



INDIAN SCHOOL MUSCAT



SENIOR SECTION

“An education isn't how much you have committed to memory, or even how much you know. It's being able to differentiate between what you know and what you don't.”

Anatole France

SHORT ANSWER AND VERY SHORT ANSWER QUESTION AND ANSWERS FROM CHAPTERS 1 TO 6

CHAPTERS 1 & 2 ELECTROSTATICS

- 1 In a parallel plate capacitor the capacitance increases from $16\mu\text{F}$ to $80\mu\text{F}$ on introducing a dielectric medium between the plates. What is the dielectric constant of the medium ?

$$K = C_m/C_a = 80/16 = 5$$

- 2 The force between two point charges kept at a distance of r apart is F . If the same charges are kept in water at the same distance, how does the force between them change?

$$F_a/F_w = K, F_w/F_a = 1/K = 1/81$$

- 3 Under what conditions The electric field intensity due to two point charges be zero at a point in the line joining the two charges but the point should not be between the charges ?

The two charges should be of opposite charges and they should have different magnitudes.

- 4 How much work is done in moving a $500\mu\text{C}$ of charge between two points on a spherical Surface at a potential of 4V ?

Zero. Work done in moving a charge along an equi potential surface is zero .

- 5 If the plates of a parallel plate capacitor are connected to each other by a copper wire, what will happen?

The charge will flow from positive to negative plate and the capacitor will be discharged completely. So the energy stored is dissipated as heat energy.

- 6 A very thin metal plate of thickness $t \ll d$ is kept in the middle of a parallel plate capacitor . What will be the effect on the capacitance of the system?
No change in the capacitance.

- 7 A 12pF capacitor is connected to a 50V supply. Calculate the electrostatic energy stored in the capacitor.

$$U = \frac{1}{2} CV^2 = \frac{1}{2} \times 12 \times 10^{-12} \times 2500 = 1.5 \times 10^{-8} \text{J}$$

- 8 Define equi potential surface. Can two equi potential surfaces intersect?

If all the points on a surface are at the same potential such a surface is equi potential surface.

Two equi potential surfaces cannot intersect if they intersect, two electric field lines must intersect which is not possible.

- 9 Define dielectric field strength.

It is the maximum electric field strength a medium can withstand before break down.

- 10 The plates of a charged parallel plate capacitor are connected to a volt meter, what will be the effect of increasing the separation between the plates on the voltmeter reading?

Voltmeter reading increases.

- 11 How does the electric field inside a dielectric change when it is placed in an external electric field?

It decreases as the induced electric field is opposite to the applied field. Net electric field decreases.

- 12 The energy stored in a capacitor of capacitance C is U, Express the charge Q stored in it in terms of C and U.

$$Q = (2CU)^{1/2}$$

- 13 What is the function of dielectric in a capacitor?

It increases the capacitance by reducing the effective potential difference between the plates. It increases the mechanical strength of capacitor.

- 14 A hollow metal sphere of radius 5cm is charged such that the potential on its surface is 10V. What is the potential at the centre of the sphere?

10 V. Potential inside a hollow metal surface is equal to its potential on the surface.

- 15 Can there be a potential difference between two adjacent conductors carrying the same charge? Yes, if their sizes are different.

- 16 What is the geometrical shape of equi potential surfaces due to a single isolated charge?

Spherical for $q > 0$ and $q < 0$.

- 17 Name a Physical quantity whose SI unit is i) J/C ii) J/m³ iii) Volt/m.

State whether it is a scalar or vector quantity?

i) electric potential – scalar ii) energy density – scalar iii) electric field strength – vector

- 18 What is the dielectric constant of a metal?

Infinity, as the electric field inside a conductor (metal) is zero

- 19 Why is the potential inside and on the surface of hollow conducting sphere same and remains constant?

$dV = -E \cdot dl$ since electric field inside the conductor is zero $dV = 0$ V is constant.

