PUC SECOND YEAR

Physics Passing Package

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Physics Annual Examination

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CHIKODI PHYSICS FORUM

Chikodi Educational District P.U. Colleges Physics Lecturers Forum

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CONTENTS

(Total Marks Covered : 52+)

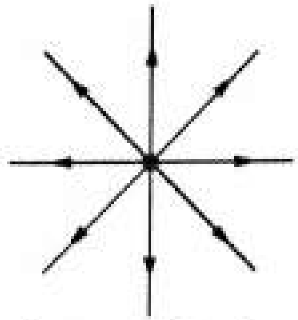
CHAPTER 1: ELECTRIC CHARGES AND FIELDS

One Mark Questions and Answers

1) What is electrostatics?
   Ans: The branch of physics which deals with the study of charges at rest.
2) What is the least possible value of charge?
   Ans: 1.6×10^{-19} C.
3) How many electrons are present in -1 coulomb of charge?
   Ans: 6.25×10^{18} electrons.
4) Name the SI unit of charge.
   Ans: coulomb or C.
5) A glass rod rubbed with silk acquires a charge of 1.6×10^{-12} C. What is the charge on the silk?
   Ans: -1.6×10^{-12} C.
6) What is the cause of charge on an object?
   Ans: Transfer of electrons.
7) Why does a glass rod become positively charged on rubbing with silk?
   Ans: Due to the loss of electrons.
8) What is an electric field?
   Ans: The electric field is a region around a charge in which another charge experiences the electric force.
9) How is electric field represented pictorially?
   Ans: By drawing electric field lines.
10) Define electric filed at a point.
    Ans: It is the electric force experienced per unit positive charge at a point in an electric field.
11) Name the SI unit of electric field.
    Ans: $N\ C^{-1}$ or $V\ m^{-1}$
12) Is electric field a scalar or a vector?
    Ans: Vector.
13) What is an electric dipole? **[Mar-2016]**
    Ans: It is a system of two equal and opposite charges separated by a distance.
14) Define electric diploe moment.
    Ans: It is defined as the product of magnitude of one of the charges and dipole length.
15) Is electric dipole moment a scalar or a vector quantity?
    Ans: Vector.
16) What is the direction of electric dipole moment?
    Ans: From negative charge to positive charge.
17) Name the SI of unit electric dipole moment.
    Ans: coulomb metre or C m.
18) What is meant by electric field line?
    Ans: It is an imaginary line in an electric field along which a free positive test charge tends to move.
19) State the principle of superposition of electric fields.
    Ans: Total electric field at a point due to number of charges is equal to the vector sum of electric fields due to individual charges at that point.

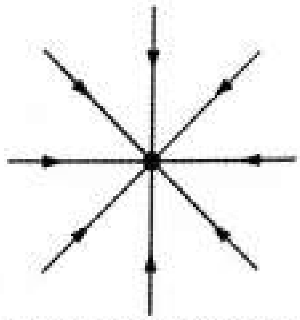
20) Draw the pattern of electric field lines due to an isolated positive point charge.

Ans:



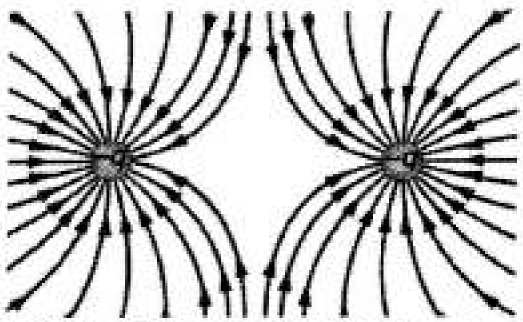
21) Draw the pattern of electric field lines due to an isolated negative point charge.

Ans:



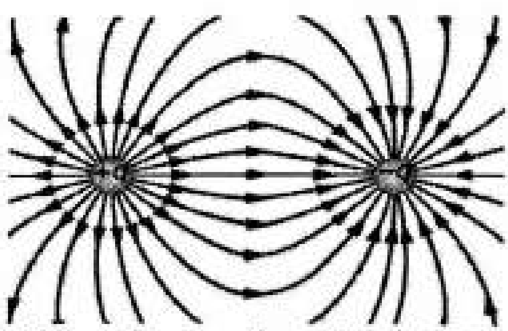
22) Draw the pattern of electric field lines due to equal like charges.

Ans:



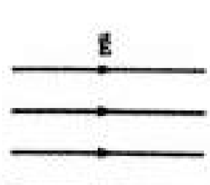
23) Draw the pattern of electric field lines due to equal unlike charges.

Ans:



24) Draw the pattern of electric field lines due to uniform electric field.

Ans:



25) What is the nature of symmetry of electric field due to a point charge?

Ans: Spherical symmetry.

26) State Gauss law in electrostatics?

Ans: The total electric flux through any closed surface in free space is equal to $1/\varepsilon_0$ times the total electric charge enclosed by the surface.

27) What is electric field inside a charged spherical shell?

Ans: Zero.

28) Write the shape of Gaussian surface due to a point charge.

Ans: Spherical surface.

29) Write the shape of Gaussian surface due to line of charges.

Ans: Cylindrical surface.

30) Write the shape of Gaussian surface due to charged spherical conductor.

Ans: Spherical surface.

Two Marks Questions and Answers

31) Distinguish between conductors and insulators.

Ans:

	Conductors	Insulators
1)	The substances which allow the charges to flow through them easily.	Substances which do not allow the charges to flow through them.
2)	Consist of large number of free charge carriers.	Do not contain free charge carriers.

32) State and explain Coulomb's law in electrostatics. **[Mar – 2014 , Jul - 2015]**

Ans: The electrostatic force of attraction or repulsion between any two stationary, point charges is directly proportional to the product of the magnitude of the charges and inversely proportional to the square of the distance between them and it acts along the line joining the two point charges.

Consider two point charges q_1 and q_2 separated by a distance r in free space. Let F be the electrostatic force between them, then from Coulomb's law we can write,

$$F \propto \frac{|q_1\, q_2|}{r^2} \quad \text{i.e.,} \quad F = k\frac{|q_1\, q_2|}{r^2}$$

33) In Coulomb's law, $F = k\,\frac{q_1 q_2}{r^2}$, what are the factors on which 'k' depends?

Ans: 1) The system of units chosen.

2) Medium between the two charges.

34) Why the two electric field lines never intersect? Explain.

Ans: If they intersect, at that point two tangents can be drawn. A test charge placed at that point has to move along the two tangents simultaneously, which is not possible. Hence two field lines never intersect.

35) Write any two differences between polar and non-polar molecules.

Ans:

	Polar molecules	Non- polar molecules
1)	Centers of positive charge and negative charge do not coincide.	Centers of positive charge and negative charge coincide.
2)	They possess permanent dipole moment.	They do not possess permanent dipole moment.

36) Define linear density of charge and mention its SI unit.

Ans: It is defined as amount of charge per unit length. SI unit is, C/m.

37) Define surface density of charge and mention its SI unit.

Ans: It is defined as amount of charge per unit area. SI unit is, C/m^2

38) Define volume density of charge and mention its SI unit.

Ans: It is defined as amount of charge per unit volume. SI unit is C/m^3.

Three Marks Questions and Answers

39) Describe how two metal spheres can be charged by induction.

Ans:

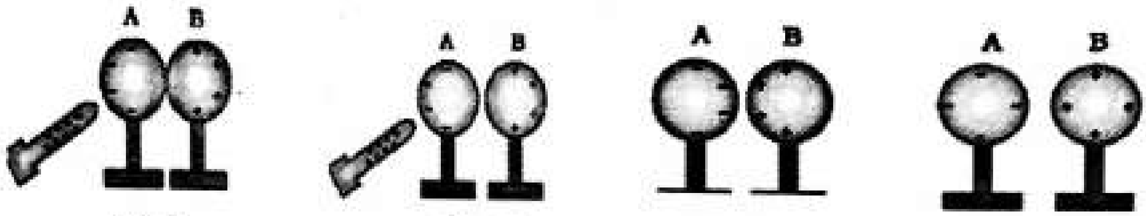


Fig.1 Fig. 2 Fig. 3 Fig. 4

Let us consider two metal spheres, A and B, supported on insulating stands in contact.

a) Bring a positively charged rod near one of the spheres, say A. The free electrons in the spheres are attracted towards the rod. As a result, the left side of A acquires negative charge and the right side of B acquires equal positive charge as shown in Fig. 1.

b) Separate the spheres by a small distance while the glass rod is still held near the sphere A, as shown in Fig. 2.

c) Now take the rod away from the sphere A. The charges on spheres rearrange themselves as shown in Fig. 3.

d) Now, separate the spheres quite apart. The charges on them get uniformly distributed over them, as shown in Fig. 4.

Thus metal spheres can be charged by induction method.

40) How can you charge a metal sphere positively without touching it?

Ans:

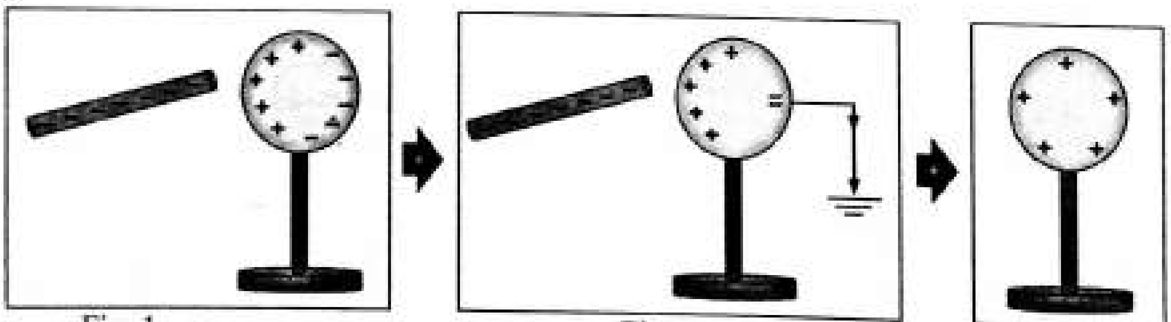


Fig. 1 Fig. 2 Fig. 3

a) Bring a negatively charged glass rod near a metal sphere placed on an insulated stand. The free electrons of the sphere are repelled by the charged object. As a result, the near surface of sphere acquires positive charge and farther surface acquires equal negative charge as shown in Fig. 1.

b) Without removing the glass rod, ground the farther surface of the sphere. This neutralizes the negative charge as shown in Fig 2.

c) Now take the glass rod away from the sphere. As a result, the positive charge is spread over the surface of the sphere as shown in the Fig. 3.

Thus a metal sphere can be charged positively without touching it.

41) Explain how do you use the gold leaf electroscope to test the presence of charge on an object.

Ans: Consider a given object. Touch it to the metal disc of electroscope. If the leaves,

a) show divergence, then the object is charged.

b) do not show divergence, then the object is neutral.

42) Explain how do you use gold leaf electroscope to test the nature of charge on an object.

Ans: Consider a given charged object and a charged gold leaf electroscope. Bring the object near the metal disc of the electroscope. Then,

a) If the leaves diverge further, then the charge on the given object is same as that on the electroscope.

b) If the leaves converge, then the charge on the given object is opposite to that on the electroscope.

43) Mention three basic properties of electric charges.

Ans:

a) Additive property of charge.

b) Conservation property of charge.

c) Quantization property of charge.

44) Write Coulomb's law in vector form. Write the two importance's of expressing it in the vector form?

Ans:

$$\vec{F} = k\left(\frac{q_1 q_2}{r^2}\right)\hat{r}$$

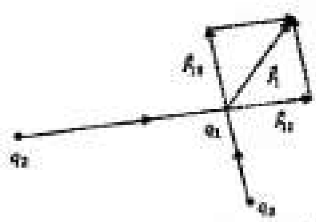
Two importance's of vector form,

a) Coulomb's force obeys the Newton's third law of motion.

b) Colombian forces are central forces.

45) Derive the expression for force on a point charge due to multiple point charges.

