CEP Phase-2 (2024- 2025)

CLASS:-12 th

Subject:-Physics (LEP- STUDY MATERIAL)

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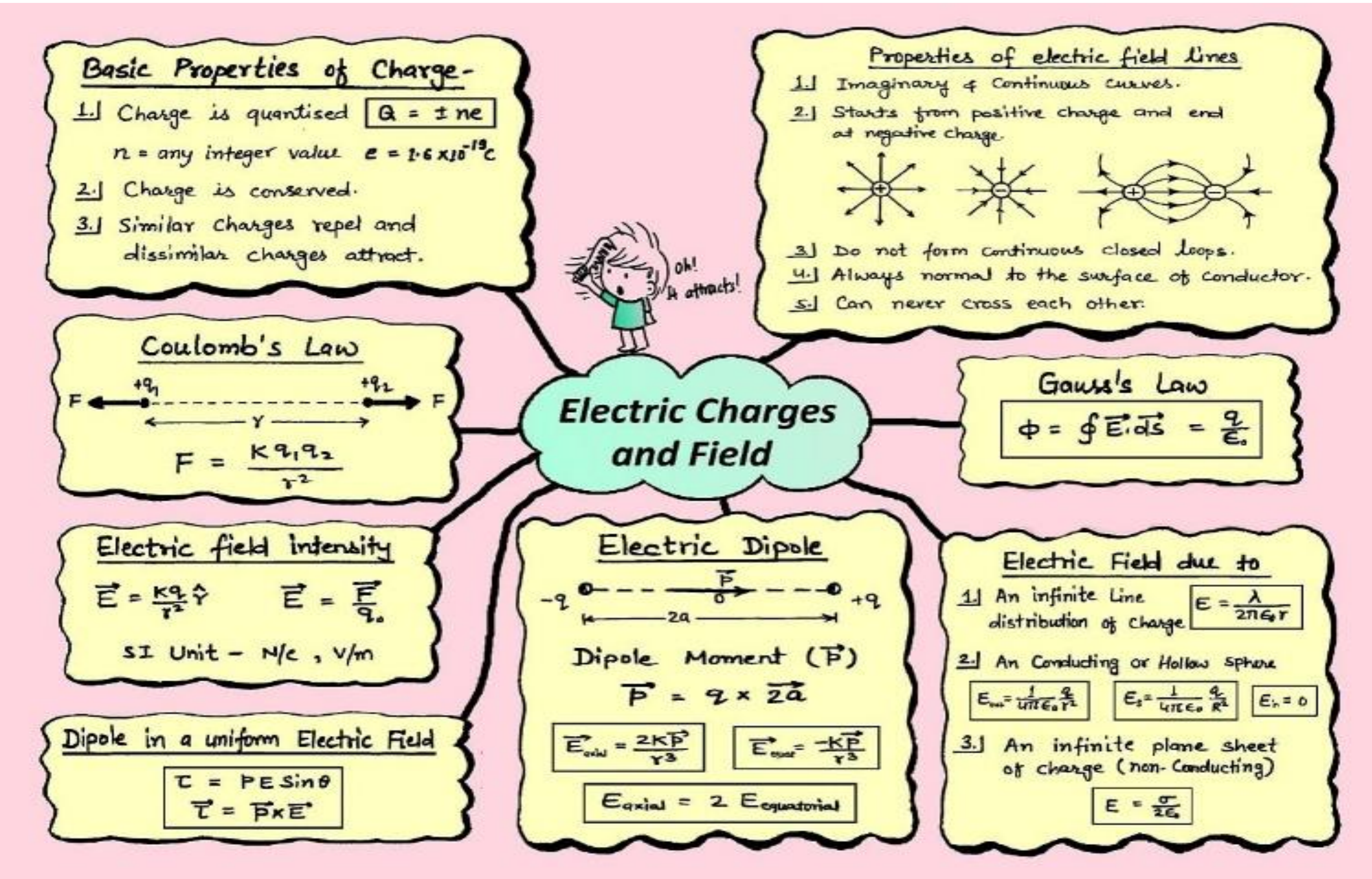


Electrostatic Potential & Capacitance

Electric Potential due to point charge

$V = \frac{1}{4\pi\epsilon_0}\frac{Q}{r}$

Q •- - - r - - -• V

Potential difference

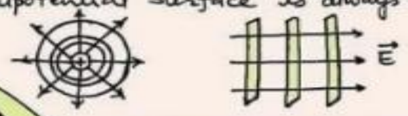
A •——— W_{AB} ———→• B (V_A, V_B, q (Test charge))

$V_B - V_A = \frac{W_{AB}}{q}$

$V_B - V_A = \frac{U_B - U_A}{q}$

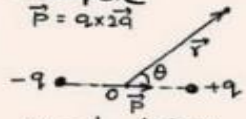
Equipotential Surface

* Potential is same at all the points of the surface
* Electric field is always perpendicular to an equipotential surface
* Work done to move a charge on the equipotential surface is always zero



Potential due to a dipole

$\vec{p} = q \times 2\vec{a}$



$V = \frac{1}{4\pi\epsilon_0}\frac{p\cos\theta}{r^2}$

(i) at axial line
$\theta = 0^\circ$, $V = \frac{1}{4\pi\epsilon_0}\frac{p}{r^2}$

(ii) at equatorial line
$\theta = 90^\circ$, $V = 0$

Relation b/w Electric field and potential

$E = -\frac{dV}{dr} \Rightarrow \Delta V = -\int \vec{E}\cdot d\vec{r}$

Potential Energy of a dipole

$U = -pE\cos\theta = -\vec{p}\cdot\vec{E}$

Work done in rotating a dipole against the torque

$W_{12} = U_2 - U_1 = -pE[\cos\theta_2 - \cos\theta_1]$

Potential Energy of a system of two charges

q_1 •— r —• q_2

$U = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r}$

Combination of Capacitors

(i) Series $\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$

(ii) Parallel $C_P = C_1 + C_2 + C_3$

Capacitance

(i) Parallel Plate capacitor

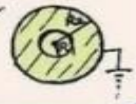
$C = \frac{K\epsilon_0 A}{d}$ K → dielectric Const.

(ii) If a dielectric slab of thickness t (t<d) is placed b/w the plates

$C = \frac{\epsilon_0 A}{\left[d - t + \frac{t}{K}\right]}$

(iii) Spherical capacitor

$C = \frac{4\pi\epsilon_0 R_1 R_2}{R_2 - R_1}$



Current Electricity

Electric Current $I = \frac{q}{t}$

Instantaneous current $I = \frac{dq}{dt}$

SI Unit - Ampere (A)

Current is a scalar quantity.

Ohm's Law

$\boxed{V = IR}$

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

$\boxed{\rho = \frac{m}{ne^2\tau}}$

Variation of Resistivity / Resistance with Temperature

For temperature variation from T_1 to T_2

$\boxed{R_2 = R_1[1 + \alpha(T_2 - T_1)]}$

Drift Velocity

$\boxed{V_d = \left(\frac{eE}{m}\right)\tau}$

$\boxed{I = neAV_d}$

Electrical Power

$\boxed{P = V \times I = I^2R = \frac{V^2}{R}}$

Electrical Energy

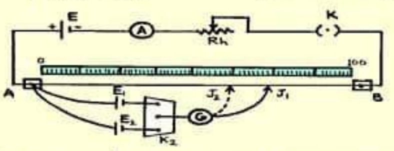
$\boxed{H = W = I^2Rt = \frac{V^2t}{R}}$

Mobility $(\mu) = \frac{V_d}{E}$

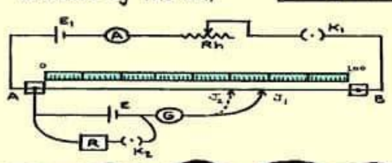
Current Density $(J) = \frac{I}{A}$

Potentiometer

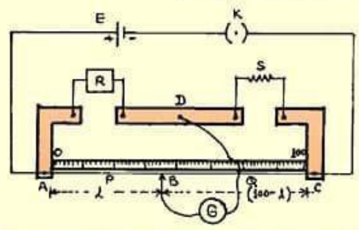
(A) Comparison of EMF's of two cells $\boxed{\frac{E_1}{E_2} = \frac{l_1}{l_2}}$



(B) Determination of internal resistance of the cell $\boxed{r = \left(\frac{l_1}{l_2} - 1\right)R}$



Meter Bridge $\boxed{S = \left(\frac{100 - l}{l}\right) \times R}$



Resistors in series

$R_s = R_1 + R_2 + R_3$

Resistors in parallel

$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

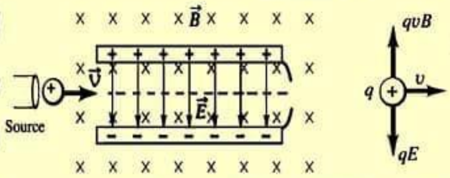
Magnetic Effect of Current

Force on a moving charge in a magnetic field

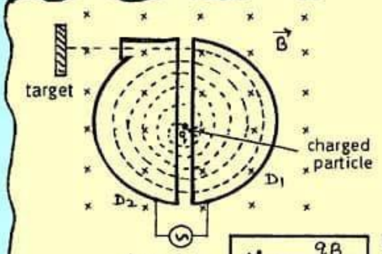
$F = qvB\sin\theta$

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

Velocity Selector $v = \frac{E}{B}$



Cyclotron



$V_c = \frac{qB}{2\pi m}$ cyclotron frequency

$K.E. = \frac{1}{2}mv^2 = \frac{q^2B^2R^2}{2m}$

Magnetic Force on a current Carrying Conductor

$F = ILB\sin\theta$

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

Motion in a Magnetic Field

(i) when charge particle moves at angle 90° to field

$r = \frac{mv}{qB}$ $T = \frac{2\pi m}{qB}$

(ii) when charge particle at any angle to the field

$r = \frac{mv\sin\theta}{qB}$ $T = \frac{2\pi m}{qB}$

Pitch $P = \frac{2\pi mv\cos\theta}{qB}$

(iii) when the charged particle is moving at ($\theta = 0°$ or $180°$) to the magnetic field

$F = 0$ Path of the particle Linear (straight line)

BIOT SAVART LAW

$d\vec{B} = \frac{\mu_0}{4\pi}\frac{I(d\vec{l}\times\hat{r})}{r^2}$

(i) Magnetic Field on the axis of a Circular current Loop

$B = \frac{\mu_0}{4\pi}\frac{2\pi nIa^2}{(a^2+x^2)^{3/2}}$

at the centre of the circular Coil $B_0 = \frac{\mu_0 nI}{2a}$

(ii) Magnetic Field due to a Straight wire carrying current of infinite length $B = \frac{\mu_0}{2\pi}\frac{I}{a}$

Ampere's Circuital Law

$\oint \vec{B}\cdot d\vec{l} = \mu_0 I$

Magnetic Field due to a Solenoid

$B = \mu_0 nI$ $n = \frac{N}{L}$

Magnetic Field due to TOROID

$B = \mu_0 nI$ $n = \frac{N}{2\pi r}$

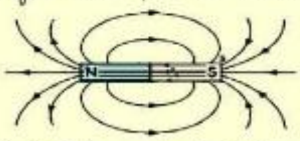
Force between two parallel Current Carrying Conductors

$F = \frac{\mu_0}{2\pi}\times\frac{I_1 I_2}{r}$

Magnetism and Matter

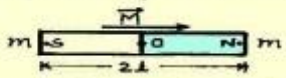
Properties of Magnetic Field Lines

- Outside the magnet the field lines are from north pole to South pole



- field lines form closed continuous loops
- field lines cannot intersect each other
- magnitude of magnetic field is proportional to the density of magnetic field lines

Magnetic Dipole Moment



$\vec{M} = m(2\vec{l})$

- its direction is from south to north pole

Magnetic Field due to Bar Magnet

On axial Line $\vec{B} = \frac{\mu_0}{4\pi}\frac{2\vec{M}}{d^3}$

On equatorial line $\vec{B} = -\frac{\mu_0}{4\pi}\frac{\vec{M}}{d^3}$

Torque on a Bar Magnet in a Magnetic field

$\tau = MB\sin\theta$

$\vec{\tau} = \vec{M}\times\vec{B}$

Curie Law in Magnetism

$\chi_m = \frac{C}{T}$

Gauss's Law

$\phi_B = \oint_S \vec{B}\cdot d\vec{S} = 0$

χ_m, μ_r and μ of magnetic substances

	Substance	χ_m	μ_r	μ
1.	Diamagnetic	$-1 \le \chi_m < 0$	$0 \le \mu_r < 1$	$\mu < \mu_0$
2.	paramagnetic	$0 < \chi_m < 1$	$1 < \mu_r < (1+\delta)$	$\mu > \mu_0$
3.	Ferromagnetic	$\chi_m >> 1$	$\mu_r >> 1$	$\mu >> \mu_0$

* Here δ is a small positive number.