- 20

State the differences between electric potential at a point due to a single point charge and an electric dipole.

NO	V due to a single point charge	V due to an electric dipole
1	Inversely proportional to r the distance from the point	Inversely proportional to r ² the distance from the point
2	Does not depend on the angle between the line joining the point from the charge and the axis on which the point charge is located.	depend on the angle between the line joining the point from the centre of the dipole to the axis of the dipole

- 21 State a similarity and a difference between the mass and charge of a particle.

Similarity : both are scalars

Differences:

Only charge is quantised ,mass is not quantised .

charge can be negative ,positive and zero but mass is a positive quantity.

- 22 A charge q is placed inside a cube what is the electric flux through the i) entire cube ii) one of its face?

$$i) \Phi = \frac{q}{\epsilon_0} \quad ii) \Phi = \frac{q}{6\epsilon_0}$$

- 23 Why should a circuit containing a capacitor must be handled cautiously even when the circuit is off?

Even when the circuit is off the capacitor might be fully charged , when we touch it we will get severe electric shock.

- 24 What is the net charge on i) a charged capacitor ii) an electric dipole?

i)zero ii) zero

- 25 Two spheres of different capacitances are charged to different potentials . When you join them by a copper wire , what happens to the total energy? Explain .

The energy will decrease and the difference in energy appears as heat in the wire.

CHAPTER 3.CURRENT ELECTRICITY

- 1 What will be the effect of the following on drift velocity of electrons in a metallic conductor i) heating the conductor ii) doubling the length of the conductor?

i) Decreases as relaxation time decreases ii) v_d will reduce to half the original value as length is doubled.

- 2 On increasing the current drawn from the cell, how does the terminal pd across the cell change?

Decreases. As $V = \mathcal{E} - Ir$

- 3 What is the effect of increasing electric field on the following i)drift velocity ii) mobility of electrons in a conductor?

i) increases as $V_d = eE\tau/m$ ii) no change, as $\mu = e\tau/m$

- 4 Which among the following electric current, electric field , current density, potential difference is/ are vector(s)?

Electric field , current density

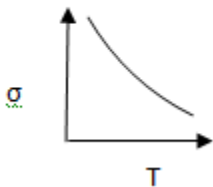
- 5 Write the expression to show the dependence of resistivity ρ on temperature.

$$\rho_t = \rho_0 (1 + \alpha (t - t_0))$$

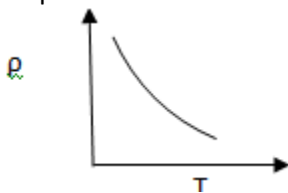
- 6 How does the conductivity of a i) good conductor ii) semiconductor change when the temperature increases?

i) increases as relaxation time decreases ii) decreases as number of holes and electrons increase due to breaking of covalent bonds.

- 7 Draw a graph to show the variation of conductivity σ of a conductor with temperature T.



- 8 Draw a graph to show the variation of resistivity ρ of i) a semiconductor ii) carbon with temperature T.



- 9 Why material of high resistivity is preferred for bridge wire in metre bridge & potentiometer?

To make it compact. Otherwise the bridge will be very long.

- 10 Name the conservation laws obeyed by Kirchoff's I & II laws.

I law – law of conservation of charge, II law- law of conservation of energy.

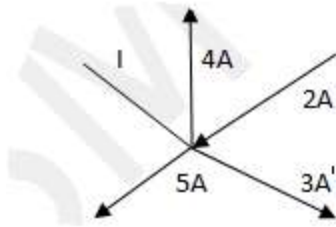
- 11 In meter bridge experiment how would the balancing length change if we interchange the battery and the galvanometer with each other ?

No change, as the wheatstone's bridge is not disturbed condition for the balance is unchanged.

- 12 A uniform conducting wire of resistance 50Ω is cut into 5 segments of equal lengths. If the five segments are connected in parallel , what would be the new resistance?

