The method of making nanomaterial by assembling the atoms is called
a) Top down approach b) Bottom up approach
c) Cross down approach d) Diagonal approach

150. "Sky wax" is an application of nano product in the field of
a) Medicine b) Textile
c) Sports d) Automotive industry

151. The materials used in Robotics are
a) Aluminium and silver b) Silver and gold
c) Copper and gold d) Steel and aluminum

152. The alloys used for muscle wires in Robots are
a) Shape memory alloys b) Gold copper alloys
c) Gold silver alloys d) Two dimensional alloys

153. The technology used for stopping the brain from processing pain is
a) Precision medicine b) Wireless brain sensor
c) Virtual reality d) Radiology

154. The particle which gives mass to protons and neutrons are
a) Higgs particle b) Einstein particle
c) Nanoparticle d) Bulk particle

155. The gravitational waves were theoretically proposed by
a) Conrad Rontgen b) Marie Curie
c) Albert Einstein `d) Edward Purcell

********* BEST OF LUCK ******