Potential Energy of a Magnetic Dipole in a Magnetic Field

$U = -MB\cos\theta$

$U = -\vec{M}\cdot\vec{B}$

$\Delta U = W = -MB(\cos\theta_2 - \cos\theta_1)$

Hysteresis Loss Q = VAnt

n = frequency of cycles

t = time

V = Volume of the material

A = Area of hysteresis loop

(i) Relative magnetic permeability

$\mu_r = \frac{\mu}{\mu_0}$ or $\mu_r = \frac{B}{B_0}$

$\mu_0 = 4\pi\times10^{-7}\ Wb\ A^{-1}m^{-1}$

(ii) Magnetising Force or Magnetic Intensity

$H = \frac{B_0}{\mu_0}$ or $H = \frac{B}{\mu}$

(iii) Magnetisation Intensity (I)

$I = \frac{\text{Magnetic moment}}{\text{volume}} = \frac{M}{V}$

$I = \frac{m}{A}$ $I = \frac{B_m}{\mu_0}$

(iv) Magnetic Susceptibility

$\chi_m = \frac{I}{H}$

$\mu_r = 1 + \chi_m$

ELECTROMAGNETIC INDUCTION

Faraday's Law of EMI

First Law – whenever the magnetic flux changes an e.m.f is induced in the circuit

Second Law –

Induced e.m.f. $e = -\frac{d\phi}{dt}$

Induced current $I = -\frac{N}{R}\frac{d\phi}{dt}$

Induced charge $\Delta Q = -\frac{N}{R}\Delta\phi$

Self Inductance

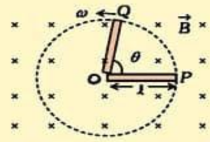
$L = \frac{\phi}{I}$

$e = -L \times \frac{dI}{dt}$

various formulae for L

Circular coil	Solenoid	Toroid
$L = \frac{\mu_0 \pi N^2 r}{2}$	$L = \frac{\mu_0 \mu_r N^2 A}{l}$	$L = \frac{\mu_0 N^2 r}{2}$

Rotating metallic rod

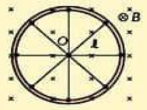


Induced e.m.f.

$e = \frac{1}{2} B l^2 \omega$

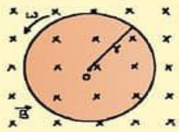
$e = \pi \nu B l^2$

Cycle wheel



$e_{net} = e = \frac{1}{2} B l^2 \omega$

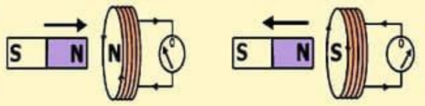
Rotation of a metal disc



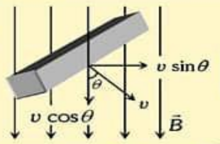
$e = \frac{1}{2} B \omega r^2$

Lenz's Law

movement against repulsion — movement against attraction



Motional Electromotive Force



$e = Bl(v\sin\theta)$

Mutual Inductance

$M = \frac{\phi_2}{I_1}$

$e_2 = -M\frac{dI_1}{dt}$

various formulae for M

Two concentric coils	Two Solenoids
$M = \frac{\pi \mu_0 N_1 N_2 r^2}{2R}$	$M = \frac{\mu_0 N_1 N_2 A}{l}$

Coefficient of Coupling

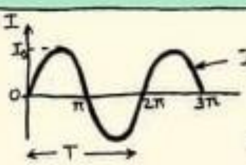
$K = \frac{M}{\sqrt{L_1 L_2}}$

$0 \leq K \leq 1$

Magnetic Energy of Inductor

$U = W = \frac{1}{2} L I^2$

Alternating Current



$I = I_0 \sin\omega t$

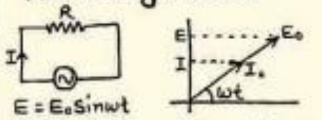
$f = \frac{1}{T}$

$\omega = \frac{2\pi}{T} = 2\pi f$

Mean/Average Value $I_{av} = 0.637 I_0$

Effective/RMS Value $I_{rms} = \frac{I_0}{\sqrt{2}} = 0.707 I_0$

A.C. through Resistor



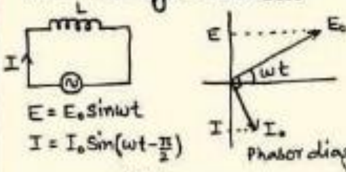
$E = E_0 \sin\omega t$

$I = I_0 \sin\omega t$

Phasor diagram

Phase diff $\phi = 0°$

A.C. through Inductor



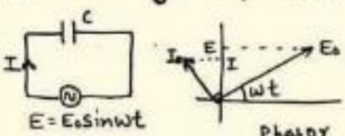
$E = E_0 \sin\omega t$

$I = I_0 \sin(\omega t - \frac{\pi}{2})$

Phasor diagram

Phase diff. $\phi = +\frac{\pi}{2}$

A.C. through Capacitor



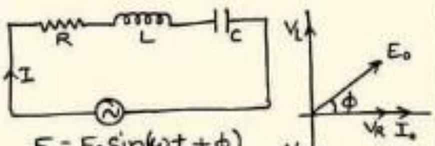
$E = E_0 \sin\omega t$

$I = I_0 \sin(\omega t + \frac{\pi}{2})$

Phasor diagram

Phase diff. $\phi = -\frac{\pi}{2}$

Series LCR Circuit



$E = E_0 \sin(\omega t + \phi)$

$I = I_0 \sin\omega t$

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

$X_L = \omega L$, $X_C = \frac{1}{\omega C}$

Phase diff. $\phi = \tan^{-1}\left(\frac{X_L - X_C}{R}\right)$

Power factor

$\cos\phi = \frac{R}{Z}$

Average Power in Series LCR Circuit

$P_{av} = E_{rms} I_{rms} \cos\phi$

Electrical Resonance

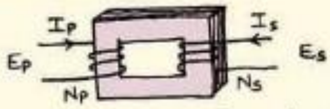
$X_L = X_C$

$Z_{min} = R$

Phase diff. $\phi = 0$

$\omega_r = \frac{1}{\sqrt{LC}}$ and $f_r = \frac{1}{2\pi\sqrt{LC}}$

Transformer



Transformer Ratio $= \frac{E_s}{E_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s}$

Efficiency $\eta = \frac{P_o}{P_i} \times 100 = \frac{E_s I_s}{E_p I_p} \times 100\%$

Quality Factor

$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$

Wattless Current

$I_{rms} \sin\phi$

ELECTROMAGNETIC WAVES

Maxwell's Equations

(1) $\oint_s \vec{E}\cdot\vec{ds} = \frac{q}{\epsilon_0}$

(2) $\oint_s \vec{B}\cdot\vec{ds} = 0$

(3) $\oint \vec{E}\cdot\vec{dl} = -\frac{d}{dt}\int_s \vec{B}\cdot\vec{ds}$

(4) $\oint \vec{B}\cdot\vec{dl} = \mu_0 I + \mu_0 I_D$

Displacement current $I_D = \epsilon_0 \int_s \frac{d\vec{E}}{dt}\cdot\vec{ds}$

Lorentz Formula

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

Production of Electromagnetic Waves

The EM waves are produced by the accelerated or oscillating charge.

$C = \frac{E_0}{B_0}$

$B_y = B_0 \sin(\omega t + Kx)$

$E_z = E_0 \sin(\omega t + Kx)$

$\omega = \frac{2\pi}{T}$ $K = \frac{2\pi}{\lambda}$

Poynting Vector ($\vec{S}$)

$\vec{S} = \frac{1}{\mu_0}(\vec{E}\times\vec{B})$

Intensity $I = U_{av} \times C$

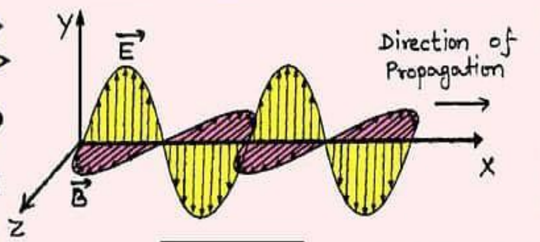
$I = \frac{1}{2}\epsilon_0 E_0^2 C = \frac{1}{2}\frac{B_0^2}{\mu_0}\cdot C$

Average electric energy density $U_E = \frac{1}{2}\epsilon_0 E^2$

Average magnetic energy density $U_B = \frac{1}{2}\frac{B^2}{\mu_0}$

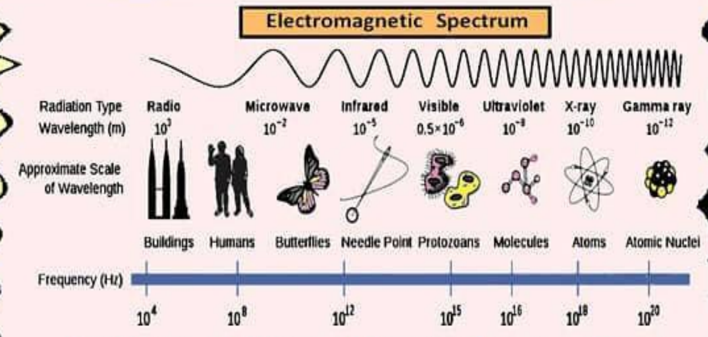
Total energy per unit volume

$U_{av} = U_E + U_B$



in vacuum $C = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$ $\mu_0 = 4\pi \times 10^{-7}$ Wb/Am

in medium $V = \frac{1}{\sqrt{\mu \epsilon}}$ $\epsilon_0 = 8.85\times10^{-12}$ C^2/Nm^2



Red Monster In Village is Ultimate eXample of Ghost

RAY OPTICS

Mirror Formula $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

Linear Magnification $m = \frac{I}{O} = -\frac{v}{u}$

Concave Mirror					
	Object	Image: Position	Image: Size	Image: Nature	Orientation
1.	at ∞	at Focus	Point	Real	Inverted
2.	between ∞ and C	between F and C	diminished	Real	Inverted
3.	at C	at C	Same	Real	Inverted
4.	between C and F	between C and ∞	Magnified	Real	Inverted
5.	at F	at ∞	Indefinetly Large	Real	Inverted
6.	between F and P	on other side of Mirror	Large	Virtual	Erect

Convex Mirror					
	Object	Image: Position	Image: Size	Image: Nature	Orientation
1.	at ∞	at Focus	Point	Virtual	Erect
2.	between ∞ and C	between P and F	diminished	Virtual	Erect

Lens Maker's Formula

$\frac{1}{f} = ({}^1\mu_2 - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$

Lens Formula

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

Combination of Lenses in contact

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

Power of a Lens $P = \frac{1}{f}$

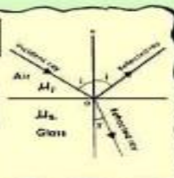
Refractive Index $\mu = \frac{c}{v}$

Relative Refractive Index

${}^1\mu_2 = \frac{\mu_2}{\mu_1} = \frac{c/v_2}{c/v_1} = \frac{v_1}{v_2}$

Snell's Law

$\mu_1 \sin i = \mu_2 \sin r$



Essential Conditions for total Internal Reflection

(i) Light should travel from a denser medium to a rarer medium.

(ii) Angle of incidence in denser medium should be greater than the critical angle.