Resistance of each segment is $R = 10\Omega$. $R_p = R/n = 10/5 = 2\Omega$

- 13 What is the value and direction of current I in the given current distribution



$I = 10A$, coming towards the junction, using Kirchoff's Junction rule.

- 14 Is it possible to have terminal pd of a cell i) equal to zero ? ii) greater than emf of the cell?

Yes i) when the cell is short circuited ii) when the cell is being charged by an external dc source

- 15 Which is preferred a voltmeter or potentiometer to measure emf of a cell , Why?

potentiometer is used to measure emf of a cell because it does not draw current from a cell as it uses null deflection method

- 16 Arrange copper, carbon, nichrome in increasing order i) their resistivities ii) temperature coefficient of resistance.

i) copper < nichrome < carbon ii) carbon < nichrome < copper

- 17 How does internal resistance of a cell change when i) temperature ii) concentration increases?

i) increases as mobility of ions increases ii) number density of charges increases

- 18 Why the internal resistance of a i) cell must be very low ii) high tension supply must be high?

i) to draw more current from the cell

ii) to prevent the flow of a large amount of current in the voltage supply when short circuit takes place.

- 19 Calculate the resistivity of a conductor in which a current density of $2.5 A/m^2$ exist, when an electric field of $15V/m$ is applied on it.

$$P = E/J = 15/2.5 = 6 \Omega m$$

- 20 A copper wire is stretched to make it 0.1 % longer .What is the percentage change in resistance?

$$R = \rho l / A , (\Delta R/R) \% = (\Delta l/l) \% + (\Delta A/A) \% \\ = 2 \times 0.1\% = 0.2\%$$

- 21 Why large resistors are made up of carbon filaments?

Due to its large resistivity a small carbon resistor can give large resistance

- 22 Carbon and silicon are known to have similar lattice structures . However ,the four bonding electrons of carbon are present in second orbit while those of silicon are present in its third orbit. How does this result in a difference in their electrical conductivities?

It is easier to eject an electron from the third orbit than from second orbit. So conductivity of silicon is more than that of Carbon.

- 24 Is Ohm's law universally applicable for all conducting elements? If not give examples of elements which do not obey Ohm's law.

No It is applicable for elements for which V-I characteristics is linear. Example for Non ohmic devices Semiconductor diode, transistor.

- 25 Given n identical resistors each of resistances R , how will you combine them to get
i) maximum resistance ii) minimum resistance ? iii) give the ratio of maximum to minimum resistance.

i) series combination ii) parallel combination ii) $R_{\max} = nR$, $R_{\min} = R/n$, $R_{\max}/R_{\min} = n^2$

Chapters 4 & 5 MOVING CHARGES IN A MAGNETIC FIELD

MAGNETISM AND MATTER

- 1 Where is the value of dip angle i) maximum ii) minimum ?

dip angle is 90° and maximum at poles. dip angle is 0° and minimum at equator

- 2 Which among the following Aluminium , Bismuth , and Iron can become super conductor when cooled to a low temperature? Why?

Bismuth, as it is a diamagnet

- 3 Arrange the following three a galvanometer, an ammeter and volt meter both are made from identical galvanometers in increasing order of resistance?
ammeter , galvanometer , volt meter.

- 4 A thin wire is made in the form of a loop of irregular shape. What will you observe when it is placed in a uniform magnetic field?

shape changes to circular. For a given perimeter a circle has more area .This is to increase the magnetic flux.

- 5 Which of the following a proton or a beta particle will describe the smallest circle when projected with same velocity perpendicular to the same magnetic field?

Beta particle as its mass is the least

- 6 A charged particle enters in a uniform magnetic field at angles i) 75° ii) 90° predict the path travelled by them

i) helical path , ii)circular path

- 7 What is the value of magnetic field within a hollow sphere made of a ferromagnetic substance? Mention one application for it.

zero. It gives magnetic shield for any device to be protected from magnetic effects

- 8 Which among the following antimony, aluminium, iron has Maximum value of magnetic susceptibility?