Ans:



Let there be a system of three charges q_1, q_2 and q_3. The force on q_1 due to q_2 is,

$$\vec{F}_{12} = k\,\frac{q_1 q_2}{{r_{12}}^2}\hat{r}_{12} \qquad (1)$$

The force on q_1 due to q_3 is,

$$\vec{F}_{13} = k\,\frac{q_1 q_3}{{r_{13}}^2}\hat{r}_{13} \qquad (2)$$

Let $\vec{F}_1$ be the total force on q_1 due to q_2 and q_3 individually, then,

$$\vec{F}_1 = \vec{F}_{12} + \vec{F}_{13}$$

$$\vec{F}_1 = k\,\frac{q_1 q_2}{{r_{12}}^2}\hat{r}_{12} + k\,\frac{q_1 q_3}{{r_{13}}^2}\hat{r}_{13}$$

46) Write the three properties of electric field lines. **[Jun – 15, Mar – 2016, Mar–2017]**

Ans:

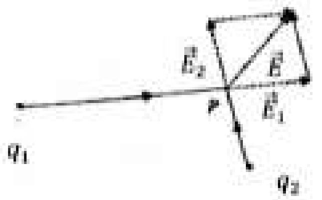
a) Electric field lines start from positive charge and terminate on negative charge.

b) Electric field lines leave or enter the charged conductor normally.

c) Electric field lines never intersect each other.

47) Obtain the expression for electric field at a point due to multiple point charges.

Ans:



The electric intensities at a point P due to q_1 and q_2 are given by,

$$\vec{E}_1 = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1}{r_{1p}^2}\right)\hat{r}_{1p}$$

$$\vec{E}_2 = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_2}{r_{2p}^2}\right)\hat{r}_{2p}$$

By the superposition principle, electric field at P due to two charges is,

$$\vec{E} = \vec{E}_1 + \vec{E}_2$$

$$\vec{E} = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1}{r_{1p}^2}\right)\hat{r}_{1p} + \frac{1}{4\pi\varepsilon_0}\left(\frac{q_2}{r_{2p}^2}\right)\hat{r}_{2p}$$

48) Write the physical significance of electric field.

Ans.

a) The field explains the mechanism by which two charges exert Colombian force on each other.

b) The force acting on any charge in a field can be easily calculated.

c) Electric field is a property of source charge and independent of magnitude of test charge.

49) State and explain the Gauss' law in electrostatics.

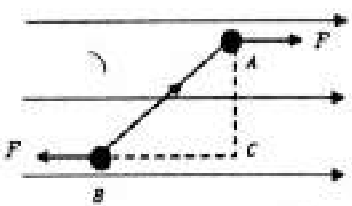
Ans: Total electric flux through a closed surface in vacuum is equal to $1/\varepsilon_0$ times the net charge enclosed by the surface.

Consider a charge q which is placed in a closed surface S which is in vacuum. Then total electric flux through the closed surface is given by,

$$\emptyset = \left(\frac{1}{\varepsilon_0}\right)q_1$$

50) Derive the expression for the torque on a dipole placed in a uniform electric field.

Ans:



The force experienced by the charges is given by $\vec{F} = \pm q\vec{E}$.

These forces constitute a torque on a dipole given by,

Torque, τ = force $\times$ perpendicular distance between the two forces

$= (q\,E)(AC)$

$= E\,(AB\sin\theta)$

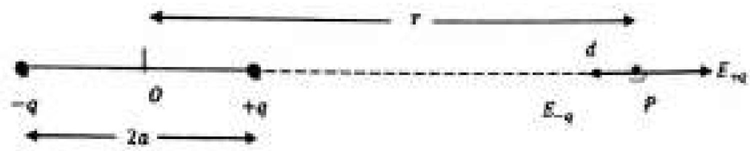
$= E\,2a\sin\theta$

$\tau = p\,E\,sin\,\theta$

Five Marks Questions and Answers

51) Derive the expression for electric field at a point on the axis of an electric dipole.

Ans:



The electric fields E_{+q} and E_{-q} at a point P due to charge $+q$ and $-q$ are given by,

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

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

The resultant electric field is given by superposition principle,

$$E_A = E_{+q} - E_{-q}$$

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

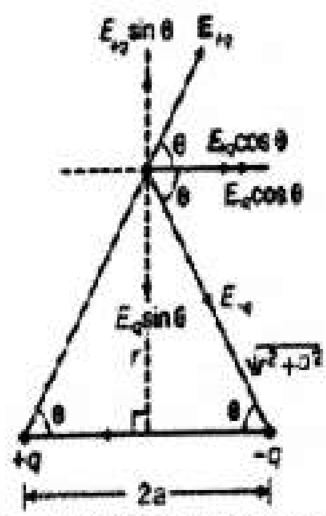
$$= \frac{q}{4\pi\varepsilon_0}\left(\frac{1}{(r-a)^2} - \frac{1}{(r+a)^2}\right)$$

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

$$E_A = \frac{1}{4\pi\varepsilon_0}\left(\frac{2pr}{(r^2-a^2)^2}\right)$$

52) Derive the expression for electric field at a point on the equatorial line of an electric dipole.

Ans:



Let P be a point at a distance r from the center of the dipole on the equatorial line. The magnitude of electric field at P due $+q$ is,

$$E_{+q} = \frac{1}{4\pi\varepsilon_0}\left(\frac{q}{(r^2+a^2)}\right), \text{ away from the charge } +q \qquad (1)$$

Similarly,

$$E_{-q} = \frac{1}{4\pi\varepsilon_0} \cdot \left(\frac{q}{(r^2 + a^2)}\right) \text{ towards the charge } + q \qquad (2)$$

The two vectors can be resolved in to two components.

1) Parallel to dipole axis $E_{+q} \cos\theta$ and $E_{-q} \cos\theta$.
2) Perpendicular to dipole axis $E_{+q} \sin\theta$ and $E_{-q} \sin\theta$.

The perpendicular components are equal in magnitude and opposite in direction so they get cancelled.
Resultant electric field is,

$$E_E = E_{+q} \cos\theta + E_{-q} \cos\theta$$

$$E_E = 2E_{+q} \cos\theta$$

But,

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

Therefore,

$$E_E = 2\left[\frac{1}{4\pi\varepsilon_0}\left(\frac{q}{r^2 + a^2}\right)\right]\cos\theta$$

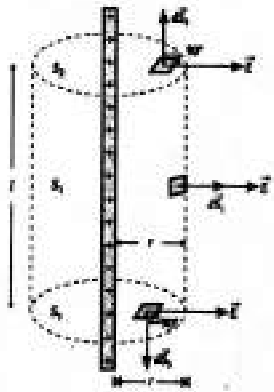
$$E_E = \frac{1}{4\pi\varepsilon_0}\frac{2q}{(r^2 + a^2)}\left(\frac{a}{(r^2 + a^2)^{1/2}}\right)$$

$$E_E = \frac{1}{4\pi\varepsilon_0}\frac{q.2a}{(r^2 + a^2)^{\frac{3}{2}}}$$

$$E_E = \frac{1}{4\pi\varepsilon_0}\frac{p}{(r^2 + a^2)^{3/2}}$$

53) Derive the expression for electric field at a point due to infinitely long uniformly charged straight wire using Gauss law.

Ans:



Consider an infinite and very thin straight wire having uniform linear charge density λ. To find the electric field at a point distant r from it. Draw a cylinder of radius r and length l as a Gaussian surface.

The cylinder has three surfaces namely S_1, S_2 and S_3. Let ϕ_1, ϕ_2 and ϕ_3 be the electric fluxes through the three surfaces S_1, S_2 and S_3 respectively.

Total flux through the Gaussian surface, $\phi = \int_{S_1} \vec{E} \cdot \overrightarrow{dS_1} + \int_{S_2} \vec{E} \cdot \overrightarrow{dS_2} + \int_{S_3} \vec{E} \cdot \overrightarrow{dS_3}$

$\vec{E}$ and $\overrightarrow{ds}$ are normal to each other for the surfaces S_2 and S_3.

Therefore, $\int_{S_2} \vec{E} \cdot \overrightarrow{ds} = 0$ and $\int_{S_3} \vec{E} \cdot \overrightarrow{ds} = 0$. Hence,

$$\phi = \int_{S_1} \vec{E} \cdot \overrightarrow{dS_1} = E\, S_1$$

$$\phi = E(\,2\pi r l\,) \qquad (1)$$

According the Gauss's law,

$$\emptyset = \frac{q}{\varepsilon_0} = \frac{\lambda\, l}{\varepsilon_0} \qquad (2)$$

(As charge enclosed by the Gaussian surface is, $q = \lambda\, l$)

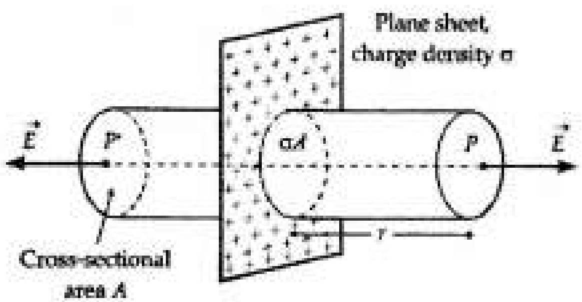
From equations (1) and (2) we can write,

$$E(\,2\pi r l\,) = \frac{\lambda\, l}{\varepsilon_0}$$

$$E = \frac{1}{4\pi\varepsilon_0}\left(\frac{2\lambda}{r}\right)$$

54) Derive the expression for electric field at a point due to uniformly charged, infinite plane sheet.

Ans:



Consider a thin sheet, infinite in size with uniform surface charge density σ. Since the sheet is infinite, by the symmetry electric field must have the same magnitude E at two points P and P' equidistant from the sheet on the either side of the sheet.

Consider the Gaussian surface as cylinder. The electric field is parallel to the curved surface; hence the flux through curved surface is zero.

The flux through the plane faces of the cylinder is,

$$\phi = 2\,E\,A \qquad (1)$$

The charge enclosed by the Gaussian surface is $q = \sigma\, A$

According the Gauss's law,

$$\emptyset = \frac{q}{\varepsilon_0} = \frac{\sigma\, A}{\varepsilon_0} \qquad (2)$$

From equations (1) and (2) we can write,

$$2EA = \frac{\sigma\, A}{\varepsilon_0}$$

$$E = \frac{\sigma}{2\varepsilon_0}$$

CHAPTER 2: ELECTROSTATIC POTENTIAL AND CAPACITANCE

One Mark Questions and Answers

1) Define Electrostatic Potential.

   Ans: Electrostatic potential at a point in an electric field is defined as the work done to move a unit positive charge, without any acceleration, from infinity to that point.

2) Name the SI unit of Electrostatic Potential.

   Ans: volt or $J\,C^{-1}$

3) What is meant by an equipotential surface?

   Ans: It is the surface having same potential at all points on it.

4) Two equipotential surfaces never intersect each other. Why?

   Ans: If two equipotential surfaces intersect, then there will be two different values of electric potential at the point of intersection, which is not possible.

5) What is the amount of work done in moving a charge between two points on an equipotential surface?

   Ans: Zero.

6) Define electrostatic potential energy of a system of charges.

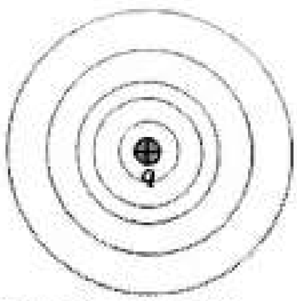
   Ans: It is defined as the work done to move the charges from infinity to their present positions.

7) What is the shape of equipotential surface around a point charge?

   Ans: Spherical surface.

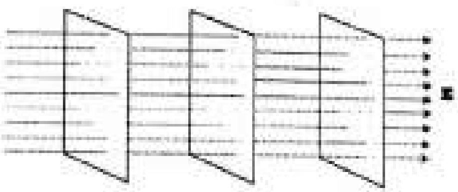
8) Draw equipotential surfaces due to a single point charge.

   Ans:



9) Draw equipotential surfaces for a uniform electric field.

   Ans:



10) What is the electric potential of the earth?

    Ans: Zero.

11) Why electric charges reside on the surface of a charged conductor?

    Ans: Due to mutual repulsion.

12) Write the expression for potential energy of a system of two point charges in the absence of an external electric field.

    Ans:

$$U = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1 q_2}{r}\right)$$

13) What is meant by electric polarization?

Ans: It is the phenomenon in which a dielectric acquires a dipole moment when placed in an external electric field.

14) Define dielectric polarization vector.

Ans: It is defined as the net dipole moment acquired per unit volume of the sample.

15) What is capacitor?

Ans: It is a device to store an electric charge and energy.

16) Define capacitance of a capacitor.

Ans: Capacitance of a capacitor is defined as the ratio of the charge on it to the potential difference V across its conductors.

17) Name the SI unit of electric capacitance.

Ans: farad or F.

18) Which form of energy is stored in a charged capacitor?

Ans: Electrostatic potential energy.

19) What is parallel plate capacitor?

Ans: It is an arrangement of two identical parallel metal plates separated by a small distance.

20) How does the capacitance of a parallel plate capacitor vary with area of plates?