${}^a\mu_b = \frac{1}{\sin C}$ a = rarer, b = dense

C = critical angle

Spherical Refracting Surfaces

(i) Refraction from Rarer to Denser Medium $\frac{\mu_1}{-u} + \frac{\mu_2}{v} = \frac{\mu_2 - \mu_1}{R}$

(ii) Refraction From Denser to Rarer Medium $\frac{\mu_2}{-u} + \frac{\mu_1}{v} = \frac{\mu_1 - \mu_2}{R}$

Astronomical Telescope

(i) Normal Adjustment

Magnifying Power $m = \frac{f_o}{-f_e}$

length of the telescope $L = f_o + f_e$

(ii) When the final Image is formed at the least distance of distinct vision (d)

Magnifying Power $m = -\frac{f_o}{f_e}\left(1 + \frac{f_e}{d}\right)$

length of the telescope $L = f_o + u_e$

Prism

Angle of deviation (δ)

$\delta = (i_1 + i_2) - A$

$r_1 + r_2 = A$

Prism formula

$\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin A/2}$

Compound Microscope

Magnifying power

$m = -\frac{V_o}{U_o}\left(1 + \frac{d}{f_e}\right)$

length of microscope tube

$L = V_o + U_e$

Resolving Power of Microscope

R.P. of microscope $= \frac{1}{d} = \frac{2\mu\sin\theta}{1.22\lambda}$

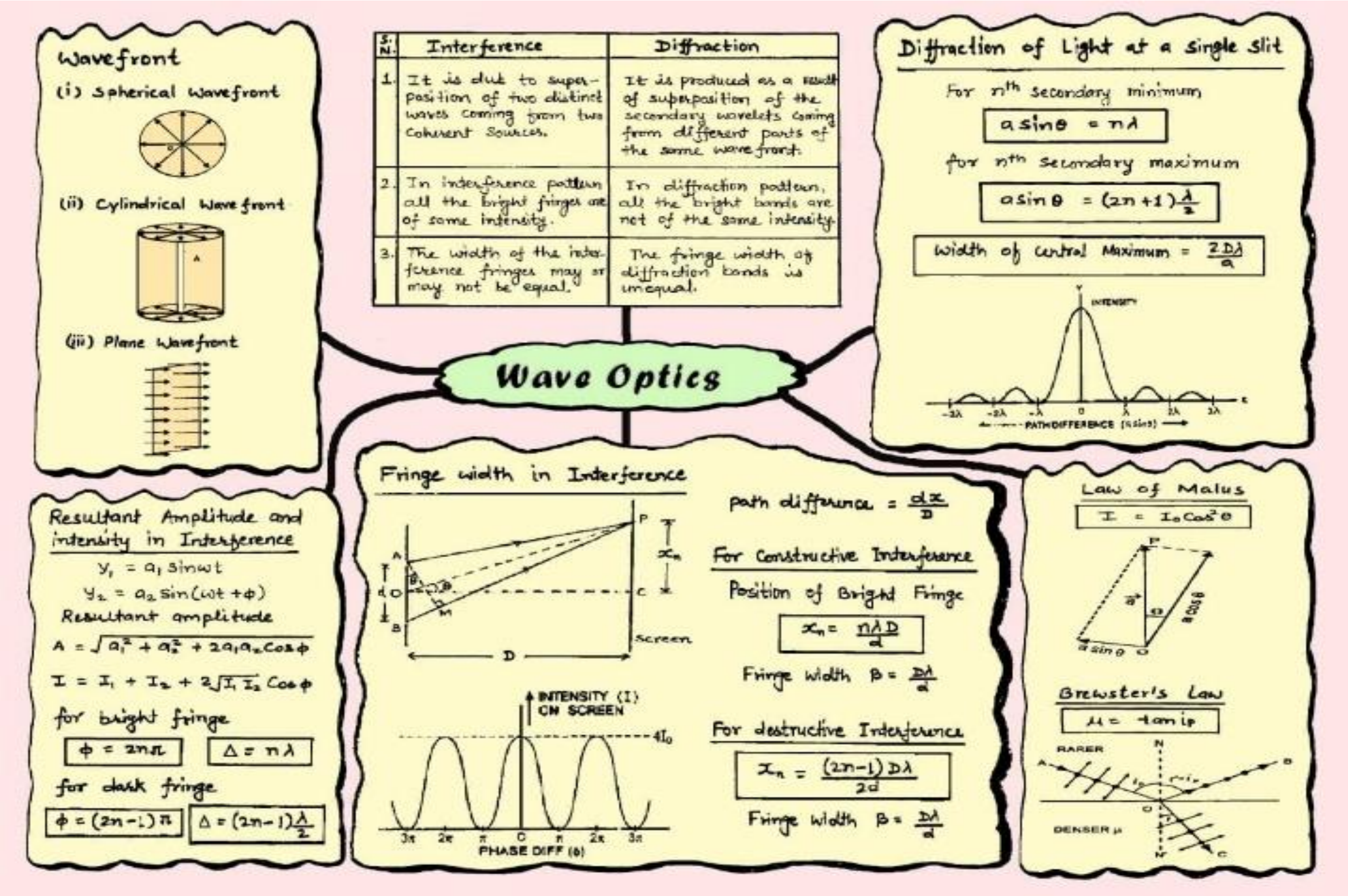
d = minimum distance between two objects

Resolving Power of telescope

R.P. of Telescope $= \frac{1}{d\theta} = \frac{D}{1.22\lambda}$

D = diameter of the objective of the telescope

λ = wavelength of light used.



MODERN PHYSICS

1. Radius of allowed Bohrs orbit

$$= \frac{\varepsilon_0 h^2 n^2}{\pi m Z e^2} = 0.53\frac{n^2}{Z}\ \text{Å}$$

Energy of hydrogen atom in n^{th} energy state =

$$-\frac{mZ^2e^4}{8\varepsilon_0^2 h^2 n^2} = -13.6\frac{Z^2}{n^2}$$

Velocity of electron Bohr orbit

$$V = \frac{Ze^2}{2\varepsilon_0 hn} = 2.191.10^6\frac{Z}{n}$$

2. The wave number of a spectral line is given by

$$\bar{\nu} = RZ^2\left(\frac{1}{m^2} - \frac{1}{n^2}\right)$$

$m = 1$, $n > 2$
Corresponds to Lyman series,
$m = 2$, $n > 2$
Corresponds to Balmer series,
$m = 3$, $n > 3$
Corresponds to Paschen series,
$m = 4$, $n > 4$
Corresponds to Bracket series,
$m = 5$, $n > 5$
Corresponds to Pfund series and so on.
(n is a natural number)

3. de-Broglie wavelength of a particle of mass m and moving with velocity v is

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

Einstein photoelectric equation is
$h\nu = W_0 + (K.E.)_{max}$
Stopping potential

$$V_0 = \left(\frac{h}{e}\right)\nu - \frac{W_0}{e}$$

4. For continuous X-rays

$$\lambda_{min} = \frac{hc}{eV}$$

Moseley law for characteristic X-rays

$$\sqrt{\nu} = a(Z - b)$$

5. Einstein mass energy equivalence principle $\Delta E = (\Delta m)c^2$
Binding energy per nucleon

$$= \left[\frac{Z}{A}(m_P - m_n) + m_n - \frac{m}{A}\right]c^2$$

The statistical radioactive law
$N = N_0 e^{-\lambda t}$

Half life $T_{1/2} = \frac{\ln 2}{\lambda}$ Mean life, $T_{av} = \frac{1}{\lambda}$ Activity $A = A_0 e^{-\lambda t}$

Semiconductor Electronics

1. For intrinsic semiconductor, $n_e = n_h = n_i$
2. For extrinsic semiconductor, $n_e \cdot n_h \simeq n_i^2$
3. In p-type semiconductor, $n_h \gg n_e$
   Holes: Majority carriers, **Electrons:** Minority carriers
4. In n-type semiconductor, $n_e \gg n_h$
5. **Electrons:** Majority carriers , **Holes:** Minority carriers
6. In semiconductors, $I = I_e + I_h$ Conductivity, $\sigma = e(n_e\mu_e + n_h\mu_h)$
7. **In $p - n$ junction diode**
   Forward current ⇒ Diffusion current Reverse current ⇒ Drift current
   Reverse resistance ≠ ∞
   In forward bias acts as closed switch In reverse bias acts as open switch

Unit 1 Electrostatics

MCQs:

(1) In the process of charging, the mass of the negatively charged body
(a) Increases (b) Decreases (c) Remains constant (d) Is not related to the charging process
(2) A soap bubble is given negative charge, it's radius will
(a) Increase (b) Decrease (c) Remain unchanged (d) Fluctuate
(3) For a uniformly charged ring of radius R, the electric field on its axis has the largest magnitude at a distance h from its centre. Then value of h is (a) R/√5 (b) R (c) R/√2 (d) R√2
(4) In a certain region of space with volume 0.2 m^3, the electric potential is found to be 5V throughout. The magnitude of electric field in this region is
(a) 0.5 N/C (b) 1 N/C (c) 5 N/C(d) Zero
(5) A capacitor is charged by a battery. The battery is removed and another identical uncharged capacitor is connected in parallel. The total electrostatic energy of resulting system
(a) Increases by a factor of 4 (b) Decreases by a factor of 2
(c) Remains the same (d) Increases by a factor of 2
(6) The electric field required to keep a water drop of mass "m" just to remain suspended, when charged with one electron is (a) mg (b) mg/e (c) emg (d) em/g
(7) Example of a real-world Faraday cage is (a) Car (b) Plastic box (c) Lighting rod (d) Metal rod
(8) The potential on the hollow sphere of radius 1m is 1000V, then potential at 1/4m from the centre of the sphere is (a) 1000V (b) 500V (c) 250V (d) Zero V
(9) If n capacitors, each of capacitance C are connected in series, then the equivalent capacitance of the combination will be (a) nC (b) n^{2C} (c) C/n (d) C/n^2
(10) A metal foil of negligible thickness is introduced between two plates of a capacitor at the centre. The capacitance of capacitor will be (a) Same (b) Double (c) Half (d) K Times
(11) Identify the wrong statement in the following, Coulomb's law correctly describes the electric force that
(a) Binds the electrons of an atom to it's nucleus
(b) Binds the protons and neutrons in the nucleus of an atom
(c) Binds atoms together to form molecules
(d) Binds atoms and molecules to form solids
(12) The dielectric constant of a metal is (a) 0 (b) 1 (c) Infinity (d) -1
(13) A parrot comes and sits on a bare high power line. It will
(a) Experience a mild shock (b) Experience a strong shock
(c) Get killed instantaneously (d) Not be affected practically
(14) Which of the following is not based on the heating effect of current?
(a) Electric heater (b) Electric bulb (with filament) (c) Electric iron (d) Microwave
(15) What gives the information on field strength, direction and nature of the charge
(a) Electric current (b) Electric flux (c) Electric field (d) Electric potential
(16) In comparison with the electrostatic force between two electrons, the electrostatic force between two protons is (a) Greater (b) Smaller (c) Zero (d) Same
(17) A parallel plate capacitor is made by stacking n equally spaced plates connected alternatively. If the capacitance between any two adjacent plates is C, then resultant capacitance is (a) (n-1) C
(b) (n+1) C (c) C (d) nC

(18) Each of two point charges is doubled and their distance is halved. Force of interaction becomes n times, where n is (a) 4 (b)1 (c) 18 (d) 16

(19) Charge on a conducting metal sphere is present
(a) On the surface of sphere (b) Inside the sphere
(c) Outside the sphere (d) Both inside and outside of sphere

(20) If e lectric flux $\Phi_E = \int_S \vec{E}.\vec{dS}$ through a closed surface is zero, it necessarily means that
(a) Electric field $\vec{E}$ at every point on the surface is zero.
(b) No charge exists inside the closed surface
(c) Only electric dipoles exist inside the surface.
(d) Electric potential is constant inside the closed surface.

Answer Key:
1 (a) 2 (a) 3 (c) 4 (d) 5 (b) 6 (b) 7 (a) 8 (a) 9 (c) 10 (a) 11 (b) 12 (c) 13 (d) 14 (d) 15 (c) 16 (d) 17 (a) 18 (a) 19 (a) 20 (c)

(2 marks questions):

(1) Define electric field intensity. What is its SI unit? What is relation between electric field and force?
(2) Show that the excess charge on a conductor resides only on its surface.
(3) The electric lines of force tend to contract lengthwise and expand laterally. What do they indicate?
(4) An arbitrary surface encloses a dipole. What is the electric flux through this surface?
(5) Why should electrostatic field be zero inside a conductor?
(6) For a given medium, the dielectric constant is unity. What is its permittivity?
(7) Vehicles carrying inflammable materials usually have metallic ropes touching the ground during motion. Why?
(8) Electrostatic experiments do not work well on humid days. Why?
(9) Sketch a graph to show how the charge Q aquired by a capacitor of capacitance C varies with increase in potential difference between it's plates.
(10) By what factor does the capacitance of a metal sphere increase if it's volume is tripled?
(11) Calculate the force between a proton and an electron separated by 0.8×10^{-15}m.
(12) 24 μF capacitor is connected to a 500 V battery. How much electrostatic energy is stored in the capacitor?
(13) What is the effective capacitance of two conductors of capacitance 3 μF and 4 μF , when connected (i) in series ; (ii) in parallel

<u>(3 marks questions):</u>

(1) Define electrostatic induction. Briefly explain how an insulated metal sphere can be positively charged by induction.
(2) An electric dipole free to move is placed in a uniform electric field, Explain along with diagram its motion when it is placed
(a) Parallel to the field
(b) Perpendicular to the field
(3) (i) Derive the expression for electric field at a point on the equatorial line of an electric dipole.
(ii) Depict the orientation of the dipole in (a) stable (b) unstable equilibrium in a uniform electric field.
(4) Two capacitors of unknown capacitances C_1 and C_2 are connected first in series and then in parallel across a battery of 100V.If the energy stored in the two combinations is 0.045J and 0.25J respectively, determine the values of C_1 and C_2. Also calculate the charge on each capacitor in parallel combination
(5) How much positive and negative charge is there in a cup of water?
(6) Five balls numbered 1 to 5 are suspended using separate threads. Pairs (1, 2), (2, 4), (4, 1) show electrostatic attraction, while pairs (2, 3) and (4, 5) show repulsion. What is the nature of charge on ball 1?
(7) An uncharged capacitor is connected to a battery. Show that half the energy supplied by the battery is lost as heat while charging the capacitor.
(8) Sketch equipotential surfaces for
(a) A positive point charge
(b) A negative point charge
(c) Two equal and opposite charges separated by a small distance
(9) Explain the meaning if the statement 'electric charge of a body is quantised'. Why can one ignore quantisation of electric charge when dealing with macroscopic charges?

