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PHYSICS

VOLUME :1 UNIT -1,2,3- STUDY MATERIAL -BOOK BACK- SHORT ANSWER

STUDENT'S NAME :	
STD : 12	SEC :
ROLL NO. :	
SUBJECT : PHYSICS	
SCHOOL :	

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UNIT -1 : ELECTROSTATICS

1. **What is meant by quantization of charges?**

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

FORMULA	S.I UNIT	QUANTITY
q = ne	Coulomb(C)	Scalar quantity

n is any integer (0, ±1, ±2, ±3,±4..........). This is called quantization of electric charge.

2. **Write down Coulomb's law in vector form and mention what each term represents.**

According to Coulombs law, $\vec{F}_{21} = \frac{kq_1q_2}{r^2}\hat{r}_{12}$

$\vec{F}_{12}$ -Force between charge q_1 and q_2 & r-Distance between two charges

$\hat{r}_{12}$ – Unit vector directed from charge q_1 to charge q_2

k- The proportionality constant.

3. **What are the differences between Coulomb force and gravitational force?**

S.NO	COULOMB FORCE	GRAVITATIONAL FORCE
1.	Coulomb force between two charges can be attractive or repulsive, depending on the nature of charges.	The gravitational force between two masses is always attractive
2.	The value of the constant k in Coulomb law is $k = 9 \times 10^9$ N m^2 C^{-2}	The value of the gravitational constant $G = 6.626\times10^{-11}$ N m^2 kg^{-2}
3.	The force between two charges depends upon the nature of the medium	The gravitational force between two masses are independent of the medium.
4.	If the charges are in motion, Lorentz force comes into play in Addition to coulomb force.	The gravitational force between two point masses is the same whether two masses are at rest or in motion

4. **Write a short note on superposition principle.**

The total force acting on a given charge is equal to the vector sum of forces exerted on it by all the other charges.

Consider a system of n charges, namely $q_1, q_2, q_3 \ldots q_n$.

$\vec{F_{21}}$	$\vec{F_{13}}$	$\vec{F_{n1}}$
The force on q_1 exerted by the charge q_2	The force on q_1 exerted by the charge q_3	The force on q_1 exerted by the charge q_n
$\vec{F_{21}}=\frac{kq_1q_2}{{r_{21}}^2}\hat{r}_{12}$	$\vec{F_{31}}=\frac{kq_1q_3}{{r_{31}}^2}\hat{r}_{13}$	$\vec{F_{n1}}=\frac{kq_1q_n}{{r_{n1}}^2}\hat{r}_{1n}$
$\hat{r}_{12}$ is the unit vector directed from charge q_1 to charge q_2	$\hat{r}_{12}$ is the unit vector directed from charge q_1 to charge q_3	$\hat{r}_{1n}$ is the unit vector directed from charge q_1 to charge q_n
r_{21} is the distance between the charges q_1 and q_2	r_{21} is the distance between the charges q_1 and q_3	r_{21} is the distance between the charges q_1 and q_n

Total force acting on the charge q_1 due to all other charges is given by

$$\vec{F^{net}} = \vec{F_{21}} + \vec{F_{31}} + ... + \vec{F_{n1}}$$

$$\vec{F^{net}} = \frac{kq_1q_2}{{r_{21}}^2}\hat{r}_{12} + \frac{kq_1q_3}{{r_{31}}^2}\hat{r}_{13} + ... + \frac{kq_1q_n}{{r_{n1}}^2}\hat{r}_{1n}$$

5. Define 'Electric field'.

The electric field at the point P at a distance r from the point charge q is the force experienced by a unit charge.

FORMULA	S.I UNIT	QUANTITY
$\vec{E}=\frac{\vec{F}}{q_o} => \vec{E} = \frac{kq}{r^2}\hat{r} = \frac{1}{4\pi\mathcal{E}_o}\frac{q}{r^2}\hat{r}$	NC^{-1}	Vector quantity

6. What is mean by 'Electric field lines'?

- Electric field vectors are visualized by the concept of electric field lines.
- They form a set of continuous lines which are the visual representation of the electric field in some region of space.

7. The electric field lines never intersect. Justify.

- No two electric field lines intersect each other. If two lines cross at a point, then there will be two different electric field vectors at the same point.
- If some charge is placed in the intersection point, then it has to move in two different directions at the same time, which is physically Impossible. Hence, electric field lines do not intersect.

8. Define 'Electric dipole'

Two equal and opposite charges separated by a small distance constitute an electric dipole.