Ans: Directly.

21) How does the capacitance of a parallel plate capacitor vary with separation between the plates?

Ans: Inversely.

22) What is the effect of dielectric medium on the capacitance of a capacitor?

Ans: It increases the capacitance of a capacitor.

23) Define dielectric constant of a substance.

Ans: It is defined as the ratio of the permittivity of a given substance to the permittivity of the free space.

24) Define dielectric strength of a substance.

Ans: It is defined as the maximum electric field that substance can withstand without break done.

25) Write the SI unit of dielectric strength.

Ans: $V\ m^{-1}$.

26) What is dielectric break down?

Ans: It is the phenomenon in which dielectric loses its insulating property when kept in a strong electric field.

27) What is the value of dielectric constant for perfect conductor?

Ans: Infinity.

Two Marks Questions and Answers

28) How does the electric field and electric potential vary with distance from a source charge?

Ans: a) Electric field varies inversely as square of the distance.

b) Electric potential varies inversely as the distance.

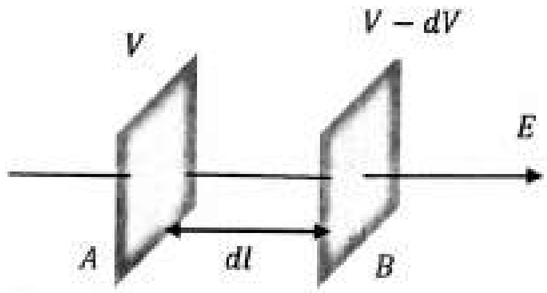
29) Using superposition principle, write the expression for electric potential at a point due to a system of charges and explain the symbols used.

Ans:

$$V = \frac{1}{4\pi\varepsilon_o}\left(\frac{q_1}{r_1} + \frac{q_2}{r_2} + \frac{q_3}{r_3} + \cdots + \frac{q_n}{r_n}\right)$$

Here $q_1, q_2, q_3 \cdots q_n$ are the point charges and $r_1, r_2, r_3, \cdots r_n$ are the distances of the points from the respective point charges and ε_0 is the permittivity of the free space.

30) Obtain the relation between the electric field and potential.



Ans: Consider two equipotential surfaces A and B with the potential difference dV between them as shown in figure. Let dl be the perpendicular distance between them.

The work done to move a unit positive charge from B to A against the field $\vec{E}$ through a displacement $\vec{dl}$ is,

$$dW = \vec{E} \cdot \vec{dl} = Edl \cos \pi = -Edl$$

This is equal to the potential difference, therefore,

$$dV = dW$$
$$dV = -Edl$$
$$E = -\frac{dV}{dl}$$

31) Mention the expression for potential energy of an electric dipole placed in a uniform electric field and explain the terms.

Ans: $U = -p\,E \cos \theta$

Where p = dipole moment.

E = Electric field.

θ = Angle between dipole moment and electric field.

32) When is the potential energy of an electric dipole placed in a uniform electric field a) maximum and b) minimum?

Ans: a) Electric potential energy is maximum when the dipole moment and electric field are parallel. $(\theta = 0^0)$.

b) Electric potential energy is minimum when the dipole moment and electric field are antiparallel. $(\theta = 180^0)$.

33) Calculate the potential at point located 9 cm away from a point charge of 2nC.

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

$$V = \frac{9\times10^9 \times 2\times10^{-9}}{9\times10^{-2}} = 200 \text{ V}$$

34) What is Electrostatic shielding? Mention one use of it.

Ans: a) The field inside the cavity of a conductor is always zero and it remains shielded from outside electric influence. This is known as electrostatic shielding.

b) It is used in protecting sensitive electrical instruments.

35) Mention the expression for electric field near the surface of a charged conductor in vector form and explain the terms.

Ans:

$$\vec{E} = \frac{\sigma}{\varepsilon_o}\hat{n}$$

Where, σ is surface charge density.

$\hat{n}$ is unit vector normal to the surface.

36) What are Dielectrics? Mention the types of Dielectrics.

Ans: Dielectrics are non-conducting substances. The two types of dielectrics are polar dielectrics and non-polar dielectrics.

37) What are non-polar Dielectrics? Give an example.

Ans: The substances in which the centers of positive and negative charges coincide. E.g. Hydrogen.

38) What are polar dielectrics? Give an example.

Ans: The substances in which the centers of positive and negative charges do not coincide. E.g. Water.

39) Write the three factors on which capacitance of a parallel plate capacitor depends.

Ans:

a) Area of plates.
b) Distance between the two plates.
c) Dielectric medium between the two plates.

40) Write any two uses of capacitors.

Ans: a) To store electric energy
b) In tuning circuits of radio.

41) What is Van de Graff generator? Mention its one use.

Ans: It is a machine which generates very high potential of the order of 10^6 V. It is used to accelerate charged particles.

42) Two capacitors of capacitances 2 μF and 3 μF are connected in series. Calculate their effective capacitance.

Ans:

$$C_S = \frac{C_1 C_2}{C_1 + C_2}$$

$$C_S = \frac{2\times 3}{2+3} = \frac{6}{5}\mu\text{F}$$

43) Two capacitors of capacitances 2μF and 7μF are connected in parallel. Calculate their effective capacitance.

Ans:

$$C_P = C_1 + C_2$$

$$C_P = 2\,\mu\text{F} + 7\,\mu\text{F} = 9\,\mu\text{F}$$

44) Mention the expression for energy stored in a charged capacitor and explain the terms.

Ans:

$$U = \frac{1}{2}CV^2$$

Where, U = Energy stored in a capacitor, C = capacitance of a capacitor, V= potential difference between the plates.

45) Write the expression for potential energy of two point charges in the presence of external electric field.

Ans: Electrostatic potential energy is given by,

$$U = q_1V_1 + q_2V_2 + \frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{r_{12}}$$

Where, q_1 and q_2 are the point charges, V_1 and V_2 are potentials at their positions, $r_{12}$is the distance between them.

46) 12 μF capacitor is connected to 50 V battery. How much electrostatic energy is stored in it?

Ans:

$$U = \frac{1}{2}CV^2$$

$$U = \frac{1}{2} \times 12 \times 10^{-6} \times (50)^2 = 15 \text{ mJ}$$

47) Mention the expression for capacitance of a parallel plate capacitor with a dielectric medium between the plates and explain the terms.

Ans:

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

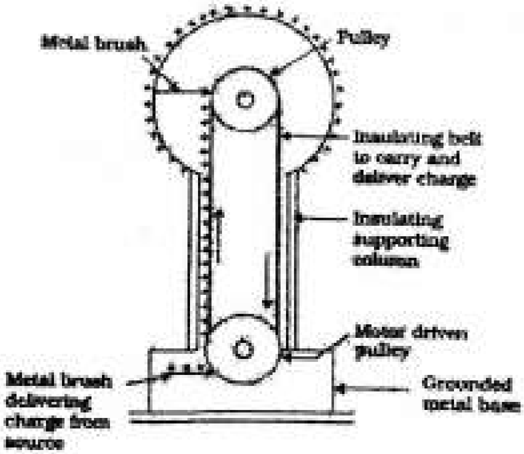
Where, K = dielectric constant of the medium between the plates, ε_0 = Permittivity of free space, A = Area of the plates. d = Plates separation.

48) Define energy density of the electric field in a capacitor. Mention its unit.

Ans: It is defined as the energy stored per unit volume in a charged capacitor. Its unit is J m^{-3}.

49) Draw the neat labeled diagram of Van de Graff generator.

Ans:



Three Marks Questions and Answers.

50) Write any thee differences between Electric field and Electric potential.

Ans:

	Electric field	Electric potential.
1)	It is the force experienced by a unit positive charge placed at that point.	It is the amount of work done in moving a unit positive charge from infinity to a point.
2)	It is vector quantity.	It is scalar quantity.
3)	Its SI unit is N C^{-1}	Its SI unit is V.

51) Write expression for electric potential due to a short dipole. Obtain the expression for electric potential at any point on its a) axial line (b) equatorial line.

Ans: Electric potential due to a short dipole is,

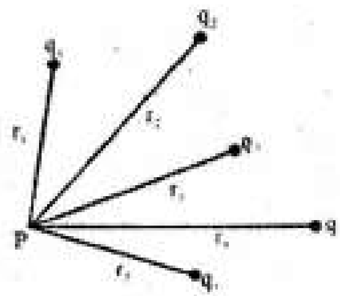
$$V = \frac{1}{4\pi\varepsilon_0}\left(\frac{p\cos\theta}{r^2}\right)$$

On axial line, $\theta = 0$ or π $\quad \therefore \cos\theta = \pm 1$, $\therefore V = \pm\frac{1}{4\pi\varepsilon_0}\left(\frac{p}{r^2}\right)$

On equatorial line, $\theta = \frac{\pi}{2}$ $\quad \therefore \cos\theta = 0$, $\quad \therefore V = \pm 0$

52) Using superposition principle, find the electric potential at a point due to system of charges.

Ans:



Consider n discrete positive charges at distance $r_1, r_2, r_3, \cdots r_n$ respectively from the point P.

Potential at P due to charge q_1 is given by,

$$V_1 = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1}{r_1}\right)$$

Similarly, potential at P due to charge q_n is given by,

$$V_n = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_n}{r_n}\right)$$

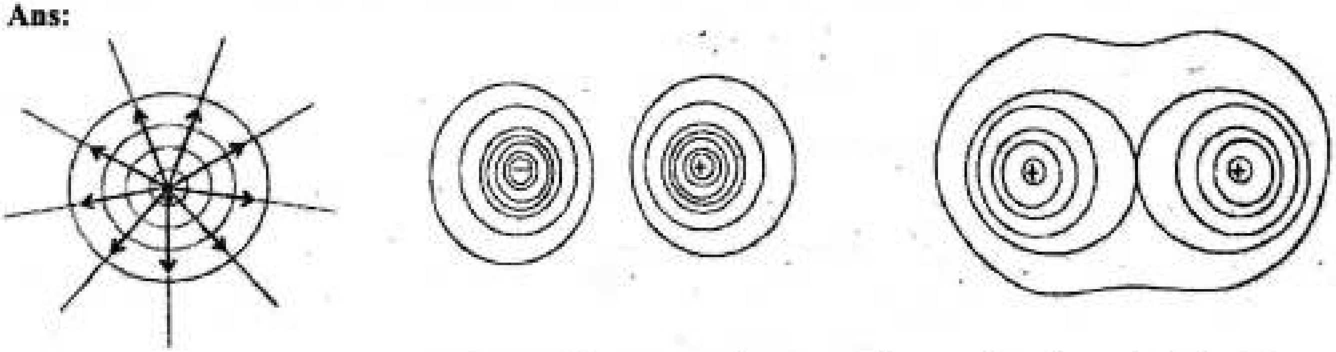
Applying principle of superposition of potentials, total potential at P due to n charges is given by,

$$V = V_1 + V_2 + \cdots + V_n$$

$$V = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1}{r_1}\right) + \frac{1}{4\pi\varepsilon_0}\left(\frac{q_2}{r_2}\right) + \cdots + \frac{1}{4\pi\varepsilon_0}\left(\frac{q_n}{r_n}\right)$$

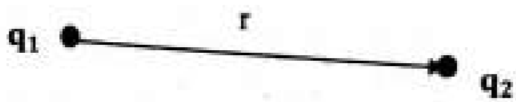
53) Draw equipotential surface for (i) a positive point charge (ii) an electric dipole or two equal and opposite point charges and (iii) two identical positive charges.

Ans:



54) Derive the expression for electric potential energy of system of two point charges in the absence of external electric field.

Ans:



Consider a system of two point charges separated by a distance r as shown in the figure.

The work done to move q_1 from infinity to the point A is,

$$W_1 = 0 \quad \text{(As there is no initial electric field)}$$

The work done to move q_2 from infinity to B is,

$$W_2 = V_B q_2$$

Where V_B is the electric potential at B due to q_1, therefore,

$$V_B = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1}{r}\right)$$

$$\therefore \; W_2 = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1}{r}\right) q_2$$

$$W = W_1 + W_2 = 0 + \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1 q_2}{r}\right)$$

By the definition $U = W$, therefore,

$$U = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1 q_2}{r}\right)$$

55) Derive the expression for electric potential energy of system of two point charges in the presence of external electric field.

Ans: Let V_1 and V_2 be the potentials due to external electric field at two points separated by a distance r. Let charge q_1 be brought from infinity and placed at that point where external potential is V_1. The work done against the external field is equal to $q_1 V_1$.