(10) A parallel plate capacitor with plate separation 5mm is charged by a battery. It is found that on introducing a mica sheet 2 mm thick, while keeping the battery connections intact, the capacitor draws 25% more energy from the battery than before. Find the dielectric constant of mica.

(5 marks questions) :

(1)(a) Derive an expression for the potential energy of an electric dipole in a uniform electric field. Explain conditions for stable and unstable equilibrium.

(b) Is the electrostatic potential necessarily zero at a point where the electric field is zero? Give an example to support your answer.

(2) What will happen to the following when dielectric slab is introduced between the plates of the capacitor (a) Capacitance (b) Charge (c) potential (d) electric field (e) total energy stored. Given i) battery remains connected with the capacitor ii) battery is disconnected.

(3) (a) Define neutral axis. Find electric field intensity at any point on the equatorial line or neutral axis due to electric dipole. Write relation for E due to short dipole. What is the angle between E and P on the equatorial line?

(b) Define gauss theorem. Find relation for electric field intensity E due to charged rod.

(4) Find the relation for energy stored in capacitor? Where and in what form this energy isstored..

(5) A point charge is placed at the centre of spherical Gaussian surface. How will electric flux change if

(a) the sphere is replaced by a cube of same or different volume.

(b) a second charge is placed near and outside the original sphere.

(c) a second charge is placed inside the sphere

(d) the original charge is replaced by an electric dipole?

6) Define capacitance of a a parallel plate capacitor. Derive an expression for the capacitance of a parallel plate capacitor with dielectric as the medium introduced between theplates.

(7) Define gaussian surface. Find relation for electric field intensity E due to charged hollow conducting shell (i) inside (ii) outside (iii) on the surface. Draw graphically also

Unit 2 Current Electricity

MCQs:

1. SI unit of electric current is (a) coulomb (b) ampere (c) tesla (d) coulomb/ ampere
2. With the increase in area of cross section, the resistance of the conductor
 (a) increases (b) decreases (c) remains same (d) cannot say
3. Which of the following has highest value of resistivity? (a) metals (b) non metals (c) alloys (d) none
4. What is mobility?(a) Ratio of magnitude of drift velocity to electric field (b) Ratio of magnitude of electric field to magnitude of drift velocity (c) Dot Product of drift velocity and electric field (d) cross product of drift velocity and electric field
5. Which of the following has positive temperature coefficient of resistivity
(a) semiconductor (b) metals (c) insulators (d) All of these
6. A wire is stretched to double of its original length, its new resistivity will
(a) increase (b) decrease (c) may decrease or increase (d) remain same
7. Current density is a ________ quantity (a) scalar (b) vector (c) Both a and b (d) none
8. Kilowatt is a unit of (a) electric charge (b) electric energy (c) electric power (d) electric current
9. Ohm's law is obeyed by (a) electrolytes (b) discharge tubes (c) vacuum tubes (d) None of these
10. The relaxation time in conductors
(a) increases with increase in temperature (b) decreases with increase in temperature
(c) does not depend on temperature (d) first increases then decreases with rise in temperature
11. The direction of flow of current through electric circuit is
(a) from low to high potential (b) from high to low potential
(c) does not depend on potential value (d) current cannot flow through circuit
12. Resistivity of a wire depends on its (a) length (b) area of cross section (c) shape (d) material
13. The drift velocity does not depend upon (a) cross section of the wire (b) length of the wire for macroscopic wires (c) number of free electrons (d) magnitude of the current
14. Which of the following has negative temperature coefficient of resistance?
(a) germanium (b) iron (c) aluminium (d) copper
15. To draw maximum current from a combination of cells, how should the cells be grouped?
(a) series (b) parallel (c) mixed (d) depends upon the relative values of external and internal resistance

16. The resistance of wire is R. If the length of the wire is doubled by stretching it, then its resistance will be (a) 2R (b) 4R (c) R (d) 0.25 R
17. Current provided by a battery is maximum, when
(a) Internal resistance is equal to external resistance (b) Internal resistance is greater than external resistance (c) Internal resistance is less than external resistance (d) None of the above
18. If potential difference V applied across conductor is increased to 3V, how will the drift velocity of electron change? (a) drift velocity becomes tripled (b) drift velocity becomes doubled
c) remains same (d) drift velocity becomes four times
19. Drift velocity is due to (a) applied electric field over a given distance (b) random motion of electrons (c) random motion of holes (d) recombination of holes and electrons
20. When current flows in a conductor, then the ratio of the intensity of electric field at any point within the conductor and the current density at a point is called
(a) resistance (b) conductance (c) specific resistance (d) conductivity

Answer key

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
B	B	B	A	B	D	B	C	D	B	B	D	B	A	D	B	A	A	A	C

TWO MARKS QUESTIONS:

1. Define the term drift velocity of charge carrier in a conductor and write its relationship with the current flowing through it.
2. Define the term electrical conductivity of a metallic wire. Write its SI unit.
3. While making standard resistance, the coil is made of manganin. Why?
4. What is internal resistance of a cell? Derive an expression for it.
5. What is emf of a cell? On what factors does its value depend?
6. On what factors does the internal resistance of a cell depend?
7. Compare ohmic and non ohmic conductors
8. State and explain Kirchhoff's laws of electric circuits.
9. How can you increase the sensitivity of a potentiometer?
10. Write the difference between emf and terminal potential difference of a cell.
11. Define resistivity of a material and discuss the factors on which it depends.
12. Write the conditions under which ohm's law is not obeyed by a conductor.

3 Marks Questions:

(1) What do you understand by electromotive force of a cell? What is the SI unit of e.m.f.?
(2) What is electric current? What is its SI unit?
(3) Is electric current a scalar quantity? Explain.
(4) State and explain Ohm’s law.
(5) What do you mean by electrical resistance? Upon what factors it depends.
(6) Define resistivity. What is its S.I. unit?
(7) Explain the terms conductance and conductivity.
(8) Discuss the mechanism of current conduction in metallic conductors.
(9) Obtain an expression for electric current in terms of drift velocity of free electrons.
(10) What do you mean by current density?
(11) How will you establish the validity of Ohm’s law?
(12) How does resistivity of a material change with temperature?
(13) Explain the effect of temperature on the resistance of metallic conductors.
(14) Derive an expression for the equivalent resistance when a number of resistors are connected in (i) series (ii) parallel.
(15) What do you mean by internal resistance of a cell?
(16) Obtain an expression for circuit current when a number of cells are connected in (i) series (ii) parallel.
(17) Derive the condition for maximum current in series-parallel grouping of cells.

UNIT – 3 MAGNETIC EFEECT OF CURRENT AND MAGNETISM

MCQs

1. Tesla is a unit of: (a) Electric flux (b) Magnetic flux (c) Electric Field (d) Magnetic Field
2. Resistance of an ideal voltmeter is (a) Zero (b) Infinite (c) High (d) Low

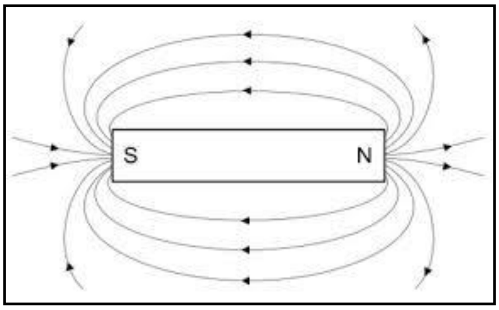
3. When the charged particles move in a combined magnetic and electric field, then the force acting is known as _________.
(a) Centripetal force (b) Centrifugal force (c) Lorentz force (d) Orbital force
4. Magnetic field at any point inside the straight solenoid is given as———.
(a) $B = \mu_0 + nI$ (b) $B = \mu_0 + n$ (c) $B = \mu_0/nI$ (d) $B = \mu_0 nI$
5. The force on a current-carrying conductor when placed perpendicular in a uniform magnetic field.
(a) F=BIL (b) F=B/IL (c) F=L/BI (d) F=I/BL
6. A soft iron bar is introduced inside a current-carrying solenoid. The magnetic field inside a solenoid: (a) Decrease (b) Will increase (c) Will become zero (d) Will remain unaffected
7. A positive charge is moving upward in a magnetic field directed towards North. The particle will be deflected towards: (a) East (b) North (c) South (d) West
8. Write the dimensional formula of magnetic flux
(a) $M^0L^{-1}T^0A^{-1}$ (b) $M^1L^0T^{-2}A^{-1}$ (c) $ML^2T^{-2}A^{-1}$(d) $M^0L^1T^0A^1$
9. What is the resistance of an ideal voltmeter and an ideal ammeter?
(a) Infinity, Zero (b) Zero, Infinity (c) Zero, Zero (d) Infinity, Infinity
10. Weber ampere per meter is equal to (a) Joule (b) Newton (c) Henry (d) watt
11. A frog can jump higher than normal in magnetic field because the tissue of a frog are:
(a) Paramagnetic (b) Diamagnetic (c) Ferromagnetic (d) Anti- Ferromagnetic
12. The path executed by charged particle whose motion is perpendicular to a uniform magnetic field is: (a) A straight path (b) An ellipse (c) A circle (d) A helix
13. In a moving coil galvanometer, we use radial magnetic field so that the scale is:
(a) Logarithmic (b) Exponential (c) Linear (d) None of these
14. Magnetic susceptibility for diamagnetic material is
(a) Small and negative (b) Small and positive (c) Large and positive (d) Large and negative
15 .The field due to a long straight wire carrying a current I is proportional to:
(a) r (b) r^2 (c)$1/r^2$ (d) 1/r
16. Magnetic effect of current was discovered by: (a) Faraday (b) Oersted (c) Ampere (d) Bohr
17. A charged particle enters a magnetic field at an angle of 60^0 with magnetic field. The path of the particle will be (a) a helix (b) an ellipse (c) a circle (d) A straight line
18. To covert a galvanometer into an ammeter, we connect
(a) low resistance in parallel (b) high resistance in series
(c) high resistance in parallel (d) low resistance in series.

Answer Key:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
D	B	C	D	A	B	D	C	A	B	B	C	C	A	D	B	A	A

(A) Read the passage carefully and answer the questions from (a) to (e).

Magnetic field of any magnetic pole is the region (space) around it in which its magnetic influence can be realised. A magnetic field line of force is a line, straight or curve tangent to which at any point gives the direction of magnetic field at that point(figure) These are only the hypothetical lines which helps us to understand certain phenomenon in magnetism. As shown in figure they travel from N-pole to S-pole outside the magnet and form S-pole to N-pole inside the body of magnet. The tangent to a field line at any point gives the direction of the net magnetic field 'B' at that point. Magnetic field lines of a magnet or a solenoid form closed and continuous curves extending through the body of the magnet. Magnetic field lines tend to contract longitudinally in case of unlike poles. This explains the attraction between unlike poles. No, two magnetic field lines intersect each other. If two lines intersect at a point, then at



that point there will be two directions of magnetic field, which is not possible. Magnetic field lines tend to dilate laterally in case of like poles. This explains the repulsion between like poles. The number of magnetic field lines crossing per unit area normally in a region gives the idea about the strength of the field, i.e., closely spaced field lines represent a strong field, whereas widely space field lines represent a weak magnetic field.
(a) What is magnetic field?
(b) What is magnetic field line?
(c) What is the direction of magnetic field line outside the magnet?
(d) What is the direction of magnetic field line inside the magnet?
(e) Can two magnetic field lines intersect each other?

(B)Answer the following questions based on the reading passage.

An object that attracts metals, especially iron, is called a magnet. The area near the magnet where it has enough power to attract things is called its magnetic field. The farther away from the magnet an item is, the weaker the magnetic field is. When it is weak, it is less likely an object will become attracted to the magnet. Magnets can be either permanent or temporary. A permanent magnet stays magnetized for a long time. A temporary magnet loses its magnetism after only a short time. You can even turn something made out of iron into a temporary magnet by rubbing it against a permanent magnet. The more you rub, the stronger your temporary magnet gets. However, the effects will wear off over time. The two ends of the magnets are called magnetic poles. The poles are found at the ends of bar magnets and the tips of the horseshoe magnets. They are the strongest parts of the magnet. Each magnet has a north pole and a south pole. Opposite poles attract, or pull toward each other. Poles that are the same repel, or push away from each other. A north pole and a south pole will pull toward each other. Two north poles will push away from each other. The same happens with two south poles. When you hold magnets, you can actually feel the push and pull effects of magnetism. A special kind of temporary magnet uses electricity to create a magnetic field. It is called an electromagnet. An electromagnet can be an extremely strong magnet. However, it only acts like a magnet when it has electricity. A stronger electrical current will produce a stronger magnet. Unlike other magnets, an electromagnet can be controlled by a switch. When the switch turns the electrical current off the electromagnet loses its magnetism. Whatever the electromagnet was holding drops to the ground. We use this technology to operate large cranes that lift heavy metal objects, such as cars. Electromagnets are also used to make motors run in small appliances. Combining regular magnets and electromagnets makes it possible for electrical energy to be turned into energy of motion.