9. What is the general definition of electric dipole moment?

The magnitude of the electric dipole moment is equal to the product of the magnitude of one of the charges and the distance between them

FORMULA	S.I UNIT	QUANTITY
$p = 2qa$	Cm	Vector quantity

10. Define 'electrostatic potential".

Electric potential at a point P is equal to the work done by an external force to bring a unit positive charge with constant velocity from infinity to the point P in the region of the external electric field $\vec{E}$

FORMULA	S.I UNIT	QUANTITY
$V_p = -\int_{\infty}^{p} \vec{E}.\vec{dr}$	V	Scalar quantity

11. What is an equipotential surface?

An equipotential surface is a surface on which all the points are at the same potential.

12. What are the properties of an equipotential surface?

- The work done to move a charge q between any two points A and B, $W=q(V_B-V_A)$. If the points A and B lie on the same equipotential surface, work done is zero.
- The electric field is normal to an equipotential surface.

13. Give the relation between electric field and electric potential.

Electric field is the negative gradient of potential $E = -\frac{dV}{dx}$

E- Electric field , dV-Electric potential , dx -Small distance

14. Define 'electrostatic potential energy'.

The electric potential energy of two point charges is equal to the work done to assemble the charges or work done in bringing each charge or work done in bringing a charge from infinite distance. $W = qV$

- This work done is stored as the electrostatic potential energy U of a system.

FORMULA	S.I UNIT	QUANTITY
$U = \frac{1}{4\pi\mathcal{E}_o}\frac{q_1q_2}{r}$	joule	Scalar quantity

15. Define 'Electric flux'

The number of electric field lines crossing a given area kept normal to the electric field lines is called electric flux.

FORMULA	S.I UNIT	QUANTITY
$\emptyset_E = EA\cos\theta$	Nm^2C^{-1}	Scalar quantity

16. What is meant by electrostatic energy density?

The energy stored per unit volume of space

FORMULA	S.I UNIT	QUANTITY
$u_E = \frac{U}{\text{volume}}$ or $u_E = \frac{1}{2}\varepsilon_0 E^2$	Joule m^{-3}	Scalar quantity

17. Write a short note on 'electrostatic shielding'.

- Whatever the charges at the surfaces and whatever the electrical disturbances outside, the electric field inside the cavity is zero.
- A sensitive electrical instrument which is to be protected from external electrical disturbance is kept inside this cavity. This is called electrostatic shielding.

18. What is Polarisation?

Polarisation p is defined as the total dipole moment per unit volume of the dielectric. $\vec{P} = \chi_e \vec{E}_{ext}$

19. **What is dielectric strength?**

The maximum electric field the dielectric can withstand before it breakdowns is called dielectric strength

20. Define 'capacitance'. Give its unit.

The capacitance C of a capacitor is defined as the ratio of the magnitude of charge on either of the conductor plates to the potential difference existing between the conductors.

FORMULA	S.I UNIT	QUANTITY
$C=\frac{Q}{V}$	Farad	Scalar quantity

21. What is corona discharge?

- The positive ions are repelled at the sharp edge and negative ions are attracted towards the sharper edge.
- This reduces the total charge of the conductor near the sharp edge.

This is called action at points or corona discharge.

UNIT - 2 : CURRENT ELECTRICITY

1. Why current is a scalar?

- For a physical quantity to be termed a vector quantity, having magnitude and direction is not enough. The quantity should obey the vector addition (triangle law or parallelogram law).
- From Kirchhoff's current rule, if two current meet at a junction, the resultant current will be the algebraic sum of two current and not vector sum.

2. Distinguish between drift velocity and mobility

S.NO	DRIFT VELOCITY	MOBILITY
1	The drift velocity is the average velocity acquired by the electrons inside the conductor when it is subjected to an electric field.	The mobility is the magnitude of the drift velocity per unit electric field.
2	$\vec{v}_d=\vec{a}\tau$	$\mu = \frac{\vec{v}_d}{\vec{E}}$
3	Unit : ms^{-1}	Unit: $m^2V^{-1}\ s^{-1}$

3. State microscopic form of Ohm's law.

The relation between current and drift velocity is $I = nAv_d e$

Current density $J = \frac{I}{A} = \frac{nAv_d e}{A}$

Current density is a vector quantity

$\vec{J} = ne\vec{v_d} = -\frac{ne^2\tau}{A}\vec{E}$ $\left(\sigma = \frac{ne^2\tau}{A}\text{E}\right)$

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

The direction of (conventional) current density as the direction of electric field.