Next a charge q_2 is brought from infinity and placed at the other point where the external potential is V_2 . Now the work done against the external field is equal to $q_2 V_2$.

Work done on q_2 against the field due to q_1 is,

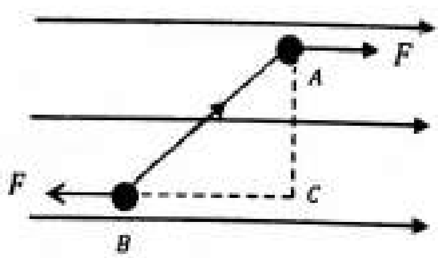
$$\frac{1}{4\pi\varepsilon_0}\left(\frac{q_1 q_2}{r_{12}}\right)$$

The total electric potential energy of the system of two charges in the presence of the external e

$$U = q_1 V_1 + q_2 V_2 + \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1 q_2}{r_{12}}\right)$$

56) Derive an expression for the potential energy of a dipole in a uniform electric field.

Ans:



Consider an electric dipole in an external field, E. It experiences torque given by,

$$\tau = p\,E \sin\theta$$

The torque brings the dipole to minimum energy configuration (in the direction of the electric field). Let the dipole is rotated from the minimum energy position ($\theta = 90^0$) by a small angle $d\theta$ against the field, with infinitesimal angular speed (angular acceleration = 0). The work done for this process is given by,

$$W = \int_{90}^{\theta} \tau . d\theta = \int_{90}^{\theta} pE \sin\theta\, d\theta$$

$$W = -[\,pE\cos\theta\,]_{90}^{\theta}$$

$$W = -p\,E[\cos\theta \;-\cos 90\,]$$

$$W = -\,p\,E\cos\theta$$

The amount of work done is the potential energy i.e. $W = U$ therefore,

$$U = -\vec{p}\cdot\vec{E}.$$

57) Write any three electrostatic properties of a conductor placed in an electrostatic field.

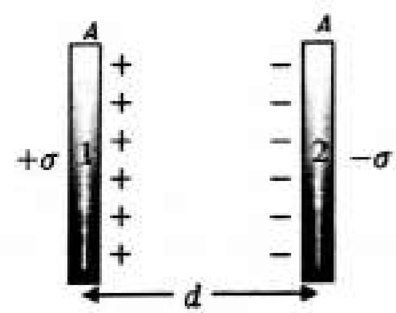
Ans: 1. Net electric field inside the conductor is zero.

2. Electric field is always normal to the surface of the charged conductor.

3. Charge always resides on the surface of a conductor.

58) Derive an expression for the capacitance of a parallel plate capacitor.

Ans:



Let A be the area of each plate, separated by a distance of d and the two plates have the charge $+Q$ and $-Q$ and their surfaces charge densities are $+\sigma$ and $-\sigma$ respectively.

In between the plates the electric field is given by,

$$E = \frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0} = \frac{\sigma}{\varepsilon_0}$$

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

Ignoring the edge effects the electric field between the plates is uniform and is equal to potential gradient. We know, $V = Ed$, therefore, the capacitance of the parallel plate capacitor is given by, therfore,

$$V = \frac{Q\,d}{\varepsilon_0 A}$$

therefore,

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

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

59) Mention the three methods to increase the capacitance of a parallel plate capacitor

Ans:

a) By using a medium of higher dielectric constant.
b) By increasing the area of plates.
c) By decreasing the separation between the plates.

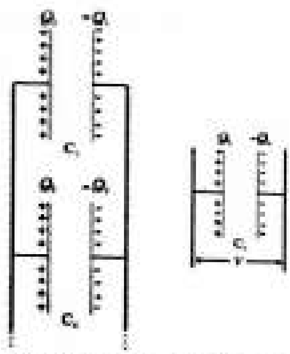
60) Write the three differences between series and parallel combination of capacitors

Ans:

	Series combination	Parallel combination
1)	Charge on each capacitor is the same.	Charge on each capacitor is different.
2)	Potential difference across each capacitor is different.	Potential difference across each capacitor is the same.
3)	Equivalent capacitance decreases.	Equivalent capacitance increases.

61) Derive the expression for the effective capacitance of two capacitors connected in parallel.

Ans:



Consider two capacitors of capacitance C_1 and C_2 connected in parallel. In parallel combination potential V is same across each capacitor and charge on the combination is equal to sum of the charges on each. Therefore,

$$Q = Q_1 + Q_2$$
$$Q_1 = VC_1$$
$$Q_2 = VC_2$$
$$Q = VC_1 + VC_2 \qquad (1)$$

If C_P is the effective capacitance of the parallel combination, then,

$$C_P = \frac{Q}{V}$$
$$Q = VC_P \qquad (2)$$

Therefore from equation (1) and (2) we can write,

$$VC_P = VC_1 + VC_2$$
$$C_P = C_1 + C_2$$

62) Derive the expression for energy stored in a charged capacitor.

Ans:

Let at any instant a charge q be on the plates of a capacitor. Then potential difference between the plates of the capacitor is given by, $V = \frac{q}{C}$

If extra charge dq is transferred from one plate of the capacitor to the other plate of the capacitor, then work done to do so is stored as electric potential energy in the capacitor.

$$dU = dW = Vdq = \frac{q}{C}\,dq$$

The total energy stored in the capacitor while charging from the 0 to Q is,

$$U = \int_0^Q dU = \int_0^Q \frac{q}{C}\,\mathrm{dq} = \frac{1}{C}\int_0^Q q\,dq = \frac{1}{C}\left[\frac{q^2}{2}\right]_0^Q = \frac{Q^2}{2C} = \frac{1}{2}CV^2$$

63) What is Van de Graaff generator? Write its principles.

Ans: A Van de Graaff generator is a machine which generates very high potential of the order of 10^6 volt.

Principle:

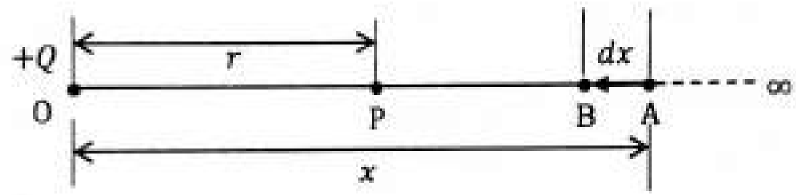
a) When a charge is given to the spherical shell, it redistributes on its outer surface.

b) Discharging action of points.

Five Marks Questions and Answers

64) Derive the expression for potential at a point due to point charge.

Ans:



Consider a point charge $+Q$ at origin O. Let P be the point at a distance $\boldsymbol{r}$ from the point charge $\boldsymbol{Q}$. The potential at P is the amount of work done in bringing a unit positive charge from infinity to point P.

Consider a point A at a distance $\boldsymbol{x}$ from O. The magnitude of electrostatic force on a unit positive charge at A is,

$$F = \frac{1}{4\pi\varepsilon_o}\left(\frac{Q}{x^2}\right)$$

The small amount of work done in moving a unit positive charge from A to B through a small distance dx is,

$$dW = -F\,dx$$

$$dW = -\frac{1}{4\pi\varepsilon_o}\left(\frac{Q}{x^2}\right)dx$$

Total work done in moving a unit positive charge from infinity to point P is given by,

$$W = \int_\infty^r -\frac{1}{4\pi\varepsilon_o}\frac{Q}{x^2}\,dx$$

$$= -\frac{Q}{4\pi\varepsilon_o}\int_\infty^r \frac{1}{x^2}\,dx$$

$$= -\frac{Q}{4\pi\varepsilon_o}\left[-\frac{1}{x}\right]_\infty^r = \frac{Q}{4\pi\varepsilon_o}\left[\frac{1}{r}-\frac{1}{\infty}\right]$$

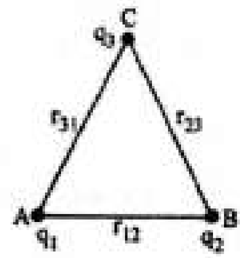
$$W = \frac{1}{4\pi\varepsilon_0}\left(\frac{Q}{r}\right)$$

But potential at P is work done per unit charge, therefore, $V = W$, hence,

$$V = \frac{1}{4\pi\varepsilon_0}\left(\frac{Q}{r}\right)$$

65) Derive the expression for electric potential energy of a system of three point charges in the absence of external electric field.

Ans:



From the diagram, work done to bring the charge q_1 from infinity to A is given by $W_1 = 0$.

Work done to bring q_2 from infinity to B is given by,

$$W_2 = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1\, q_2}{r_{12}}\right)$$

Work done to bring q_3 from infinity to C is given by,

$$W_3 = V_c q_3$$

Where V_c is the potential at C due to charges q_1 and q_2,

$$V_c = \frac{1}{4\pi\varepsilon_0}\left[\frac{q_1}{r_{31}} + \frac{q_2}{r_{23}}\right]$$

Therefore total work done,

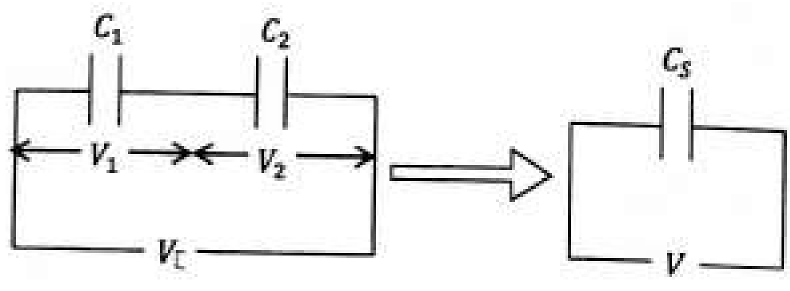
$$W = W_1 + W_2 + W_3 = \frac{1}{4\pi\varepsilon_0}\left[\left(\frac{q_1\, q_2}{r_{12}}\right) + q_3\left(\frac{q_1}{r_{31}} + \frac{q_2}{r_{23}}\right)\right]$$

Since $U = W$, therefore,

$$U = \frac{1}{4\pi\varepsilon_0}\left(\frac{q_1\, q_2}{r_{12}} + \frac{q_1 q_3}{r_{31}} + \frac{q_2 q_3}{r_{23}}\right)$$

66) What is effective capacitance? Derive an expression for the effective capacitance of two capacitors connected in series.

Ans: It is the capacitance of a single capacitor whose effect is same as that of system of capacitors.



From the circuit, we can notice that,

$$V = V_1 + V_2$$

But $V = Q/C$ therefore,

$$V_1 = \frac{Q}{C_1}$$

$$V_2 = \frac{Q}{C_2}$$

Therefore,

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

$$V = Q\left[\frac{1}{C_1} + \frac{1}{C_2}\right] \qquad (1)$$

Let the system of capacitors be replaced by the single capacitor of equivalent capacitance C_s such that it acquires the same charge Q at the same potential difference V.

Then,

$$V = \frac{Q}{C_s} \qquad (2)$$

Comparing the equations (1) and (2) we can write,

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

CHAPTER 3: CURRENT ELECTRICITY

One Mark Questions and Answers

1) Define electric current.
   Ans: The time rate of flow of charges through any cross section of the conductor is electric current.
2) Give the SI unit of current.
   Ans: ampere or A.
3) Name the electric charge carriers in conductors.
   Ans: Free electrons.
4) How many electrons flowing per second constitute a current of one ampere?
   Ans: 6.25×10^{18} electrons.
5) State Ohm's law.
   Ans: The current through a conductor is directly proportional to the potential difference across its ends, provided the temperature and other physical conditions remain constant.
6) Define electric resistance of a conductor.
   Ans: It is defined as the ratio of the potential difference across the ends of the conductor to the electric current through it.
7) Write the SI unit of electric resistance.
   Ans: ohm or Ω
8) Define ohm.
   Ans: The resistance of a conductor is said to be one ohm if one ampere of current passes through it when the potential difference across its ends is one volt.
9) How does the resistance of a conductor vary with its length?
   Ans: Directly.
10) How does the resistance of a conductor vary with its area of cross section?
    Ans: Inversely.
11) Define resistivity of the material of a conductor.
    Ans: The resistivity of material of a conductor at a given temperature is equal to resistance of unit length of the conductor having unit area of cross section.
12) Mention the SI unit of the electrical resistivity.
    Ans: Ω m.
13) Define the term current density.
    Ans: It is defined as the electric current per unit area taken normal to the direction of current.
14) Write the relation between current density and conductivity.
    Ans: $j = \sigma E$.
15) Write the SI unit of electric current density.
    Ans: A m^{-2}
16) Write the relation between the resistance and resistivity.
    Ans: $R = \frac{\rho l}{A}$
17) How does the resistivity of a conductor vary with temperature?
    Ans: Directly.
18) How does the resistivity of a semiconductor vary with temperature?
    Ans: Decreases exponentially.
19) What is the cause for electric resistance?
    Ans: Collision of free electrons with ions.