(i) Explain the difference between a temporary magnet and a permanent magnet.
(ii) Would two north poles attract each other or push away from each other?
(iii) What is different about an electromagnet?
(iv) What do we use electromagnets for?
(v) What does attract mean when speaking about magnets?

(C)Read the following paragraph and answer the questions given below

Iron and steel are not the only substances which are attracted by a magnet or which can be magnetised. In fact all the substances possess magnetic properties. On the basis of their magnetic behaviour, Faraday divided the magnetic materials into three classes- diamagnetic, paramagnetic and ferromagnetic material . Diamagnetic substance is feebly repelled by a magnet. The behaviour of diamagnetic substance is independent of temperature eg copper , zinc, gold etc. Paramagnetic substance is feebly attracted by a magnet. In contrast to diamagnetic, the behaviour of a paramagnetic is temperature dependent. Aluminium, sodium, manganese are paramagnetic substances. Ferromagnetic substances are strongly attracted by a magnet. Further the ferromagnetic behaviour of a substance becomes temperature dependent above the certain temperature which is characteristic of that substance. It is called Curie temperature. The diamagnetic substances do not obey Curie's law but paramagnetic substances obey Curie's law. At a certain temperature, a ferromagnetic substance starts behaving as a paramagnetic substance. Iron, Nickel, Cobalt are the examples of ferromagnetic substances.

Questions-

Q1 What happens when a diamagnetic substance is placed in a varying magnetic field?
Q2 Is the behaviour of paramagnetic substances is independent of temperature like diamagnetic substances?
Q3 What is Curie point or Curie temperature?
Q4 Write any two properties of ferromagnetic substance.
Q5 When does a ferromagnetic substance starts behaving as a paramagnetic substance?

<u>TWO MARKS QUESTIONS</u>

1. Define Ampere's swimming rule for the magnetic effect of current.
2. What is SNOW rule?
3. How can a Galvanometer be converted into an ammeter?
4. Define current sensitivity of moving coil galvanometer.
5. What is shunt? State its SI unit.
6. If a piece of ferromagnetic substance is placed in non- uniform magnetic field. How will it behave?
7. Write two properties of ferromagnetic substances.
8. A Solenoid of length 50cm, having 100 turns carries a current of 2.5A. Find the magnetic field (B) in the interior of solenoid.
9. Why two magnetic field lines of force do not cross each other.
10. How much force will be experienced by a charge in uniform magnetic field?

<u>THREE MARKS QUESTIONS</u>

11. Using Biot Savart's law, derive an expression for magnetic field due to circular current carrying loop at any point on its axis.
12. State and explain Ampere's circuital law and find magnetic field intensity at point well within the solenoid carrying current.

13. Find an expression for torque acting on a current carrying loop suspended in uniform magnetic field.
14. Find an expression for the force acting on current carrying conductor placed in magnetic field. How will you determine the direction of this force?
15. Obtain an expression for force between two current carrying parallel conductors.
16. How a moving coil galvanometer can be converted into voltmeter.
17. Define Magnetic field intensity at a point and derive its expression at a point on the axis of magnetic dipole.
18. Find an expression for the torque acting on a magnetic dipole (bar magnet) suspended in a uniform magnetic field.
19. Find the ratio of radii of the circle covered by a proton and alpha particle when both enter in the same uniform magnetic field perpendicularly with same kinetic energy.
20. Define magnetic field intensity at a point. Derive its expression at a point on equatorial line of magnetic dipole.
21. Explain Biot Savart's law for small current carrying conductor.
22. Drive an expression for magnetic field produced at center of current carrying coil. How will you find direction of this field?
23. Using Ampere's circuital law drive and expression for magnetic field due to infinitely long current carrying wire at a distance (r) from it.
24. Obtain an expression for the force between two current carrying parallel conductors in same direction.
25. How can a galvanometer be converted into voltmeter?
26. How can a galvanometer be converted into ammeter?
27. Find the expression for the force acting on a current carrying conductor placed in a magnetic field.
28. A solenoid of length 50 cm having 100 turns carries a current of 2.5 A. Find the magnetic field (B). (a) In the interior of the solenoid (b) At the end of the solenoid
29.A circular coil of wire of 50 turns each of radius 0.08 cm carries a current of 0.8 A. Find the magnetic flux density at the center of the coil.
30. Calculate the force per unit length on a long straight wire carrying current of 4A due to similar parallel wire carrying same current. Distance between them is 3×10^{-2} m.
31. A voltmeter reacts up to 3 V. Its resistance is 200 ohm. It is to be used to measure a potential difference which may be as large as 60 V. What would be the resistance used to protect the voltmeter?
32. Two infinite long straight parallel wires A and B carry current of 4A and 10A respectively in opposite direction and are placed at 10 cm apart in vacuum. Find the force on 15 cm length of wire.
33. What do you understand by magnetic field? Define its SI units and give its dimensional formula.
34. What do you understand by Lorentz force? Explain.
35. Define current sensitivity and voltage sensitivity of a moving coil galvanometer. How can a galvanometer be made more sensitive?
36. Define Magnetic permeability and magnetic susceptibility and derive relation between them?
37. State and explain Curie's law in magnetism?
38. Write any three properties of magnetic lines of force?
39. Find expression for Time period of oscillation of a bar magnet on being disturbed slightly from its equilibrium position in uniform magnetic field?
40. How are materials classified according to their behaviour in magnetic field? Give examples of each type?
41. State properties of ferromagnetic substances?
42. Write three properties of paramagnetic substances?
43. State three properties of bar magnet?
44. A short bar magnet placed with its axis at 30° with a uniform external magnetic field of 0.25T experiences a torque of magnitude 4.5×10^{-2}J. What is magnitude of magnetic moment of the magnet?
45. A shot bar magnetic of magnetic moment $0.32 JT^{-1}$ is placed in uniform magnetic field of 0.15T. Find the potential energy in its state of stable equilibrium?

Unit 4 Electromagnetic Induction and Alternating Current

Multiple Choice Questions:

1. Which of the following laws give the polarity of induced emf?

(a) Biot –Savart's law (b) Lenz' law (c) Faraday's law (d) Coulomb's law

2. Electrical inertia is the measure of:
(a) Self inductance (b) Mutual inductance (c) Impedance (d) Reactance

3. Dimensional formula of inductance is:
(a) [M L^3 T^2 A^2] (b) [M L^2 T^2 A] (c) [M L^2 T^{-2} A^2] (d) [M L^2 T^{-2} A^{-2}]

4. Direction of current induced in a wire moving in magnetic field is given by: (a) Fleming's left hand rule (b) Fleming's right hand rule (c) Right hand thumb rule (d) SNOW rule

5. If N-pole of a bar magnet goes away from the coil, direction of current induced in it will be:
(a) Anti-clockwise (b) Clockwise (c) Either 'a' or 'b' (d) Can't say

6. Coils in a resistance box are doubly wound to: (a) Increase self-induction (b) Decrease self-induction (c) Increase resistance (d) Decrease resistance

7. At resonant frequency, the impedance of LCR circuit is:
(a) Zero (b) Maximum (c) Minimum (d) Infinite

8. Power dissipation is maximum for:
(a) Pure capacitive circuit (b) Pure inductive circuit (c) Pure resistive circuit (d) All of these

9. If frequency of AC increases, then inductive reactance
(a) Increases (b) Decreases (c) Remains same (d) Becomes zero

10. Power factor is unity for:
(a) Pure capacitive circuit (b) Pure resistive circuit (c) Pure inductive circuit (d) All of these

11. If frequency of AC Is doubled, then capacitive reactance will be:
(a) Same (b) Doubled (c) Halved (d) Zero

12. Transformation ratio in a step up transformer is:
(a) 1 (b) Less than 1 (c) Greater than 1 (d) Zero

13. Energy loss due to eddy currents in a transformer can be minimised using:
(a) Copper coils (b) Thick coils (c) Solid core (d) Laminated core

14. If current lags behind voltage by a phase difference of π/2, then the AC circuit contains:
(a) Only 'R' (b) Only 'C' (c) Only 'L' (d) Both 'L' and 'R'

15. A transformer steps up or down:
(a) Alternating current (b) Direct current (c) Induced current (d) All of these

True or False

1) At resonance, current through series LCR circuit becomes maximum.
2) Transformer works on the principle of self induction.
3) SI unit of mutual inductance is Weber.
4) A capacitor blocks DC.
5) AC can be used for electrolysis and electroplating.
6) AC generator works on the principle of mutual induction.
7) Dimensions of impedance are same as resistance.
8) Lenz' law is based on the conservation of momentum.
9) Whenever there is a relative motion between a magnet and a coil, current is induced in the coil.

Answer Key

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
B	**A**	**D**	**B**	**B**	**B**	**C**	**C**	**A**	**B**	**C**	**C**	**D**	**C**	**A**

True/False 1. True, 2. False 3. False 4. True 5. False 6. False 7. True 8. False 9. True

Two Marks Questions

1) State Fleming's Right-hand rule.
2) Name the physical quantity which is measured in weber/ampere. Is it a scalar or vector quantity?
3) State and explain Faraday's law of electromagnetic induction.
4) Find an expression for energy stored in an inductor.
5) An induced current has no direction of its own. Explain, why?
6) Self-induction is called the inertia of electricity. Explain, why?
7) Define the coefficient of mutual induction and write its units.
8) Define coefficient of self-induction and write its units.
9) What is wattles and wattful current?
10) Why high frequency ac cannot pass easily through an inductor?
11) An alternating e.m.f. is supplied to a pure resistor. Investigate the phase relationship between the current passing through it and the e.m.f. applied.

12) An alternating e.m.f. is supplied to a pure inductor. Investigate the phase relationship between the current passing through it and the e.m.f. applied.

Three Marks Questions

1) State Lenz' rule and show that it is in accordance with the law of conservation of energy.
2) What is self-induction? Derive an expression for the coefficient of self-induction for a long solenoid.
3) What is mutual-induction? Derive an expression for the coefficient of mutual-induction for two long solenoids.
4) Discuss the principle, construction and working of an AC generator.
5) Derive an expression for average power in a series LCR circuit. How does it differ from the virtual power?
6) With the help of a phasor diagram, derive an expression for impedance in series LCR circuit.
7) What is a transformer? Discuss its principle and theory.
8) Explain various energy losses in a transformer. Also discuss the methods to minimise these losses.
9) With the help of a diagram, explain the construction and working of a step-up transformer. Why is its core laminated?
10) How transformer is useful for long distance transmission of electrical energy? Why soft iron is used to make its core?

Unit 5 Electromagnetic waves

MCQs:

Q.1. In electromagnetic waves the phase difference between electric and magnetic field vectors are
(a) zero (b) $\pi/4$ (c) $\pi/2$ (d) π

Q.2. Which of the following has minimum wavelength?
(a) Blue light (b) γ-rays (c) infrared rays (d) microwave

Q.3. The correct option, if speeds of gamma rays, X-rays and microwave are V_g ,V_x an V_m respectively will be.
(a) $V_g>V_x>V_m$ (b) $V_g<V_x<V_m$ (c) $V_g>V_x>V_m$ (d) $V_g = V_x = V_m$

Q.4. Which of the following has maximum penetrating power?
(a) Ultraviolet radiation (b) Microwaves (c) γ-rays (d) Radio waves

Q.5. The quantity $\sqrt{\mu_o \varepsilon_o}$ represents
(a) speed of sound (b) speed of light in vacuum
(c) speed of e.m. waves (d) inverse of speed of light in vacuum

Q.6. Which of the following is called heat radiation?
(a) X-rays (b) γ-rays (c) Infrared radiation (d) Microwave

Q.7. From Maxwell's hypothesis, a changing electric field gives rise to
(a) an electric field. (b) an induced e.m.f (c) a magnetic field. (d) a magnetic dipole.