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

This equation called microscopic form of ohm's law

4. State macroscopic form of Ohm's law.

From microscopic form of ohm's law $J=\sigma E$

$J=\sigma\frac{V}{l}$ ------(1) $\left(E = \frac{V}{l}\right)$

Current density $J = \frac{I}{A}$------(2)

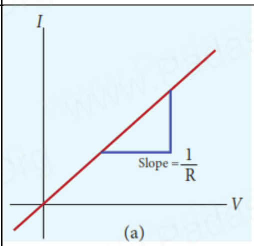
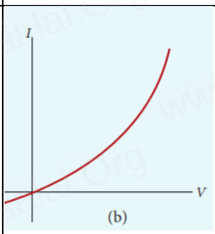
From eq 1 and eq2, $\sigma\frac{V}{l} = \frac{I}{A}$

$V = I\left(\frac{l}{\sigma A}\right)$

Then V=IR $\left(R = \frac{l}{\sigma A}\right)$

Ohm's law states that at **constant temperature, the steady current** flowing through a conductor is directly proportional to the **potential difference between two ends of the conductor**. V α I

5. What are ohmic and non ohmic devices?

S.NO	OHMIC DEVICES	NON OHMIC DEVICES
1	Materials for which the current against voltage graph is a straight line through the origin, are said to obey Ohm's law and their behavior is said to be ohmic.	Materials or devices that do not follow Ohm's law are said to be non ohmic. These materials have more complex relationships between voltage and current.
2		
3	Eg: Copper, aluminum, silver	Eg: Diode, transistor

6. Define electrical resistivity.

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

FORMULA	S.I UNIT	QUANTITY
$\rho = \frac{RA}{l}$	Ohm m *or Ω m*	Scalar

7. Define temperature coefficient of resistance.

Temperature coefficient of resistance is defined as the ratio of increase in resistance per degree rise in temperature to its resistance at T_o.

Temperature coefficient of resistance $= \frac{\text{increase in resistance per degree rise in temperature}}{\text{its resistance at To}}$

FORMULA	S.I UNIT	QUANTITY
$\alpha = \frac{R_T - R_0}{R_0(T - T_0)}$	Per ^{0}C	Scalar

8. What is superconductivity?

- The resistance of certain material become zero below certain temperature called critical or transition temperature (T_C)
- The materials which exhibit this property are known as super conductors.
- The property of conducting current with zero resistance is called super conductivity.

9. What is electric power and electric energy?

S.NO	ELECTRIC POWER	ELECTRIC ENERGY
1	The rate at which the electrical potential energy is delivered,	The electric energy used by any device Product of the power and duration of the time duration of the time when it is ON.
2	$P=\frac{dw}{dt}$= or VI	E=Pxt or VIt
3	Si unit : watt	Si unit : joule
4	Practical unit :horse power (HP) 1 Hp=746 W	Practical unit :kilowatt hour (kWh) 1 kWh=3.6×10^6 joule

10. Define current density.

The current density (J) is defined as the current per unit area of cross section of the conductor.

FORMULA	S.I UNIT	QUANTITY
$J=\frac{I}{A}$	Am^{-2}	Vector

11. Derive the expression for power P=VI in electrical circuit.

- Electric power $P=\frac{dw}{dt}$ W=V x Q
- $P=\frac{d(VQ)}{dt}=V\frac{dQ}{dt}$

P=VI $\left(I=\frac{dQ}{dt}\right)$

12. Write down the various forms of expression for power in electrical circuit.

- Electric power P =VI

  by using ohms law
- Electric power $P=v\frac{V}{R}=\frac{V^2}{R}$

  $P=\frac{V^2}{R}$
- Electric power P =VI=(IR)I

  $P=I^2R$

13. State Kirchhoff 's current rule.

The algebraic sum of the currents at any junction of a circuit is zero.

14. State Kirchhoff 's voltage rule.

In a closed circuit the algebraic sum of the products of the current and resistance of each part of the circuit is equal to the total emf included in the circuit

15. State the principle of potentiometer.

For uniform cross-section of potentiometer wire, when constant current flow through a wire, then **potential difference between any two points of the wire is directly proportional to the length of the wire between two points**

$\xi = \text{I}r\, l$

$\xi \propto l$

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

I is the current flowing through the wire, r is the resistance per unit length of the wire.

16. What do you mean by internal resistance of a cell?

A resistance is offered to current flow by the electrolyte inside the cell.