20) What is meant by electric conductivity?
Ans: The reciprocal of electric resistivity is called conductivity.

21) Write the SI unit of electric conductivity.
Ans: S/m

22) What is drift phenomenon of electrons in a conductor?
Ans: It is the phenomenon in which the free electrons experience a force opposite to the direction of external electric field.

23) Define drift velocity of electrons.
Ans: It is defined as the average velocity with which free electrons of a conductor move in a direction opposite to the applied electric field.

24) Define relaxation time or mean free time.
Ans: It is defined as the average time interval between successive collisions of an electron.

25) Define mobility.
Ans: Mobility is defined as the magnitude of drift velocity per unit electric field.

26) Write the SI unit of mobility.
Ans: m^2/Vs.

27) Write the factor on which the mobility of a charge carrier depends.
Ans: Temperature.

28) Name the material which does not obey Ohm's law.
Ans: Ga As.

29) What does forth colour band represents in colour code system of carbon resistors?
Ans: Tolerance.

30) What is the colour of 3rd band of a carbon resistor of resistance 120 Ω.
Ans: Brown.

31) Define temperature coefficient of resistivity.
Ans: Fractional change in resistivity per unit rise in temperature.

32) Write the SI unit of temperature coefficient of resistivity.
Ans: K^{-1}

33) Write the expression for ohmic loss in a conductor carrying current I and having resistance R.
Ans: $P = I^2R$

34) What is meant by series combination of resistors?
Ans: It is a combination in which resistors are connected end to end such that current through each resistor is same.

35) What is meant by parallel combination of resistors?
Ans: It is a combination in which resistors are connected between two common terminals such that potential difference across each resistor is same.

36) What is emf of an cell?
Ans. The potential difference between the terminals of a cell when the cell is in open circuit.

37) Write the SI unit of emf of a cell.
Ans: volt or V.

38) Define internal resistance of a cell.
Ans: The resistance offered by the cell to the current through it.

39) Define terminal potential difference.
Ans: The potential difference between the terminals of a cell when the cell is in closed circuit.

40) Write the expression for the potential difference between the terminals of a cell of emf, ε and internal resistance r.

Ans: $V = \varepsilon - Ir$

41) What is a node or junction in an electrical network?

Ans: It is a point in a network where more than two currents meet.

42) Write the condition for balanced Wheatstone's network.

Ans: $\frac{P}{Q} = \frac{R}{S}$

43) What is Metre Bridge?

Ans: It is practical form of Wheatstone's network.

44) Write the principle of meter bridge.

Ans: Balanced Wheatstone's bridge.

45) Name the device which measures the emf of a cell accurately?

Ans: Potentiometer.

46) Write the principle of potentiometer.

Ans: When a steady current exists in a wire of uniform thickness, the potential difference between any two points on it is directly proportional to length of the wire between the points.

Two Marks Questions and Answers

47) Name the charge carries in a) metals b) electrolytic conductors.

Ans: a) free electrons

b) ions

48) Name the current carriers in a) Gases b) Semiconductors.

Ans: a) positive ions and electrons

b) free electrons and holes.

49) Explain the mechanism of current through a conductor.

Ans: Every metal conductor has large number of free electrons which move randomly at room temperature. Their average thermal velocity at any instant is zero. When a potential difference is applied across the ends of a conductor electric field is set up. Due to it, the free electrons of the conductor experience force due to electric field and drift towards the positive end of the conductor, causing electric current.

50) State and explain Ohm's law.

Ans: The current through the conductor is directly proportional to the potential difference applied across its ends, provided the temperature and other physical conditions of the conductor remain constant. That is,

$$V \propto I$$

$$V = IR$$

Where V is potential difference across the conductor, I is current through the conductor and R is resistance of the conductor.

51) Mention the two limitations of Ohm's law.

Ans: a) Ohm's law is valid only if temperature and other physical quantities remain constant.

b) It is not applicable for semiconductors.

52) Mention the factors on which resistance of a conductor depend?

Ans: a) Length of the conductor.

b) Area of cross section of the conductor.

53) Mention the two factors affecting the electric resistivity of a material.

Ans: a) The nature of the material.

b) Temperature.

54) Why alloys like constantan or magnanin are used for making standard resistors?

Ans: a) They have high resistivity.

b) They have low temperature coefficient of resistivity.

55) State Kirchhoff's first rule. Write its significance.

Ans: At any junction in an electric network the sum of the currents entering the junction is equal to the sum of currents leaving the junction.

Significance: Law of conservation of charge.

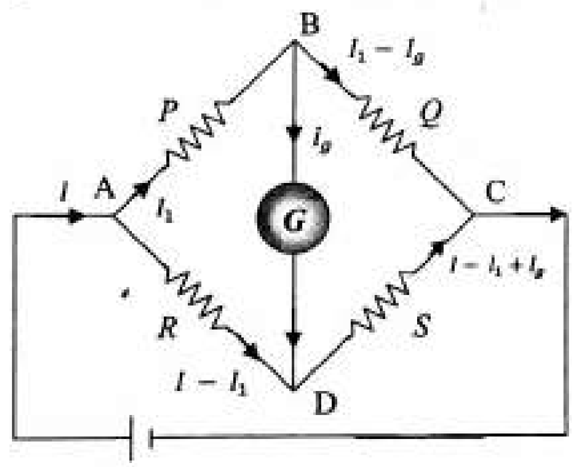
56) State Kirchhoff's second rule. Write it's significance.

Ans: The algebraic sum of changes in potential around any closed loop involving resistors and cells in the loop is zero

Significance: Law of conservation of energy.

57) Draw Wheatstone's bridge circuit and write the condition for its balance.

Ans:



Condition for balance is,

$$\frac{P}{Q}=\frac{R}{S}$$

58) Write the two uses of Metre Bridge.

Ans: a) To compare the resistances.

b) To find the resistance.

59) Define potential gradient. Give its SI unit.

Ans: The potential drop per unit length of the potentiometer wire is potential gradient.

Its SI unit is, V m^{-1}

60) Write two applications of potentiometer?

Ans: a) To compare the emf of two cells.

c) To find the internal resistance of cell.

Three Marks Questions and Answers

61) Derive the expression for drift velocity of electrons in a conductor.

Ans: Consider a conductor in the absence of external electric field. The free electrons are moving randomly within the conductor. Thus, the average velocity of electrons is zero.

$$\vec{v}_i = 0$$

Under the influence of electric field $\vec{E}$, each free electron experiences a force given by,

$$\vec{F} = -e\vec{E}$$

Due to this force the electron is accelerated and acceleration of electron is given by,

$$\vec{a} = \frac{\vec{F}}{m} = \frac{-e\vec{E}}{m}$$

The electrons are accelerated for an average interval of time τ.

Therefore the average final velocity of all free electrons is called drift velocity and denoted by $\vec{v}_d$.

$$\vec{v}_d = \vec{v}_i + \vec{a}\,\tau$$

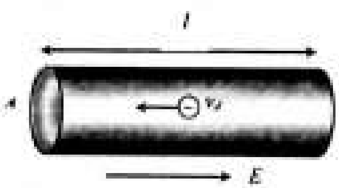
$$\vec{v}_d = 0 + \left(\frac{-e\vec{E}}{m}\right)\tau$$

Therefore,

$$\vec{v}_d = -\frac{e\vec{E}}{m}\tau$$

62) Derive the expression $I = nAev_d$; where the symbols have their usual meanings.

Ans:



Let n be the number of free electrons per unit volume of the conductor.

Therefore, total number of free electrons in the conductor = n × volume of the conductor

= $n\,A\,l$

If e is the charge on each electron then total free charge in the conductor,

$$Q = \text{Number of electrons} \times e$$

$$Q = (nAl)\,e$$

Drift velocity of electron is given by,

$$\vec{v}_d = \frac{l}{t}$$

Or,

$$t = \frac{l}{\vec{v}_d}$$

By definition of current,

$$I = \frac{Q}{t} = \frac{n\,A\,l\,e}{\left(\frac{l}{v_d}\right)}$$

Therefore,

$$I = nAev_d$$

63) Derive an expression $j = \sigma E$ where the symbols have their usual meanings.

Ans: The current through a conductor is given by,

$$I = neAv_d$$

Current density,

$$j = \frac{\text{current}}{\text{area}} = \frac{I}{A}$$

$$= \frac{nAev_d}{A} = nev_d$$

$$= ne\frac{eE}{m}\tau = \frac{ne^2\tau}{m}E$$

But, $\sigma = \frac{ne^2\tau}{m}$

Therefore, $j = \sigma E$

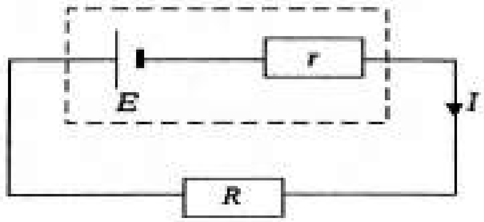
64) Distinguish between resistance and resistivity.

Ans:

	Resistance	Resistivity
1)	Opposition offered by the conductor to the flow of charges through it.	It is the resistance of the conductor of unit length and unit area of cross section.
2)	SI unit is ohm.	SI unit is Ω m.
3)	It is dependent of dimensions of the conductor.	It is not dependent of dimensions of the conductor.

65) Derive an expression for current drawn by an external resistor using Ohm's law.

Ans:



Consider a simple circuit in which an external resistance R is connected to a cell of emf, ε and of internal resistance r. Let I be the main current through the circuit.

$$V = \mathcal{E} - Ir$$

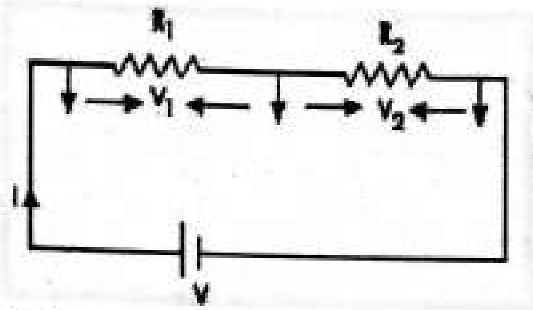
$$IR = \mathcal{E} - Ir$$

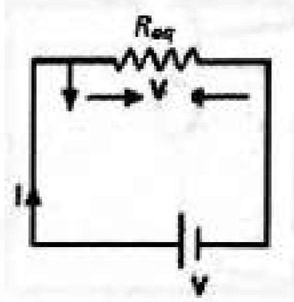
$$IR + Ir = \mathcal{E}$$

$$I = \frac{\mathcal{E}}{(R + r)}$$

66) Derive an expression for an equivalent resistance of a series combination of two resistors.

Ans:





Let I be the current through each resistor and V be potential difference applied across the combination.

$V = V_1 + V_2$ (1)

By Ohm's law, we have,

$V_1 = I R_1$ and $V_2 = I R_2$

Equation (1) becomes,

$V = I(R_1 + R_2)$ (2)

Let the series combination be replaced by an equivalent resistor of resistance R_{eq} such that the same current through R_{eq} when the same potential difference is applied across it.

$V = IR_{eq}$ (3)

From equation (2) and (3) we can write,

$R_{eq} = R_1 + R_2$

67) Distinguish between series and parallel combination of resistors.

Ans:

	Series	**Parallel**
1)	Current through each resistor is same.	Current through each resistor is different.
2)	Potential difference across each resistor is different.	Potential difference across each resistor is same.
3)	$R_{eq} = R_1 + R_2 + \cdots + R_n$	$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots + \frac{1}{R_n}$
4)	R_{eq} is always greater than the largest resistance used in the combination.	R_{eq} is always less than the smallest resistance used in the combination.

68) Write the three factors on which internal resistance of a cell depends.

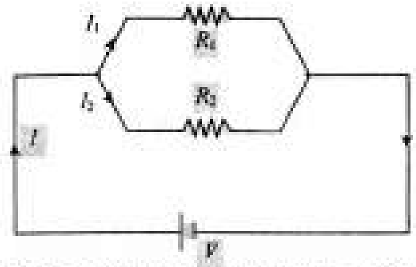
Ans:

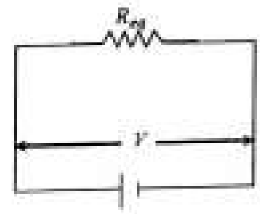
a) Concentration of electrolyte.
b) Distance between the electrodes.
c) Area of the plates of electrodes.