Q.8. The ultra-high frequency band of radio waves in electromagnetic wave is used as in (a) television waves
(b) cellular phone communication (c) commercial FM radio (d) both (a) and (c)

Q.9. Electromagnetic waves are transverse in nature is evident by
(a) polarisation (b) interference (c) reflection (d) diffraction

Q.10. Which of the following are not electromagnetic waves?
(a) Cosmic rays (b) γ-rays (c) β-rays (d) X-rays

Q.11. 10 cm is a wavelength corresponding to the spectrum of
(a) infrared rays (b) ultraviolet rays (c) microwaves (d) X-rays

Q.12. Which of the following EMW has highest wavelength?
(a) X-ray (b) ultraviolet rays (c) infrared rays (d) microwaves

Q.13. The structure of solids is investigated by using
(a) cosmic rays (b) X-rays (c) γ-rays (d) infrared rays

Q.14. The condition under which a microwave over heats up a food item containing water molecules most efficiently is
(a) The frequency of the microwaves must match the resonant frequency of the water molecules.
(b) The frequency of the microwaves has no relation with natural frequency of the water molecules.
(c) Microwaves are heat waves, so always produce heating.
(d) Infrared waves produce heating in a microwave oven.

Q.15. Which radiations are used in treatment of muscle ache?
(a) Infrared (b) Ultraviolet (c) Microwave (d) X-rays

Q.16. Waves in decreasing order of their wavelength are
(a) X-rays, infrared rays, visible rays, radio waves
(b) radio waves, visible rays, infrared rays, X-rays.
(c) radio waves, infrared rays, visible rays, X-rays.
(d) radio waves, ultraviolet rays, visible rays, X-rays.

Q.17. Electromagnetic waves with wavelength λ are used by a FM radio station for broadcasting. Here λ belongs to (a) radio waves (b) VHF radio waves (c) UHF radio waves (d) microwaves

Q.18. Maxwell in his famous equations of electromagnetism introduced the concept of
(a) ac current (b) displacement current (c) impedance (d) reactance

Q.19. The conduction current is same as displacement current when source is
(a) a.c. only (b) d.c. only (c) eithera.c. or d.c. (d) neither dc nor a.c.

Q.20. If a variable frequency ac source is connected to a capacitor then with decrease in frequency the displacement current will
(a) increase (b) decrease (c) remains constant (d) first decrease then increase

Q.21. An electromagnetic wave can be produced, when charge is
(a) moving with a constant velocity (b) moving in a circular orbit
(c) falling in an electric field (d) both (b) and (c)

Q.22. Which of the following statement is false for the properties of electromagnetic waves?
(a) Both electric and magnetic field vectors attain the maxima and minima at the same place and same time.
(b) The energy in electromagnetic waves is divided equally between electric and magnetic field vectors.
(c) Both electric and magnetic field vectors are parallel to each other and perpendicular to the direction of propagation of wave.
(d) These waves do not require any material medium for propagation.

Q.23. Which of the following has/have zero average value in a plane electromagnetic wave?
(a) Both magnetic and electric fields (b) Electric field only (c) Magnetic field only (d) None of these

Q.24. Which of the following laws was modified by Maxwell by introducing the displacement current?(a) Gauss's law (b) Ampere's law (c) Biot-Savart's law (d).None of these

Q.25. The waves used by artificial satellites for communication is
(a) Microwaves (b) infrared waves (c) radio waves (d) X-rays

Q.26. Which of the following electromagnetic waves is used in medicine to destroy cancer cells? (a) IR-rays (b) Visible rays (c) Gamma rays (d) Ultraviolet rays

Q.27. A linearly polarized electromagnetic wave given as $E = E_0\hat{\imath}\ \cos(kz - \omega t)$ is incident normally on a perfectly reflecting infinite wall at z =a. Assuming that the material of the wall is optically inactive, the reflected wave will be given as
(a) $E_r = -E_0\hat{\imath}\ \cos(kz - \omega t)$. (b) $E_r = E_0\hat{\imath}\ \cos(kz + \omega t)$.
(c) $E_r = -E_0\hat{\imath}\ \cos(kz + \omega t)$. (d) $E_r = E_0\hat{\imath}\ \sin(kz - \omega t)$.

Q.28 The source of electromagnetic waves can be a charge
(a) moving with a constant velocity. (b) moving in a circular orbit
(c) at rest. (d) falling in a magnetic field.

Q.29. If **E** and **B** represent electric and magnetic field vectors of the electromagnetic wave, the direction of propagation of electromagnetic wave is along(a) **E**. (b) **B**. (c) **B × E**. (d) **E × B**.

True or False

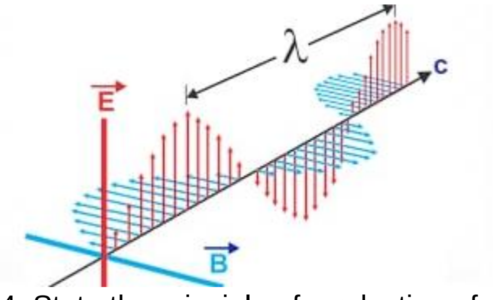
Q.30. X-rays travel in the vacuum at a higher speed than the visible light. (T/F)
Q.31. Electromagnetic waves are classified as transverse waves. (T/F)
Q.32. Sound waves are electromagnetic waves. (T/F)
Q.33. All objects emit electromagnetic waves. (T/F)
Q.34. Electromagnetic waves need no matter to move. (T/F)

Answer Key (MCQs)

| 1. (a) | 2. (b) | 3. (d) | 4. (c) | 5. (d) | 6. (c) | 7. (c) | 8. (b) | 9. (a) | 10. (a),(c) |11. (c) | 12. (d) | 13. (b) | 14. (a) | 15. (a) | 16. (c) | 17. (b) | 18. (b) | 19. (c) | 20. (b) || 21. (d) | 22. (c) | 23. (a) | 24. (b) | 25. (a) | 26. (c) | 27. (b) | 28. (b) | 29. (d) | 30. False | 31. True | 32. False | 33. False | 34. True |

2 Marks Questions:

1. What is Maxwell's displacement current?
2. What are Maxwell's equations?
3. What does an e.m waves consist of? On what factors does its velocity in vaccum depends.



4. State the principle of production of em waves. What is the value of velocity of these waves?
5. Can an em wave be deflected by magnetic field of electric field? Explain your answer.
6. State any four properties of em waves.

7. What are radio waves? Give their two uses.
8. What are microwaves? Write their two uses.
9. What are infrared rays? Write their two uses.
10. What are ultra violet rays? Give their two uses.
11. What are x rays? Write their two uses.
12. What are gamma rays? Write their two uses.
13 .Is displacement current like conduction current, source of magnetic field?
14. The charging current for a capacitor is 0.25A, what is displacement current across its plate?
15. What is the wavelength of a television station which transmits vision on 500 MHz?
16. Find the wavelength of em wave of frequency 6x 10^{12} hertz.
17. An em wave exerts pressure on the surface on which it is incident. Justify.
18. Why can light travel in vacuum where is sound cannot do so?
19. Why is the amount of the momentum transferred by the em waves incident on the surface so small?
20. Which part of the em spectrum has largest penetration power?

<u>**Unit-6 Optics**</u>

Q1. Two lenses of power -15 D and +5D are in Contact with each other. The focal length of the combination is (a)-20 cm (b)-10cm (c)+20cm (d)+10cm
Q2. A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lenses Then its focal length will be
(a) becomes zero (b) becomes infinite (c)remains unchanged (d)becomes small
Q3. If two lenses of power +1.5D and +1.0 D are placed in Contact then the effective power of thecombination (a)2.5 (b)1.5 (c)0.5 (d)3.25
Q4. Brilliance of diamond is due to (a)shape(b)cutting (c)reflection (d)total internal reflection
Q5. Velocity of light is maximum in (a) diamond(b)water (c)glass (d) vacuum
Q6. When light passes from one medium to another medium which one of the quantities remainsunchanged (a) refractive index (b)frequency (c) wavelength(d) velocity
Q7. At critical angle the angle of refraction becomes (a) 60^0 (b) 90^0 (c)30^0 (d)none
Q8. An air bubble inside the water behaves as
(a)convex lens (b)concave lens (c)plano convex (d) concave mirror
Q9. The value of the critical angle is least for which of the following colour of light (a) violet (b) green (c)blue (d)yellow
Q10. To a fish under water, viewing obliquely a fisherman standing in the bank of lake, the man looks(a)tall (b)small (c)same size (d) none
Q11. A virtual image larger than the object can be produced by
(a)plane mirror (b)concave mirror (c)convex mirrors (d)all
Q12. Total internal reflection takes place when ray of light goes from
(a)water to glass (b)glass to diamond (c)water to air (d)air to mercury
Q13. In optical fibres the following principle is used
(a)scattering (b)refraction (c) total internal reflection (d) none
Q14. The convex lens of focal length 0.3 m and 0.05 m are used to make a telescope. In normaladjustment. The distance between them is equal to
(a)0.35 m (b)0.25m (c)0.175m (d)0.15 m
Q15. A reflecting telescope uses (a)concave mirror(b) convex mirror(c)prism (d) plano convex lens
Q16. Light has the following property (a)transverse (b)longitudinal(c)both (d) none
Q17. Waves that cannot be polarized (a) longitudinal (b)transverse (c)electromagnetic (d)light
Q18. At polarising angle, the angle between reflected and refracted light is (a)0^0 (b)90^0 (c)180^0 (d)60^0
Q19. The relation between polarising angle and refractive index is
(a)μ tan p =1 (b) μ cot p=1 (c) μ sin p=1 (d) μ cosp=1
Where μ called refractive index
Q20. The colour of the sky is blue due to
(a) reflection (b)refraction (c)scattering (d)dispersion
Q21. If a glass rod is immersed in a liquid of the same refractive index, the it will
(a) disappear (b) look bent (c) look longer (d) look shorter
Q22.The velocity of light in medium is $2x10^8$ $m\text{-}s^{-1}$. Refractive index of the medium is
(a) 1 (b) 1.1 (c) 1.4 (d) 1.5

Q23. If the critical angle for a medium is 45^0, then its refractive index will be
(A) $\sqrt{2}$ (B) $\sqrt{3}/2$ (C) $1/\sqrt{2}$ (D) $2/\sqrt{3}$
Q24. The focal lengths for violet, green and red light rays are f_V, f_G and f_R respectively. Which ofthe following is the true relationship ?
(a) $f_R < f_G < f_V$ (b) $f_V < f_G < f_R$ (c) $f_G < f_R < f_V$ (d) $f_G < f_V < f_R$
Q25. A double convex lens of refractive index μ_1 is immersed in a liquid of refractive index μ_2.This lens will act as converging lens, if
(a) $\mu_1 > \mu_2$ (b) $\mu_2 > \mu_1$ (c) $\mu_1 = \mu_2$ (d) $\mu_1 = \mu_2 = 0$
Q26. The power of a plane glass is (a)zero (b) 1 D (c) 2 D (d) infinity
Q27. The splitting of white light into several colours, while passing through a glass prism, is called (A) dispersion (B) reflection (C) diffraction (D)interference
Q28. The Cauchy's dispersion formula for the refractive index is
(A) $\mu = A + B\lambda^{-2} + C\lambda^{-4}$ (B) $\mu = A + B\lambda^{2} + C\lambda^{-4}$
(C) $\mu = A + B\lambda^{-2} + C\lambda^{4}$ (D) $\mu = A + B\lambda^{2} + C\lambda^{4}$
Q29. Which nature of the wavefront is associated with a parallel beam of light ?
(A) plane (B) spherical (C) cylindrical (D) all of these
Q30. In Young's double slit experiment, for which colour, fringe width is the least ?
(A) green (B) blue (C) red (D) yellow
Q31. What is the path difference for destructive interference ?
(A) $n\lambda$ (B) $(n+1)\lambda$ (C) $(2n+1)\lambda/2$ (D) $(2n+1)\lambda/4$
Q32. Two coherent light beams of intensity I and 4 I are superposed. The maximum and minimumpossible intensities in the resulting beam are
(A) 5I and I (B) 5I and 3 I (C) 9I and I (D) 9I and 3 I
Q33. Which of the following property of light waves is not observed in sound waves ?
(A) reflection (B) refraction (C) polarization (D) Doppler effect
Q34. When exposed to sunlight, thin films of oil on water often exhibit brilliant colours due to thephenomenon of
(A) interference (B) diffraction (C) dispersion (D) polarization

True or False

Q1. The polarising angle also depends upon wave length of light also.
Q2. At angle of polarisation reflected and refracted light becomes perpendicular to each other.
Q3. At angle of polarisation the reflected light is totally polarised.
Q4. A lens when immersed in a transparent liquid becomes invisible when refractive index of liquid and lens is same.
Q5. Sound waves cannot be polarised because these are longitudinal in nature.
Q6. Total internal reflection takes place when ray of light goes from rarer to denser medium.
Q7. The colour of the sky from moon surface is black.
Q8. The sun is seen a little before it rises and for a short while after its sets due to refraction of light.