FORMULA	S.I UNIT	QUANTITY
$r=\left(\frac{\xi-V}{V}\right)R$	Ohm	scalar

17. State Joule's law of heating.

The heat developed in an electrical circuit due to the flow of current varies directly as (i) the square of the current (ii) the resistance of the circuit and (iii) the time of flow.

18. What is Seebeck effect?

- In a closed circuit consisting of two dissimilar metals, when the junctions are maintained at different temperatures an emf (potential difference) is developed. (The two dissimilar metals connected to form two junctions is known as thermocouple.)
- The current that flows due to the emf developed is called thermoelectric current.

19. What is Thomson effect?

If two points in a conductor are at different temperatures, the density of electrons at these points will differ and as a result the potential difference is created between these points. Thomson effect is also reversible.

20. What is Peltier effect?

When an electric current is passed through a circuit of a thermocouple, heat is evolved at one junction and absorbed at the other junction.

21. State the applications of Seebeck effect.

- Seebeck effect is used in thermoelectric generators (Seebeck generators). These thermoelectric generators are used in power plants to convert waste heat into electricity.
- This effect is utilized in automobiles as automotive thermoelectric generators for increasing fuel efficiency.
- Seebeck effect is used in thermocouples and thermopiles to measure the temperature difference between the two objects.

UNIT -3 MAGNETISM AND MAGNETIC EFFECTS OF ELECTRIC CURRENT

1. What is meant by magnetic induction?

The magnetic induction (total magnetic field) inside the specimen $\vec{B}$ is equal to the sum of the magnetic field B_o produced in vacuum due to the magnetising field and the magnetic field B_m due to the induced magnetisation of the substance.

FORMULA	S.I UNIT	QUANTITY
$\vec{B}=\vec{B}_O+\vec{B}_m=\mu_O\vec{H}+\mu_O\vec{M}=\mu_O(\vec{H}+\vec{M})$	Tesla	Vector quantity

2. Define magnetic flux.

The number of magnetic field lines crossing per unit area is called magnetic flux Φ_B

FORMULA	S.I UNIT	QUANTITY
$\emptyset_B$=BA cosθ	weber	Scalar quantity

3. Define magnetic dipole moment.

The magnetic dipole moment is defined as the product of its pole strength and magnetic length.

FORMULA	S.I UNIT	QUANTITY
$\vec{P_m} = q_m \vec{d}$ or $P_m = q_m 2l$	A m^2	vector quantity

4. State Coulomb's inverse law.

The force of attraction or repulsion between two magnetic poles is directly proportional to the product of their pole strengths and inversely proportional to the square of the distance between them. $\vec{F} = \frac{q_{mA} q_{mB}}{r^2} \hat{r}$

5. What is magnetic susceptibility?

Magnetic susceptibility is defined as the ratio of the intensity of magnetization$(\vec{M})$ induced in the material due to the magnetising field$(\vec{H})$

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

6. State Biot-Savart's law

Magnitude of magnetic field $\vec{dB}$ at a point P at a distance r from the small elemental length taken on a conductor carrying current varies

(i) directly as the strength of the current I

(ii) directly as the magnitude of the length element $\vec{dl}$

(iii) directly as the sin of the angle between $\vec{dl}$ and $\hat{r}$

(iv) inversely as the square of the distance between the point P and length element $\vec{dl}$

$$dB = \frac{\mu_0 I\, dl \sin\theta}{4\pi\ r^2}$$

7. What is magnetic permeability?

The magnetic permeability can be defined as the measure of ability of the material to allow the passage of magnetic field lines through it or measure of the capacity of the substance to take magnetisation or the degree of penetration of magnetic field through the substance.

8. 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.

$$\oint_c \vec{B} \cdot \vec{dl} = \mu_0 I_{enclosed}$$

9. Compare dia, para and ferro-magnetism.

Properties	Diamagnetism	Para magnetism	Ferromagnetism
Magnetic susceptibility	Negative	Positive and small	Positive and large
Relative permeability	Is slightly less than unity.	Is greater than unity.	Large
Susceptibility	Is nearly temperature independent	Is inversely proportional to temperature	Is inversely proportional to temperature.
Examples	Bismuth, Copper and Water	Aluminium, Platinum, chromium.	Iron, Nickel and Cobalt.
The magnetic field lines	Are repelled or expelled by diamagnetic materials when placed in a magnetic field.	Are attracted into the paramagnetic materials when placed in a magnetic field.	Are strongly attracted into the ferromagnetic materials when placed in a magnetic field.

10. What is meant by hysteresis?

The phenomenon of lagging of magnetic induction behind the magnetizing field is called hysteresis

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