Five Marks Questions and Answers

69) Obtain the expression for equivalent resistance of parallel combination of two resistors

Ans:





If I_1 and I_2 be currents through the resistances R_1 and R_2 respectively, then,

$$I = I_1 + I_2 \qquad (1)$$

By Ohm's law, we have, $I_1 = \frac{V}{R_1}$ and $I_2 = \frac{V}{R_2}$

Then equation (1) becomes, $I = \frac{V}{R_1} + \frac{V}{R_2}$

$$I = V\left(\frac{1}{R_1} + \frac{1}{R_2}\right) \qquad (2)$$

Let the parallel combination is replaced by an equivalent resistor of resistance R_{eq} such that the same current exists through the R_{eq} when the same potential difference is applied across it. Then,

$$I = V\left(\frac{1}{R_{eq}}\right) \qquad (3)$$

From the equations (2) and (3) we can write,

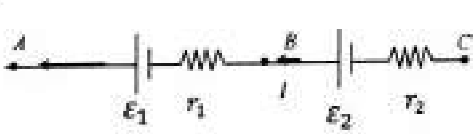
$$V\left(\frac{1}{R_{eq}}\right) = V\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$

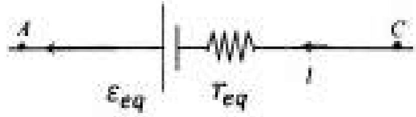
Or,

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

70) Obtain the expression for equivalent emf and equivalent internal resistance of two cells connected in series.

Ans:





Consider two cells of emfs $\mathcal{E}_1$ and $\mathcal{E}_2$ and internal resistances r_1 and r_2 connected in series.

The potential difference across the first cell, $V_{AB} = \mathcal{E}_1 - Ir_1$

The potential difference across the second cell, $V_{BC} = \mathcal{E}_2 - Ir_2$

Now, potential difference between the points A and C is given by,

$$V_{AC} = \mathcal{E}_1 - Ir_1 + \mathcal{E}_2 - Ir_2$$

$$V_{AC} = \mathcal{E}_1 + \mathcal{E}_2) - I(r_1 + r_2) \qquad (1)$$

Let the combination be replaced by a single cell of emf $\mathcal{E}_{eq}$ and internal resistance r_{eq}, such that the same current exists through the combination. The potential difference between the points A and C, is also given by,

$$V_{AC} = \mathcal{E}_{eq} - I r_{eq} \qquad (2)$$

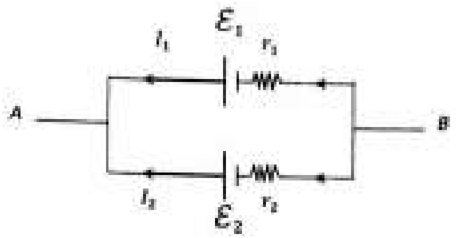
Therefore comparing equations (1) and (2) we get,

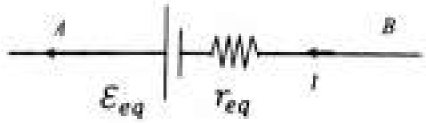
$$\mathcal{E}_{eq} = \mathcal{E}_1 + \mathcal{E}_2$$

$$r_{eq} = r_1 + r_2$$

71) Obtain the expression for equivalent emf and equivalent internal resistance of two cells connected in parallel.

Ans:





From the circuit diagram main current,

$$I = I_1 + I_2 \qquad (1)$$

Consider the first cell the potential difference across the points A and B is given by

$$V_{AB} = \mathcal{E}_1 - I_1 r_1 \qquad (2)$$

Consider the second cell the potential difference across the points A and B is given by

$$V_{AB} = \mathcal{E}_2 - I_2 r_2 \qquad (3)$$

From equations (1), (2) and (3) we can write,

$$I = I_1 + I_2$$

$$= \frac{\mathcal{E}_1 - V}{r_1} + \frac{\mathcal{E}_2 - V}{r_2}$$

$$= \left(\frac{\mathcal{E}_1}{r_1} + \frac{\mathcal{E}_2}{r_2}\right) - \left(\frac{V}{r_1} + \frac{V}{r_2}\right)$$

$$= \left(\frac{\mathcal{E}}{r_1} + \frac{\mathcal{E}_2}{r_2}\right) - V\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$$

$$= \left(\frac{\mathcal{E}_1 r_2 + \mathcal{E}_2 r_1}{r_1 r_2}\right) - V\left(\frac{r_1 + r_2}{r_1 r_2}\right)$$

Multiplying both sides by, $\left(\frac{r_1 r_2}{r_1 + r_2}\right)$ we get,

$$I\left(\frac{r_1 r_2}{r_1 + r_2}\right) = \left(\frac{\mathcal{E}_1 r_2 + \mathcal{E}_2 r_1}{r_1 r_2}\right)\left(\frac{r_1 r_2}{r_1 + r_2}\right) - V$$

$$V = \left(\frac{\mathcal{E}_1 r_2 + \mathcal{E} r_1}{r_1 + r_2}\right) - I\left(\frac{r_1 r_2}{r_1 + r_2}\right) \qquad (4)$$

Let the combination be replaced by a single cell of emf $\mathcal{E}_{eq}$ and internal resistance r_{eq} between A and B. Then the potential difference between A and B is given by,

$$V = \mathcal{E}_{eq} - I r_{eq} \qquad (5)$$

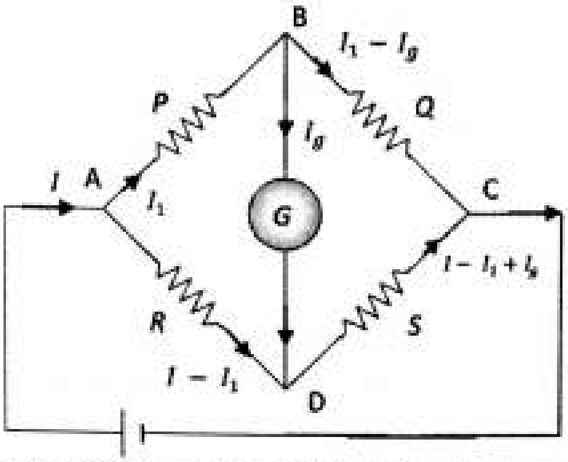
Comparing the equations (4) and (5) we get,

$$\mathcal{E}_{eq} = \frac{\mathcal{E}_1 r_2 + \mathcal{E}_2 r_1}{r_1 + r_2}$$

$$r_{eq} = \frac{r_1 r_2}{r_1 + r_2}$$

72) Obtain the condition for balanced Wheatstone's Network using Kirchhoff's rules.

Ans:



The currents through in different arms of Wheatstone bridge are marked. I_g is the current flowing through the galvanometer.

Kirchhoff's second rule to the loop ABDA,

$$-I_1 P - I_g G + (I - I_1)R = 0 \qquad (1)$$

Kirchhoff's second rule to the loop BCDB,

$$-(I_1 - I_g)Q + (I - I_1 + I_g)S + I_g G = 0 \qquad (2)$$

Now adjust the values of P, Q, R and S till the current through the galvanometer becomes zero. Now bridge is said to be balanced. When the bridge is balanced, $I_g = 0$. Equations (1) and (2) become,

$$I_1 P = (I - I_1)R \qquad (3)$$

$$I_1 Q = (I - I_1)S \qquad (4)$$

Dividing equation (3) by equation (4) we get,

$$\frac{P}{Q} = \frac{R}{S}$$

CHAPTER: 14 SEMICONDUCTORS

One Mark Questions and Answers

1) Name the three types of solids based on their conductivity.
   Ans: Metals, semiconductors and insulators.
2) What are energy bands?
   Ans: Different energy levels with continuous energy variation are called energy bands.
3) What is a valance band?
   Ans: The energy band which includes all the energy levels of valance electrons is called valance band.
4) What is a conduction band?
   Ans: The energy band above the valance band is called conduction band.
5) What is the effect of rise in temperature on the covalent bond of a semiconductor?
   Ans: Covalent bond breaks.
6) What is a hole?
   Ans: The vacancy created in a covalent bond due to absence of an electron is called hole.
7) How does the intrinsic semiconductor behave at $T = 0$ K?
   Ans: As an insulator.
8) What is doping?
   Ans: The process of adding impurities into a pure semiconductor is called doping.
9) What are extrinsic semiconductors/doped semiconductors?
   Ans: When an intrinsic/pure semiconductor is doped with a suitable tetra or pentavalent it becomes an extrinsic semiconductor.
10) Write the name of any one pentavalent doping element.
    Ans: As, Sb, P; (Arsenic, antimony, phosphorus) (any one)
11) Write the name of any one trivalent doping element.
    Ans: In, B, Al; (Indium, Boron, Aluminum) (any one)
12) What does the doping element cause in doped semiconductor?
    Ans: It increases the conductivity of the doped substance.
13) How do you obtain the n- type of semiconductor?
    Ans: When an intrinsic semiconductor is doped with a pentavalent impurity then that extrinsic semiconductor is called n-type semiconductor.
14) What is a n-type semiconductor?
    Ans: It is an extrinsic semiconductor in which electrons are majority charge carriers.
15) How do you obtain the p- type of semiconductor?
    Ans: When an intrinsic semiconductor is doped with a trivalent impurity we obtain extrinsic semiconductor.
16) What is p-type semiconductor?
    Ans: It is an extrinsic semiconductor in which holes are majority charge carriers.
17) What is p-n junction?
    Ans: It is boundary between p-type and n-type semiconductors.
18) What is depletion region?
    Ans: The small region on both sides of the p-n junction which is depleted of charge carriers is called depletion region.
19) What is potential barrier?
    Ans: It is that potential difference across the junction.

20) What is semiconductor diode?

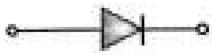
Ans: Semiconductor diode is a p-n junction diode.

21) How many terminals a diode has?

Ans: Two

22) Draw the circuit symbol of diode?

Ans:



23) What is forward biasing of a diode?

Ans: A bias in which p-type is connected to positive terminal and n-type is connected to negative terminal of a battery.

24) How does the width of depletion of a p-n junction change when it is forward biased?

Ans: Depletion region decreases.

25) How does the width of depletion of a p-n junction change when it is reversed biased?

Ans: Depletion layer increases.

26) What is reverse bias of diode?

Ans: The biasing in which p-type is connected to negative terminal and n-type is connected to positive terminal of battery.

27) What is rectifier?

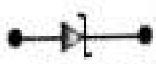
Ans: Rectifier is an electric device which converts AC to DC.

28) What is Zener diode?

Ans: A properly doped junction diode which has sharp reverse breakdown voltage is a Zener diode.

29) Draw the symbol of Zener diode.

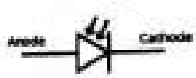
Ans:



30) What is a photodiode?

Ans: Photodiode is a semiconductor diode which responses to light signals.

31) Draw the circuit symbol of the photodiode.

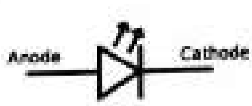
Ans: 

32) What is LED?

Ans: LED is a semiconductor diode which emits visible light when forward biased.

33) What is the circuit symbol of LED?

Ans:



34) What is solar cell?

Ans: Solar cell is a semiconductor diode which generates emf when radiation falls on p-n junction.

35) What is transistor?

Ans: Junction transistor is a three terminals and two junctional semiconductor device.

36) Write the three layers of transistors in the ascending order of their doping

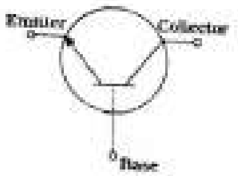
Ans: Base, Collector, Emitter

37) Write the three layers of a transistor in the ascending order of their size

Ans: Base, Emitter, Collector

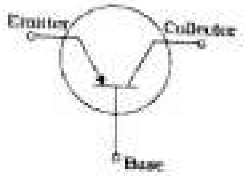
38) Draw the circuit symbol of n-p-n transistor.

Ans:



39) Draw the circuit symbol of p-n-p transistor.

Ans:



40) When do we say that transistor is in active state?

Ans: When emitter-base junction is forward biased and collector-base junction is reverse biased.

41) Define current gain of a transistor.

Ans: It is the ratio of collector current to base current.

42) Mention the equation for voltage gain of the CE amplifier.

Ans: $A_v = -\beta_{ac}\left(\frac{R_C}{R_B}\right)$

43) What is positive feedback?

Ans: The portion of the output power is returned to the input in phase with the starting phase is termed as positive feedback.

44) What are logic gates?