Answers (MCQs)

1	2	3	4	5	6	7	8	9	10
b	b	a	d	d	b	b	b	a	a
11	12	13	14	15	16	17	18	19	20
b	c	c	a	a	a	a	b	b	c
21	22	23	24	25	26	27	28	29	30
a	d	a	b	a	a	a	a	a	b
31	32	33	34						
c	c	c	a						

True/ False Statements 1. True 2. True 3. True 4. True 5. True 6.False 7. True 8. True

3 marks

1. State Huygen principle and prove the laws of refraction on its basis.
2. State Huygen principle and prove the laws of reflection on its basis.
3. Derive Prism formula for a prism of small angle.
4. State and prove Brewster's law of polarisation of light.
5. Obtain an expression for the effective focal length of a combination of two thin lenses placed in contact coaxially with each other.
6. Show that interference obeys law of conservation of energy?

7. Derive the relation for mirror formula for convex lens when image is real or virtual.
8. Derive thin lens formula relating object distance, image distance and focal length of a convex lens.

5 marks

Q1. State the necessary conditions for sustained interference pattern. Derive an expression for fringe width using Young's double slit experiment interference of light.
Q2. Discuss fully Fraunhofer diffraction at a single slit. Also derive the relation for linear width of central maximum.
Q3. Derive a relation between focal length of a double convex lens and its radius of curvature.
Q4. Discuss refraction of light from rarer to denser medium at a convex spherical refracting surface.
Q5. What is total internal reflection? What are necessary conditions for total internal reflection to take place? Obtain a reflection between critical angle and refractive index of medium. Give an example showing total internal refraction.
Q6. With the help of a diagram, explain the working of a compound microscope and find the expression for its magnifying power.
Q7. Draw a course of rays in case of astronomical refracting telescope when (i) final image at distance of distinctvision (ii) final image at infinity. Obtain expression of magnifying power in each case.

Numericals (3 marks)

Q1. A rod of length 5 cm lies along the principal axis of the concave mirror of focal length 15cm in such a way that the end closer to the pole is 30 cm away from it . Find the length of the image?
Q2. A concave mirror produce a magnification of ½ when an object is placed at a distance of 50 cm from it. Where should be the object be placed so that image becomes 1/3 of the object.? (Ans: 80 cm)
Q3. The refractive index of glass and water with respect to air are 3/2 and 4/3. What is the refractive of glass w.r.t water? (Ans: 9/8)
Q4 . The radius of curvature of either face of a convex lens is equal to its focal length. What is the refractive index of the material? (Ans: 1.5)
Q5. The image obtained with a convex lens is erect and its length is four times the length of the object.If the focal length of the lens is 20 cm. Calculate the object image distances ? (Ans: u= -10cm, v= -20cm)
Q6. The radii of curvature of two surfaces of a double convex lens are 10 cm and 20 cm respectively.Calculate the power of the lens, if the refractive index of the material of glass is 1.5? (Ans: 7.5 D)
Q7. Two lenses, one diverging of power 2D and the other converging of power 6 D are combinedtogether. Calculate the focal length and power of the combination? (Ans: 4 D. f= 25 cm)
Q8 The angle of prism is 30^o. The rays incident at 60^o on one refractive surface suffers a deviation 30^o.What is the angle of emergence? (Ans: 0^o)
Q9. The minimum deviation produced by a glass prism of angle 60° is 30°. If the velocity of light invacuum is $3 \times 10^8 ms^{-1}$, calculate the velocity of light in glass? (Ans: $2.12 \times 10^8 ms^{-1}$)
Q10. in a Young's double slit experiment the distance between the slits and screen is 1 m. If the distance between the slits is 5 mm, the fringe width is found to be 0.1 mm. Calculate the wavelength of light used? Ans: λ = 5000A
Q11. Red light of wavelength 6500 A from a distant source falls on a slit 0.50 mm wide. What is the distance between the two dark bands on each side of the central bright band of diffraction pattern observed on a screen placed 1.8 from slit? Ans: 4.68 mm.
Q12. A beam of polarised light makes an angle of 60° with the axis of the polaroid sheet. How much isthe intensity of light transmitted through the sheet? Ans: 25%.

Unit 7 Dual Nature of Matter

Q1. Which one among the following shows particle nature of light.
(a)photo electric effect (b)interference (c)refraction (d)polarisation
Q2. If we consider electrons and photons of same wavelength then they will have same
(a)energy (b)velocity (c)momentum (d)angular momentum
Q3. The minimum energy required to remove an electron is called
(a)work function (b)kinetic energy (c)stopping potential (d)potential energy
Q4. Light from a bulb falls on the wooden piece but no photo electrons are emitted. It is because (a) of much higher than energy if photon (b)less than energy of photon
(c) equal to energy of photon (d)none
Q5. In photo electric effect the electrons are ejected from metals, if the incident light had a certainminimum (a) wave length (b)frequency (c)angle of incidence (d)amplitude
Q6. If momentum of particle is doubled, then its DE Broglie wavelength
(a)unchanged (b)four times (c)becomes two times (d)becomes half
Q7. The maximum kinetic energy of photoelectrons emitted from a surface, when photons of energy 6eV fall on it is 4eV. The stooping potential in volt is (a)2 V (b)4 V (c)6V(d) 10V
Q8. Electron volt is unit of (a)charge (b)momentum (c)potential difference (d)energy
Q9. The unit of planks constant is (a)Nm (b)eV (c) Js (d)none
Q10.photoelectrons are emitted when

(a) zinc plate is heated (b)zinc plate is hammered (c) zinc plate is irradiated with ultraviolet light (d)zinc plate is subjected to very high pressure

Q11.when ultraviolet radiation is incident on a surface no photo electrons are emitted. If a secondbeam causes photoelectrons to be ejected it may consist of

(a) radio waves (b)infra red rays (c) visible light (d)X Rays

Q12. The kinetic energy of an electron, which is accelerated in the potential difference of 100 V, is (a) $1.6x10^{-17}$ J (b) $1.6x10^{-14}$ J (c) $1.6x10^{-10}$ J (d) $1.6x10^{-8}$ J

Q13. If the velocity of an electron increases, then its de-Broglie wavelength will

(a) increase (b) decrease (c)remain the same (d) first '1' then '3'

Q14. If particles are moving with same velocity, then maximum de-Broglie's wavelength will before (a) neutron (b) proton (c) β -particle(d) α-particle

Q15. An electron and a proton have same de-Broglie's wavelength. The kinetic energy of anelectron is

(a)infinity (b) zero (c) Equal to that of proton (d) Greater than that of proton

Q16. If the kinetic energy of an electron doubles, its de-Broglie's wavelength changes by a factor

(a)2 (b) $\sqrt{2}$ (c) ½ (d) $1/\sqrt{2}$

Q17. Photoelectric effect proves the

(a) wave nature of light (b) wave nature of electron

(c) particle nature of light (d) particle nature of electron

Q18. In photoelectric effect, the no. of electrons ejected per second is proportional to

(a) intensity of light (b) wavelength of light

(c) frequency of light (d) frequency of the metal

Q19. The slope of a graph between frequency of light (v) and stopping potential (V_0) is (where h = Planck's constant and e = Charge on an electron)(a) h (b) e (c) h e (d) h/e

True /False

Q1. The relation between energy and momentum for photon is E= Pc, where c is the speed of light.

Q2. If the intensity of incident radiation on a mental surface is doubled, then kinetic energy of the electrons emitted remains constant.

Q3.If the frequency of incident light on a metal surface is doubled, the K.E. of electrons be doubled.

4. The work function of aluminum is 4.2eV. If two photons each of energy 2.5 eV strike an electronof aluminum, the emission of electron be possible.

Q5. The alkali metals are most suitable for studying the photoelectric emission because their work function is low.

Q6. Matter waves are electromagnetic waves.

Q7. 1 eV= $1.6x10^{-19}$ J

Q8. The debroglie wavelength associated with moving football is not visible due to its large mass.

Q9. Violet colour has minimum stopping potential.

Q10. The velocity of Photon in different media is same.

Answer key

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A	C	A	A	B	D	B	D	C	C	D	A	B	C	D	D	C	A	D

True/False Statements

1	2	3	4	5	6	7	8	9	10
True	True	False	False	True	False	True	True	False	False

Two marks

Q1. What is a photon. Write its three properties.

Q2. Define photo electric effect. Write its four laws.

Q3. Find the relation for debroglie wavelength associated with particle.

Q4. Define photo electric effect. Derive the relation for photo electric equation?

Q5. Explain stopping potential and threshold frequency in photo electric emission. Give an appropriate graph.

Q6. Prove that rest mass of the photon is zero.

Q7. A particle of mass M at rest decays in to two particles of masses m_1 and m_2 having non zero velocities. Calculate the ratio of De- Broglie wave length

Unit-8 : Atomic nucleus

Q1. What is the ionisation potential of hydrogen atom.

(a)-13.6 V (b)13.6V (c)27.2V (d)None

Q2. The total energy of an electron in the first excited state of hydrogen atom is -3.4 eV. What is thekinetic energy of the electron in this state
(a)-3.4 eV (b)3.4eV (c)zero (d)1.5eV
Q3.For an electron in the second orbit of Bohr's hydrogen atom, the moment of linear momentum is
(a)πh (b) 2 π h (c) h/ π (d) 2h/ π
Q4. The no. of neutrons in the U^{235}_{92} nucleus is (a) 445(b) 235 (c) 200(d) 143
Q5. The isotopes have
(a) same atomic no. and mass no. (b) same mass no. but different atomic no.
(c) different atomic no. and mass no. (d) same atomic no. but different mass no.
Q6. Elements having different atomic no. as well as different mass no., but same no. of neutrons,are known as (a) isobars (b) isotones (c) isotopes (d) isodiaphers
Q7. The nuclei of which one of the following pairs of nuclei are isotones ?
(A) $_{20}Ca^{40}$ and $_{16}S^{32}$ (B) $_{42}Mo^{92}$ & $_{40}Zr^{92}$ (C)$_{38}Sr^{84}$ & $_{38}Sr^{86}$ (D) $_{34}$ Se^{74} & $_{31}Ga^{71}$
Q8. The elements $_{17}Cl^{35}$ & $_{17}Cl^{37}$ are(a) isotopes(b) isobars (c) isotones (d) none of these
Q9. If M is atomic mass, A is mass no. of a nucleus, then *(M – A)/A*
(a) mass defect (b) fermi energy (c) binding energy (d) packing fraction
Q10. A radioactive substance emits is called
(a) α-rays (b) β-rays (c) γ-rays (d) all of these
Q11. In Bohr's model the atomic radius of the first orbit is r then the radius of the third orbit is
(a)r/9 (b)9r (c)r (d)3r
Q12. Rutherford alpha scattering experiment shows that the atoms have
(a)electron (b) neutron (c) nucleus (d)protons
Q13. The velocity of an electron in the innermost orbit of an atom is
(a)highest (b)lowest (c)mean (d)zero
Q14.The energy of ground electronic state of hydrogen atom is -13.6 eV. The energy of the firstexcited state will be (a)-52.4eV (b)-27.2 eV (c) -6.8 eV (d)-3.4eV
Q15.which one of the following is stable (a) positron (b) proton (c)electron (d)neutron
Q16.If r_1 and r_2 are the radii of the atomic nuclei of mass numbers 64 and 125 respt. Then the ratior_1/r_2 is (a) 4/5 (b)5/4 (c) 64/125 (d)125/64
Q17.Which is not released in nuclear disintegration.
(a) α particles (b)β particles (c) γ $rays$ (d) X rays
Q18. The large scale destruction that would because due to use of nuclear weapons is known as(a) nuclear holocaust (b) thermonuclear reaction (c) neutron reproduction factor (d) none
Q19.Hydrogen bomb is based upon
(a) fission (b) fusion (c)chemical reaction (d)none of these
Q20.Which of the following is an essential requirement for initiating the fusion reaction
(a) critical mass (b)thermal neutrons (c)High temperature (d)critical temperature

True/ false

Q1. Solar energy is due to fusion reaction.
Q2. Those particles which are produced during beta decay called beta particles. They having samecharge and mass as electrons.
Q3. The SI unit of radioactivity is becquerel.
Q4. Free neutrons which are not bound to the nucleus are called thermal neutrons.
Q5. The angular momentum of electron in nth orbit is nh/2π
Q6. Hydrogen bomb is based upon nuclear fission reaction.
Q7. The impact parameter for scattering of alpha particle by angle 180^0 is zero.
Q8. Among neutron, proton, electron and alpha particle, the neutron is unstable.
Q9. ionization power of α particle is less than beta particle.
Q10. 1 MeV= 1.6 x10^{-16} J

Answer key

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
B	B	C	D	D	B	D	A	D	D	B	C	A	D	B	A	D	A	B	C

True/ False

1	2	3	4	5	6	7	8	9	10
True	True	True	False	True	False	True	True	False	False

Two mark

Q1. What is the difference nuclear fusion and nuclear fission.
Q2. Show that density of the nucleus is independent of mass number?
Q3. What is the ratio of radii of the orbits corresponding to first excited state and ground state of the hydrogen atom.
Q4. What are the drawbacks of Rutherfords's atomic model?
Q5. Differentiate between isotopes and isobars with suitable examples.
Q6. Differentiate between isobars and isotones with suitable examples.
Q7. Write two applications of gamma rays.
Q8. What is the difference between electron and Beta particle.
Q9. Explain the source of energy of stars.