Iron as it is ferromagnetic.

- 9 A bar magnet of magnetic moment M is divided into n parts. Will each part be a magnetic dipole ? What will be the dipole moment of each part.

Yes. $M' = M/n$

- 10 If a compass box and a dip circle were to be taken to the magnetic north pole of earth, what would you observe with regard to directions of their respective needles?

Compass needle would point an arbitrary direction , needle of dip circle points 90°

- 11 An electron beam projected along +ve X axis, experiences a force due to magnetic field along the +ve Y axis .What is the direction of the magnetic field?

Negative z direction.

- 12 What is the effect of increasing the number of turns of the coil in a galvanometer on i) current sensitivity ii) voltage sensitivity?

i) increases ii) no change as number of turns increases resistance of the coil also increases.

- 13 Explain why i) steel is preferred for making permanent magnet ii) soft iron is preferred for making electro magnet iii) soft iron is preferred for making core of a transformer.

Due to i) its high coercivity and retentivity

ii) its less coercivity and retentivity

iii) its less hysteresis loss.(area of hysteresis loop is small)

- 14 An electron beam passes through a region of crossed electric and magnetic fields of strengths E and B respectively .For what value of electron speed the speed of electron beam will be un deflected?

$$Bqv = qE, v = E/B$$

- 15 What is the advantage of radial magnetic field in a galvanometer?

It makes the torque maximum and the relation between current and θ becomes linear

- 16 Horizontal component of earth's magnetic field at a place is $\sqrt{3}$ times the vertical component ,what is the angle of dip at that place?

$$\tan \delta = B_v/B_H = 1/\sqrt{3} \quad \delta = 30^\circ$$

- 17 Vertical component of earth's magnetic field at a place is $\sqrt{3}$ times the Horizontal component ,what is the angle of dip at that place?

$$\tan \delta = B_v/B_H = \sqrt{3} \quad \delta = 60^\circ$$

- 18 current is set up in a copper pipe. Is there a magnetic field i) inside ii) outside the pipe ?
i) magnetic field inside is zero

$$\text{ii) } B = \frac{\mu_0 I}{2\pi r}$$

- 19 A loop of irregular shape carrying current is located in an external magnetic field . If the wire is flexible why does it change to circular shape?

The loop of irregular shape of flexible wire attain circular shape with its plane normal to the magnetic field to minimise its potential energy since for a given perimeter a circle has maximum area.

- 20 Two streams of electrons of same number of electrons are moving parallel to each other in the same direction. What type of force is existing between them?

Repulsive force due to like charges. As they are considered as straight conductors carrying current through them magnetic force acts. Electrostatic force is greater in magnitude. Net force is electrostatic and repulsive.

- 21 State two differences between force due to magnetic field and force due to electric field on a charged particle.

S.NO	Force due to electric field	Force due to magnetic field
1	It acts on charge at rest as well as on moving charge	It acts only on charge in motion not parallel to magnetic field
2	It accelerates a charged particle	It changes the direction of motion of a charged particle
3	There is a change in kinetic energy	There is no change in kinetic energy

- 22 How does the magnetic moment of a bar magnet change when it is divided into two equal parts i) along its length ii) transverse to its length .

i) $M = 2lm$ m pole strength , M magnetic moment of bar magnet

along the length $l' = l$, $m' = m/2$ $M' = 2lm/2 = lm$

transverse to the length $l' = l/2$, $m' = m$ $M' = lx m$

in both the cases $M' = M/2$

- 23 What is an ideal voltmeter?

It is a volt meter of infinite resistance so that it draws least current

- 24 What is an ideal ammeter?

It is an ammeter of almost zero resistance

- 25 What is the role of i) magnetic field ii) high frequency oscillator in a cyclotron?

i) to provide centripetal force for the positively charged particle.

ii) to change the polarities of the two dees after each half revolution so that the charged particles is accelerated.