Ans: Logic gates are digital circuits which work according to some digital relationships between input and output voltages.

Two Mark Questions and Answers

1) What are intrinsic semiconductors? give an example

Ans: Pure semiconductors are called intrinsic semiconductors. E.g., Pure Ge or pure Si

2) .What are extrinsic semiconductors? Give an example.

Ans: The doped semiconductors are called extrinsic semiconductors E.g.. n-type of semiconductor or p-type of semiconductor.

3) Mention any two ways of increasing the conductivity of semiconductors.

Ans: a) By adding suitable impurity.

b) By increasing the temperature.

4) Write majority and minority charge carriers in n-type of semiconductors.

Ans: Majority charge carriers are electrons.

Minority charge carriers are holes.

5) Name the two types of dopants in semiconductors.

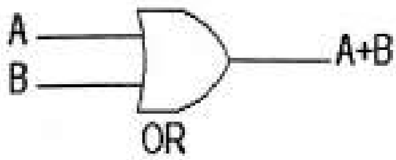
Ans: Trivalent and Pentavalent

6) Write two types of biasing of a semiconductor diode.

Ans: Forward and reverse

7) Write the circuit symbol and truth table for OR logic gate.

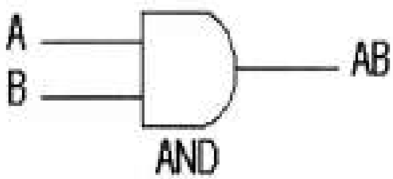
Ans:



2 Input OR gate		
A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

8) Write the circuit symbol and truth table for AND logic gate.

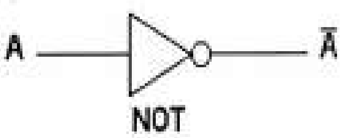
Ans:



2 Input AND gate		
A	B	A.B
0	0	0
0	1	0
1	0	0
1	1	1

9) Write the circuit symbol and truth table for NOT logic gate.

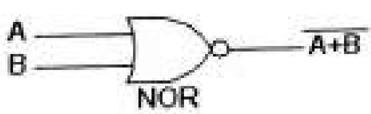
Ans:



NOT gate	
A	$\bar{A}$
0	1
1	0

10) Write the circuit symbol and truth table for NOR logic gate.

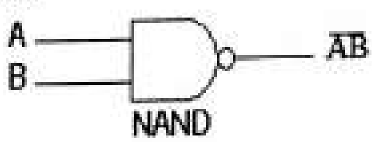
Ans:



2 Input NOR gate		
A	B	$\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

11) Write the circuit symbol and truth table for NAND logic gate.

Ans:

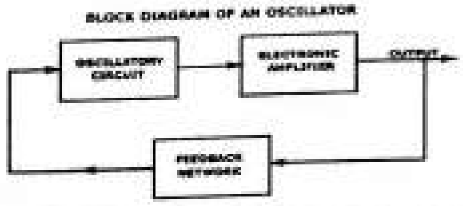


2 Input NAND gate		
A	B	$\overline{A.B}$
0	0	1
0	1	1
1	0	1
1	1	0

12) Draw a neat and labelled block diagram of transistor as an oscillator.

Ans:

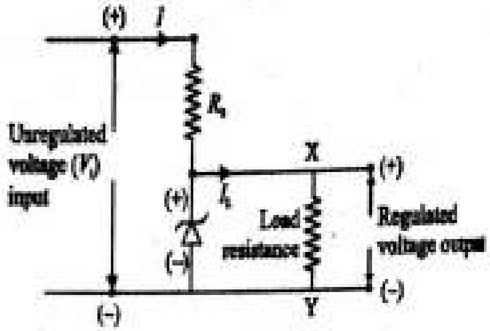
BLOCK DIAGRAM OF AN OSCILLATOR



Three Marks Questions and Answers

13) With circuit diagram explain the working of Zener diode as voltage regulator.

Ans:



When the input voltage increases the current through R_S and current through the zener diode increases. Which increases the voltage drop across R_S and without any change in voltage across the zener diode, because when the voltage across Zener diode is equal to break down voltage of the diode, the Zener voltage remains constant even though the current through the Zener diode increases

If the input voltage decreased the current through the R_S and also current through the Zener diode decreases which results in drop of voltage across resistance R_S but voltage across Zener diode does not vary.

Thus any increase or decrease in input voltage results in the increase or decrease in the voltage drop across the resistance R_S but voltage across Zener diode remains constant. Therefore a constant output across load R_L is obtained. Therefore Zener diode acts as voltage regulator.

14) Name three optoelectronic devices.

Ans: Light emitting diode, photo diode and solar cells.

15) Write three uses of photo diode

Ans:

a) Reading of film sound tracks.
b) Used as remote controls in T.V., A.C.'s
c) Light operating switches.

16) Write three uses of LED.

Ans: (any three)

a) Used in alarm system.
b) Counting system
c) Optical communication
d) Traffic light
e) Calculators.

17) Write three uses of solar cell.

Ans:

a) Used in charging the batteries in satellites.
b) Wrist watches and calculators.
c) Used to supply power to traffic signals.

18) Distinguish between half wave and full wave rectifier.

Ans:

	Half wave rectifier	Full wave rectifier
1)	It converts half cycle of AC signal into DC.	It converts full cycle of AC signal into DC.
2)	One diode is used.	Two diodes are used.
3)	Output current is unidirectional.	Output current is bidirectional.

19) Write the three applications of a transistor.

Ans: It can be used as

a) as an amplifier

b) as an oscillator

c) as a switch.

20) Write the three configurations of a transistor.

Ans:

a) Common base

b) common collector

c) common emitter

21) Name three logic gates.

Ans:

a) OR gate

b) AND gate

c) NAND gate.

Five Marks Questions and Answers

22) Distinguish between intrinsic and extrinsic semiconductors.

Ans:

	Intrinsic semiconductor	Extrinsic semiconductor
1)	Pure form of semiconductors.	Impure form of semiconductors.
2)	The positive charge and negative charge carriers are equal.	Electrons are the majority charge carriers in n-type and holes are the majority charge carriers in p-type material.
3)	Electrical conductivity is low.	Electrical conductivity is high.
4)	Conductivity is temperature dependent.	Conductivity is temperature and amount of impurity dependent.
5)	There is no doping process.	There is doping process.
6)	No practical use.	Used in electronic devices.

23) Distinguish between n type and p type semiconductors.

Ans:

	n – type	p - type
1)	Pentavalent impurity is present	Trivalent impurity is present.
2)	Electrons are the majority charge carriers.	Holes are the majority charge carriers.
3)	Holes are the minority charge carriers.	Electrons are the minority charge carriers.
4)	Current is due to electrons.	Current is due to holes.
5)	Donor levels is just below the bottom of conduction band.	Acceptor level is just above the valence band.

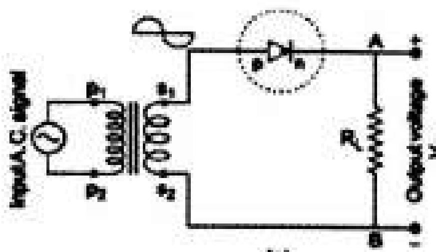
24) Distinguish between forward and reverse biased of semiconductor diode.

Ans:

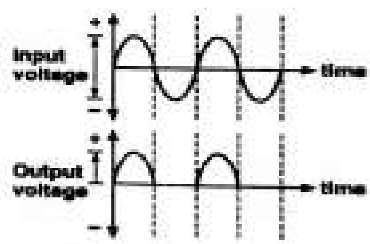
	Forward bias	Reverse bias
1)	Width of the barrier potential decreases.	Width of barrier potential increases.
2)	Offers minimum resistance.	Offers maximum resistance.
3)	Diode conducts the current	Diode does not conduct
4)	Current is due to majority charge carriers	Current is due to minority charge carriers

25) What is half wave rectifier? Explain the working of half waver rectifier with neat labelled diagram and draw the input and output wave forms.

Ans:



(a)

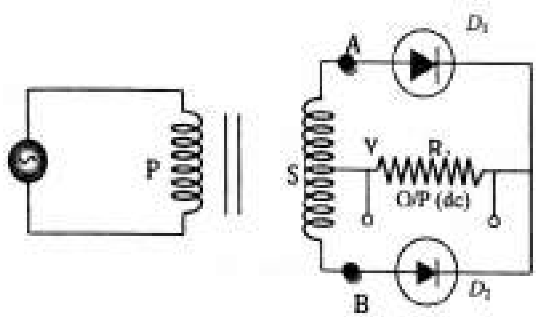


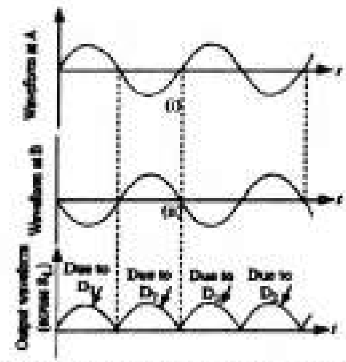
Half wave rectifier is an electronic circuit, during the positive half of the cycle, diode conducts the current and during negative half cycle diode the same does not conduct the current.

Working:

1) During positive half the cycle of AC input signal the secondary terminal S_1 of transformer be positive. Then the junction diode is forward biased. Therefore the current flows in load resistance R_L from A to B.
2) In the next half cycle the terminal S_1 is negative therefore the diode is reverse biased. Hence no current flows in the diode therefore there is no potential difference across load R_L.
3) Thus a p-n junction diode acts as a half wave rectifier.
4) The Fig. 2. shows the input and output wave forms of a half wave rectifier.

26) What is full wave rectifier? Explain the working of full wave rectifier with neat labelled diagram and draw the input and output wave forms.





Full wave rectifier is an electronic circuit, during the positive cycle, one diode conducts the current and during negative cycle other diode conducts the current in the same direction.

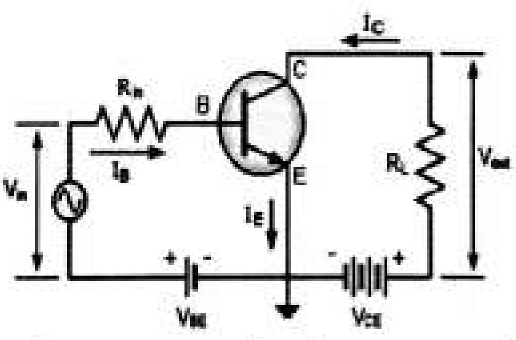
Suppose during the first half of the cycle of input AC signal the terminal A is at positive relative to S and B is negative relative to S, then diode D_1 is forward biased and diode D_2 is reverse biased. Therefore current exists in diode D_1 but not in diode D_2. The direction of current through the diode D_1 and through the load resistance R_L is from X to Y.

In the next half cycle, the terminal A is at negative relative to S and B is positive relative to S. Then diode D_1 is reverse biased and diode D_2 is forward biased. Therefore current exists in the diode D_2 and there is no current through the diode D_1. The direction of current through the diode D_2 and through the load resistance is again from X to Y.

Thus for input AC signal the output current is a continuous series of unidirectional pulses.

27) What is an amplifier? Explain the working of n-p-n transistor as an amplifier in CE mode.

Ans:



An amplifier circuit consists an n-p-n transistor in common emitter configuration. Let I_E, I_B and I_C be the currents through the emitter, base and collector respectively.

In the absence of input signal, according to Kirchhoff's law,

$$I_E = I_B + I_C \qquad (1)$$

Let V_{CE} be the voltage across emitter-collector junction and $(I_C R_L)$ be the voltage across the load R_L.

$$V_{CC} = V_{CE} + I_C R_L$$

$$V_{CE} = V_{CC} - I_C . R_L \qquad (2)$$

During the positive half cycle the base will be more positive and hence emitter current increases. This will increases the collector current and collector current produces more voltage across load resistance R_L.

From equation (2) when $I_C R_L$ increases and V_{CE} becomes more negative and hence an output signal is amplified but out of phase.

During the negative half cycle the base becomes more negative and emitter current decreases consequently, collector current decreases hence $I_C R_L$ decreases but V_{CE} increases i.e. output signal amplified but in phase.