Three marks

Q1. Define Binding Energy. How does binding energy per nucleon vary with mass number? What isits significance.
Q2. What is radioactivity ? State radioactive decay law and show that it is exponential in nature..
Q3. Show that Bohr's radius is directly proportional to the square of the principal quantum number.
Q4. State Bohr's Postulates for the permitted orbits for the electron in a hydrogen atom.
Q5. By using Bohr's theory derive an expression for energy of electron in nth orbit.
Q6. State and explain binding energy curve?
Q7. What are nuclear forces. What are their properties?
Q8. Find an expression for the wave number of a wave emitted by an electron when it jumps from anouter orbit to inner orbit.
Q9. What were the observations and important conclusions drawn from α scattering experiment.
Q10. What is meant by Q value of nuclear reaction? What physical quantities are conserved in the nuclear reaction.
Q11. Draw energy level diagram for hydrogen atom and show different series in hydrogen atomspectrum.

Unit-9 SEMICONDUCTOR DEVICES

1.Conductivity in a semiconductor is ______________
a. directely proportional to number density and independent of mobility.
b.directly proportional to number density and inversely proportional to mobility.
c.directely proportional to mobility and inversely proportional to charge density.
d.directely proportional to mobility and independent of charge density.
2. Depletion layer in a p-n junction consists of ___________
a.Electron b.Holes c.Positive and negative ion fixed in this position. d. Both holes and electron.
3. The electrical conductivity of a semiconductor increases when electromagnetic radiation of wavelength shorter than 2480 nm is incident on it. The band gap in eV for the semiconductor is:
(a) 0.9 b.0.7 c.0.5 d.1.1
4. A half-wave recitifer is fed with ac mains of frequency 50 Hz, the frequency output ripples is :
a. 25 Hz b.50Hz c.75Hz d. No Change
5. A full-wave rectifier is fed with ac mains of frequency 50 Hz, the frequency output ripples is :
a. 25 Hz b.50Hz c.100Hz d. No Change
6. The rms value of a half wave rectifier current is 10A.Its value for full wave rectification would be: a.14.14A b.10A c.7.07A d.5A
7. At absolute zero, silicon acts as a. non-metal b. metal c. insulator d. none of these

Answers

1	2	3	4	5	6	7
D	C	C	B	C	A	C

True/False Type Questions

1. Charge carriers in n type semiconductor are both electrons and holes.
2. Current increases linearly with applied potential difference in a p-n diode.
3. Resistance of p-n junction is low when forward biased & high when reverse biased.
4. Rectifier converts alternating supply voltage into dc- voltage.
5. Electrons have higher mobility as compared to holes.
6. When a forward bias is applied to a pn junction, depletion layer increases

Answers

1. True **2.** False **3.** True **4.** True **5.** True **6.** False

Three marks

Q1. On the basis of energy diagram distinguish between conductors, insulators and semiconductors.
Q2. What is p-n junction. Explain the formation of depletion layer and potential barrier in it.
Q3. What do you mean by forward bias and reverse bias. Draw the forward bias and reverse biascharacteristics.
Q4. Define rectifier. How diode is used as half wave rectifier.
Q5. Define rectifier. How diode is used as full wave rectifier.

Time 3 hr Class XII Sub Physics MM 70

Sample Paper 2025

Section A: 1 mark questions

1. Multiple Choice Type (i to xv)

(i) Charging without actual contact is called
(a) Charging by friction (b) Charging by conduction (c) Charging by induction (d) None of above
(ii) The units of linear charge density are (a) C/m (b) C/m^2 (c) C/m^3 (d) unit less
(iii) On increasing temperature of a conductor
(a) both drift velocity and relaxation time decreases (b) both drift velocity and relaxation time increase (c) Drift velocity increase relaxation time decreases (d) Drift velocity decrease relaxation time increases
(iv) On increasing the temperature of a conductor its resistance increases because the: (a) Relaxation time increases (b) Mass of electron increases (c) Electron density increases (d) Relaxation time decreases
(v) The magnetic field due to infinitely long current carrying conductor at a distance r from conductor depends upon distance r as (a) $B \propto r$ (b) $B \propto \frac{1}{r}$ (c) $B \propto r^2$ (d) $B \propto \frac{1}{r^2}$
(vi) When a charge particle moves perpendicular to a magnetic field, then
(a) Speed of the particle is changed (b) Speed of the particle remains unchanged (c) Direction of the particle remains unchanged (d) Acceleration of the particle remains unchanged
(vii) Lenz's Law gives: (a) Magnitude of induced e.m.f. (b) Direction of induced current (c) Both magnitude and direction of induced current (d) Magnitude of induced current
(viii) Choose the wrong statement.
(a) in an AC circuit containing R only, current is in phase with emf
(b) in an ac circuit containing L only, current lags behind the emf
(c) in an ac circuit containing C only, current lags behind the emf
(d) in an ac circuit containing C only, current leads the emf
(ix) The speed of em waves in vacuum is equal to (a) $\mu_o\varepsilon_o$ (b) $\sqrt{\mu_o\varepsilon_o}$ (c) $1/\sqrt{\mu_o\varepsilon_o}$ (d) $1/\mu_o\varepsilon_o$
(x)Light transmits through optical fibres using the phenomenon of
(a) Dispersion of light **(b)** Total internal reflection **(c)** Refraction of light **(d)** Interference of light
(xi) Which of the following colours moves fastest inside glass prism?
(a) Blue **(b)** Green **(c)** Yellow **(d)** Orange
(xii) When two thin lenses of focal lengths f_1 and f_2 are placed in contact with each other, then the focal length f of the combination will be (a) $f = f_1 \times f_2$ **(b)** $f = f_1 + f_2$ **(c)** $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ **(d)** $\frac{f_1+f_2}{f_1 f_2}$
(xiii) **Rest mass of a photon is (a)** zero **(b)** infinity **(c)** 1 gram **(d)** 1 amu
(xiv) Balmer series of hydrogen atom spectrum lies in
(a) UV region **(b)** visible region **(c)** infrared region **(d)** microwave region
(xv) The density of nucleus
(a) increases with mass number A of the nucleus.
(b) decreases with mass number A of the nucleus.
(c) is independent of mass number A of nucleus and same for all the nuclei.
(d) is much smaller than density of water which is 10^3 kg/m^3

True False Type (xvi to xx)

(xvi) When the phase difference between two vibrating sources changes rapidly with time, we say that the two sources are coherent.
(xvii) In diffraction pattern, the intensity of maxima goes on decreasing as we move away from the centre of the screen on either side.
(xviii) When intensity of light is doubled keeping frequency same, the energy of each photon also doubles
(xix) In an n type silicon, electrons are majority carriers and trivalent atoms are the dopants.
(xx) When a forward bias is applied to a pn junction, depletion layer increases

Section B: 2 marks questions

2. What are electric lines of force? Sketch them for an electric dipole. (1+1) OR
Two charges of 3×10^{-8} C and -2×10^{-8} C are located 15 cm apart. At what point on the line joining the two charges is the electric potential zero? Take the potential at infinity to be zero. (2)
3. What are ohmic and non-ohmic materials? Give examples. (½ + ½ + ½ + ½)OR
Calculate the resistance of a manganin wire 100 m long having a uniform area of X-section of 0.1 mm^2. Given that resistivity of manganin is 50×10^{-8} Ωm. (2)
4. How can a galvanometer be converted into (a) an ammeter (b) voltmeter? (1+1)

5. What is capacitive reactance? Give its SI unit. Make the graph of capacitive reactance X_C vs frequency ν. (½ + ½ +1)
6. Write two properties of a photon. Which photon is more energetic - Red or violet. Why? (½+½+½+½)
7. Write the four laws of photoelectric emission. (½+½+½+½)**OR**
7. The threshold frequency for a certain metal is 3.3×10^{14} Hz. If light of frequency 8.2×10^{14} Hz is incident on the metal, predict the cut off voltage for the photoelectric emission. (2)
8. How De Broglie explained Bohr's second postulate of quantisation? (2)

Section C: 3 marks questions

9. Find the expression of energy stored inside a parallel plate capacitor and hence find the energy density at any point in parallel plate capacitor. (2+1)
10. What do you mean by temperature coefficient of resistivity? What is its expression? Write its sign for metals, alloys and semiconductors or insulators and make graph of α versus T for these materials. (½ + ½ +½ +½ +½ + ½)
11. Derive an expression for the force between two long parallel current carrying conductors. Use this expression to define SI unit of current. (2+1) OR
An α particle describes a circle of radius 0.45 m in a magnetic field of strength 1.2 T. Find (i) speed (ii) frequency of rotation and (iii) kinetic energy. The mass of α particle is 6.8×10^{-27} kg its charge is 3.2×10^{-19} C. (1+1+1)
12. By drawing phasor diagram, find expression for impedance (Z) of a series LCR circuit and phase difference (ϕ) between voltage and current. (1+1+1) OR
A metallic rod of 1 m length is rotated with a frequency of 50 rev/s, with one end hinged at the centre and the other end at the circumference of a circular metallic ring of radius 1 m, about an axis passing through the centre and perpendicular to the plane of the ring. A constant uniform magnetic field of 1 T parallel to the axis is present everywhere. What is the e.m.f. between the centre and the metallic ring?(1formula + 2 solve)
13. Derive the relation, $\frac{-\mu_1}{u} + \frac{\mu_2}{v} = \frac{\mu_2 - \mu_1}{R}$ When refraction occurs from rarer medium (μ_1) to denser medium (μ_2) at a convex spherical refracting surface. (3) **OR**
Double convex lenses are to be manufactured from a glass of refractive index 1.55 with both faces of the same radius of curvature. What is the radius of curvature required if the focal length is to be 20 cm?
14.(i) Give definition of mass defect and write its expression. (½+½)
(ii) Define nuclear fission with an example. (½+½)
(iii) What is the function of moderator in nuclear reactor? Give an example. (½+½)
15. Differentiate between conductors, insulators and semiconductors on the basis of their energy band gap by making proper energy band diagrams. (½+½+½+½+½+½)

Section D: Comprehension type question

16. Comprehension type question:
Diamagnetic substances are those in which individual atoms/molecules have zero magnetic dipole moment. When the sample of diamagnetic material is placed inside magnetic field, it gets magnetised weakly in the direction opposite to the applied magnetic field. Examples of diamagnetic substances are Antimony, Bismuth, Copper, Gold, Silver, Water, Alcohol, Nitrogen, all inert gases like Helium, Neon, Argon. Diamagnetic substances are weakly repelled by magnets. They try to keep the magnetic field lines away. They do not allow the magnetic field lines to enter into them. ∴ relative permeability of these substances is slightly less than 1 and susceptibility slighly negative. Susceptibility of diamagnetic substances is independent of temperature because diamagnetic property appears due to orbital and spin motion of electrons in their orbits which is not affected due to temperature. Now every atom contains electrons in them which are revolving in their orbits and spinning also. Therefore, diamagnetic property is the universal property of all the substances. This sometimes gets overpowered by some other properties like para and ferromagnetism but it always remains there.
Questions:
1. Give two examples of diamagnetic substances.
2. How does a diamagnetic sample behave, when a magnet is brought near it?
3. What are the approximate relative permeability and susceptibility of diamagnetic substances?
4. What is the effect of temperature on the susceptibility of diamagnetic substances?
5. Diamagnetism is the __________ property of all the substances. (1×5 = 5)

Section E: 5 marks questions

17. Write the expression of dipole moment of an electric dipole and specify direction of dipole moment. Making a neat and clean diagram, derive expression for electric field intensity due to an electric dipole on equatorial line. Also discuss the case when the observation point is far away. (½ + ½ + 3 +1) OR
17. State coulomb's law. Write the units and dimensions of ε_0. Define 1 C of charge based on this law. Write any limitation of coulomb's law. (1+1+1+1+1)
18. Making well labelled ray diagram of compound microscope, derive the expression for magnifying power in case of image formed at least distance of distinct vision. (2+3) **OR**
18. What do you mean by diffraction of light? Why diffraction of sound is commonly observable in day to day life but not of light waves? Make a ray diagram of the single slit diffraction pattern. Only write the conditions (without explanation) of diffraction minima and maxima and hence find the width of central maximum. (1+1+1+1+1)