CHAPTER – 15 COMMUNICATION SYSTEMS

One mark Questions and Answers

1) What is meant by Communication?
   Ans: Communication is the process by which information is transferred faithfully from one point (source) to another (destination) in an intelligible form.
2) What is meant by Bandwidth of transmission medium?
   Ans: It is the frequency range with in which a transmission is made.
3) What is the frequency range of audio waves?
   Ans: 20 Hz to 20 kHz
4) What is the function of demodulator?
   Ans: To recover the original modulating signal.
5) What is a carrier wave?
   Ans: It is a high frequency wave which carries the information or signal.
6) What is a ground wave?
   Ans: The radio waves propagating from one place to another on the Earth's surface are called ground waves.
7) What should be the length of the dipole antenna for a carrier wave of wavelength λ?
   Ans: The size of the dipole antenna should be $1/4^{th}$ of the wavelength.
8) What is a space wave?
   Ans: Radio waves having high frequencies are called as space waves.
9) What type of modulation is required for radio broadcast?
10) **Ans:** Amplitude modulation.
11) What is a range in a communication system?
    Ans: It is the largest distance between the source and the destination up to which the signal is received with sufficient strength.
12) Which layer of atmosphere reflects Radio waves back to Earth?
    Ans: Ionosphere.
13) What is meant by Attenuation?
    Ans: Its loss of strength of a signal during its propagation.
14) What is a repeater in communication system?
    Ans: It is device used to extend the range of communication.
15) What is noise in a communication System?
    Ans: The unwanted signal is called noise.
16) What is meant by amplification of a signal?
    Ans: It is the process of raising the strength of a signal.
17) Define line-of-sight (LOS) Communication.

Ans: It is a communication of signal from transmitter to receiver along a straight line.

18) What is modulation?

Ans: It is a process of mixing the message signal with carrier wave.

19) What is demodulation?

Ans: It is the process of separating the message signal from the carrier wave.

20) What bandwidth is required by video signals for transmission of pictures?

Ans: 4.2 MHz.

21) What bandwidth is required for TV transmission?

Ans: 6 MHz.

22) Define amplitude modulation.

Ans: It is the process in which the amplitude of the carrier wave changes in accordance with the amplitude of base band signal.

Two or Three Marks Questions and Answers

23) What are the three main units of a Communication System?

Ans:

a) Transmitter
b) Transmission channel
c) Receiver

24) What are the different types of Communication?

Ans: a) Point-to-point Communication and b) Broadcast.

25) What is a transducer? Give an example.

Ans: It is a device which converts one form of energy into another. E.g., A microphone, speaker etc.

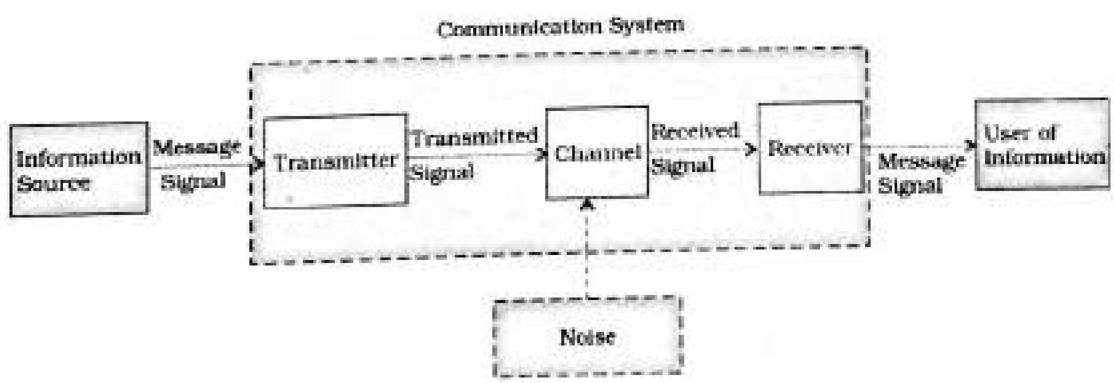
26) Mention three different modes of propagation of electromagnetic waves.

Ans:

a) Ground wave propagation
b) Sky wave propagation
c) Space wave propagation.

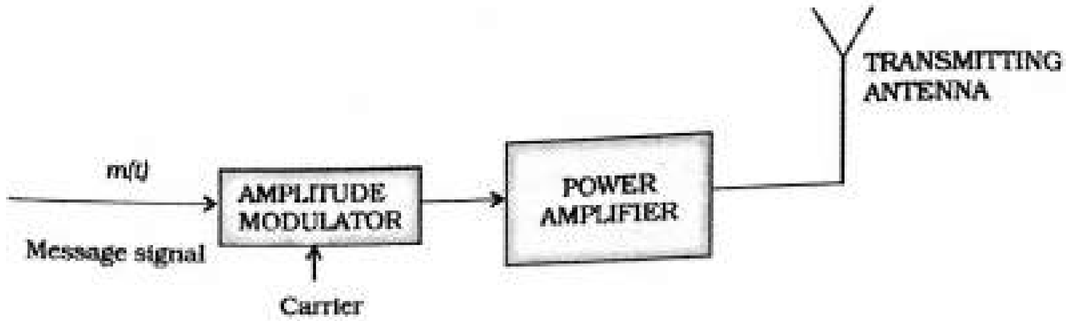
27) Draw the block diagram of generalized communication system.

Ans:



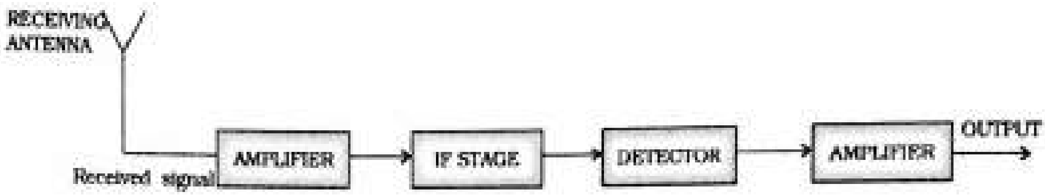
28) Draw the block diagram of Transmission of Amplitude Modulated Signal.

Ans:



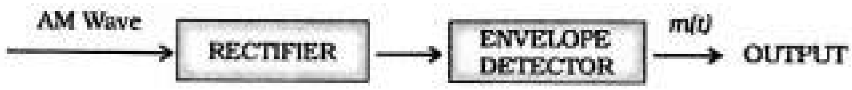
29) Draw the block diagram of A.M. Receiver.

Ans:



30) Draw the block diagram for AM signal detector.

Ans:



31) Write the three needs for modulation in communication.

Ans: a) Size of an antenna or aerial:

b) Effective power radiated by an antenna:

c) Mixing up of signals from different transmitter:

Miscellaneous Questions From Other Chapters

Chapter 3: Current electricity

1) Derive an expression $\sigma = \frac{ne^2\tau}{m}$ where the symbols have their usual meanings.

Chapter 4: Moving Charges and Magnetism

1) Derive the expression for the magnetic field at a point on the axis of a circular coil carrying current. [Mar-14, Mar-15, Mar-17]
2) Deduce the force between two parallel current carrying conductors. hence define ampere. [Mar-2016]
3) Derive the expression for torque acting on a rectangular current loop placed in a uniform magnetic field.
4) What is moving coil galvanometer? Give the theory of moving coil galvanometer.

Chapter 5: Magnetism and Matter

1) Write the properties of magnetic field lines.
2) Show that current carrying solenoid behave as a magnet. [Jul-2017]
3) Derive the expression for period of oscillation of a magnetic dipole placed in a uniform magnetic field.
4) Explain hysteresis loop with neat graph.
5) Write any five differences between the diamagnetic and paramagnetic substances.
6) Write any five differences between the paramagnetic and ferromagnetic substances.
7) Write a note on terrestrial magnetism.
8) Write the five properties of ferromagnetic materials [Mar-2017]

Chapter 6: Electromagnetic Induction

1) Deduce the expression for mutual inductance between the pair of cylindrical coils.
2) Deduce the expression for self-induction of a cylindrical coil.
3) Derive an expression for magnetic potential energy stored in a self-inductor.
4) Describe the essential parts of AC generator with a labelled diagram.
5) Derive the expression for an emf induced in AC generator.

Chapter 7: Alternating Current

1) Deduce the expression for current in a series LCR circuit by phasor diagram method.
2) Define Q-factor of series LCR circuit. Derive the expression for Q-factor.

Chapter 9: Ray Optics and Optical Instruments

1) Derive mirror equation
2) Obtain the relation between n, u, v and R for a spherical refracting surface.
3) Derive Lens makers formula. [Jul-2015, Jul-2016, Mar-2017, Jul-2017]
4) Obtain the expression for the equivalent focal length in case of combination of two thin lenses in contact.
5) Derive prism formula.

Chapter 10: Wave Optics.

1) Using Huygens wave theory of light, derive Snell's law of refraction.
2) Give the theory of interference. Hence arrive at the conditions for constructive and destructive interferences.
3) Explain the phenomenon of diffraction of light due to a single slit and mention the condition for diffraction minima and maxima.

4) Show that fringes are of equal width in interference pattern.
5) Derive the expression for fringe width of interference bands in Young's double slit experiment [Mar-14]
6) Distinguish between interference and diffraction.
7) State Brewster's law. Show that the reflected ray and refracted ray are perpendicular to each other at polarizing angle.

Chapter 11: Dual Nature of Radiation and Matter.

1) Write the laws of photoelectric effect [Mar-16]
2) Describe the experimental study of photoelectric effect with a neat diagram.
3) write Einstein's equation of photoelectric effect. Give Einstein's explanation of photoelectric effect. [Mar-15]

Chapter 12: Atoms

1) Write the three postulates of Bohr. Mention two limitations of Bohr model. [Mar-14]
2) 5 14, Jul-15]
3) Give an account on the spectral series of hydrogen atom.
4) The first member of Balmer series is 6563 Å. Calculate the second member of Balmer series. [Mar-17]

Chapter 13: Nuclei

1) Write a note on properties of nucleus.
2) Write a note on nuclear forces.
3) Give the salient features of binding energy curve.
4) Distinguish between the nuclear fission and fusion.
5) Calculate the binding energy and binding energy per nucleon in MeV for carbon-12 nucleus. Given that mas of the proton is 1.00727 u while the mass of the neutron is 1.00866 u
6) State radioactive decay law. Deduce expression $N = N_0 e^{-\lambda t}$ for radioactive element.[Mar-2017]
7) Calculate the binding energy and binding energy per nucleon in MeV of a nitrogen nucleus, $^{14}_{7}N$ from the following data, mass of the proton 1.00783 u, mass of neutron 1.00867 u and mass of the nitrogen nucleus, 14.00307 u. [Mar-2014]
8) Determine the mass of Na^{22} which has an activity of 5 mCi. Half-life of $Na^{22}$is 2.6 years, Avogadro number is 6.023×10^{23} [Mar-2015]
9) Calculate half-life and mean-life of radium-226 of activity 1 Ci. Given mass of radium-226 is 1 gram and 226 gram consists of 6.023×10^{23} atoms. [Jul-2015]

Chapter 14: Semiconductors

1) Explain the formation of energy bands in solids. On the basis of energy bands distinguish between metals, semiconductors and insulators.

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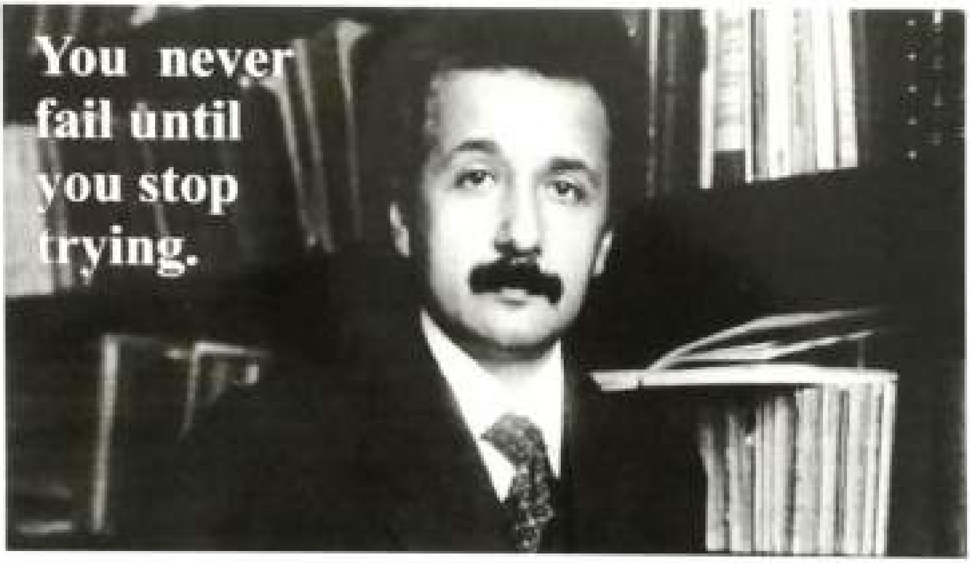

- Albert Einstein

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