1. Define electrostatics.
The study of charges at rest is called electrostatics or static electricity.

***2. How electric charge is produce?**
Electric charge is defined as a physical quantity which is produce by rubbing a neutral body with another neutral body. For example, combing hair creates a charge on the comb.

3. Define charge and also write its types.
Charge is a basic property of a material body due to which it attracts or repels another object. There are two types of charges.

(i) Positive charge
(ii) Negative charge

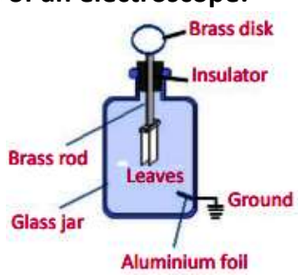
***4. Describe the characteristics of charges.**
(i) Charge is a basic property of a material body due to which it attracts or repels another object.
(ii) Friction produces two different types of charge on different materials (such as glass and plastic).
(iii) Like charges always repel each other.
(iv) Unlike charges always attract each other.
(v) Repulsion is the sure test of charge on a body.

****5. Define electrostatic induction.** ***(ALP)***
Whenever a charged body is brought close to an insulated conductor, the near end of conductor develops an unlike charge while the far end of conductor develops a like charge. This separation of charge is called electrostatic induction.

****6. What is gold leaf electroscope? Also write working principle of electroscope.**
The gold leaf electroscope is a sensitive instrument for detecting charges, identification of charges and identification of insulator and conductor.

Working principle: When a charged body is brought close to the disk, the gold leaves will show divergence. When a neutral body brought close to the disk, the leaves will not show any divergence.

7. Describe the construction of an electroscope.
Electroscope consists of a brass rod with a brass disk at the top and two thin leaves of gold foil hanging at the bottom. The rod passes through an insulator that keeps the rod in place.



Charges can move freely from the disk to the leaves through the rod. A thin aluminium foil is attached on the lower portion of the inside of the jar. Usually, the aluminium foil is grounded by connecting a copper wire. This protects the leaves from the external electrical disturbances.

8. How can we identify conductors and insulators with help of electroscope?
Electroscope can also be used to distinguish between insulators and conductors. Touch the disk of a charged electroscope with material under test. If the leaves collapse from their diverged position, the body would be a good conductor. If there is no change in the divergence of the leaves, it will show that the body under test is an insulator.

9. What is meant by point charge?** ***(ALP)
Charges are said to be point charges point charges if their sizes are very small as compared to the distance between them. **OR**

An electric charge which for convenience in mathematical discussion is regarded as concentrated in a single point in space.

****10. Define Coulomb's law.** ***(ALP)***
Coulomb's law states that the force of attraction or repulsion between two charged bodies is directly proportional to the product of the magnitude of charges and inversely proportional to the square of the distance between them. Mathematically, it is given by

$$F = k\frac{q_1 q_2}{r^2}$$

If the medium between the two charges is air, then the he value of k in SI units will be $9 \times 10^9\ Nm^2C^{-2}$.

11. What will happen to Coulomb's force, if the distance between two point charges become double? ***(ALP)***
According to Coulomb's law

$$F = k\frac{q_1 q_2}{r^2}$$

When $r = 2r$, then

$$F' = k\frac{q_1 q_2}{(2r)^2}$$
$$F' = k\frac{q_1 q_2}{4r^2}$$
$$F' = \frac{1}{4}\left(k\frac{q_1 q_2}{r^2}\right)$$
$$F' = \frac{1}{4}(F)$$

Thus, if the distance between two point charges is doubled, the Coulomb's force between them reduced to one forth.

****12. Define electric field. Also write its unit.** ***(ALP)***
The electric field is a region around a charge in which it exerts electrostatic force on another charges.
SI Unit: Electric field has no unit.

****13. Define electric field intensity. Also write its unit.** ***(ALP)***

The strength of an electric field at any point in space is known as electric field intensity. **OR**

The electric field intensity at any point is defined as the force acting on a unit positive charge placed at that point. It is denoted by E.

$$E = \frac{F}{q_o}$$

It is a vector quantity.

SI Unit: SI unit of electric field intensity is NC^{-1}.

14. Is electric field intensity vector quantity? Also describe its direction.** ***(ALP)

Electric intensity being a force is a vector quantity. Its direction is the same as that of the force acting on the positive test charge. If the test charge is free to move, it will always move in the direction of electric intensity.

****15. What are the electric field lines? Also write characteristics of these lines.** ***(ALP)***

The direction of electric field intensity in an electric field can also be represented by drawing lines. These lines are known as electric lines of force.

Characteristics:

(i) The electric field lines are imaginary lines.

(ii) Field lines always directed from positive charge are towards negative charge.

(iii) Electric field is strong when the field lines are close to each other and weak when the lines are far apart.

(iv) Electric field lines never cross each other.

****16. Define electrostatic potential. Also write its formula and SI unit.** ***(ALP)***

Electric potential at a point in an electric field is equal to the amount of work done in bringing a unit positive charge from infinity to that point.

$$V = \frac{W}{q}$$

Electric potential is a scalar quantity.

SI Unit: SI unit of electric potential is $volt$ which is equal to JC^{-1}.

****17. Define volt.** ***(ALP)***

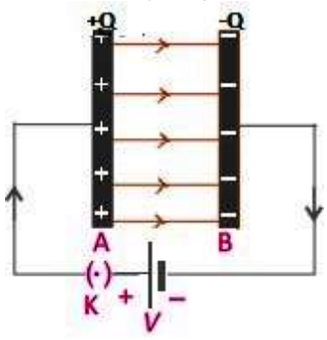
If one joule of work is done against the electric field in bringing one coulomb positive charge from infinity to a point in the electric field, then the potential at that point will be one volt.

$$1\,V = 1JC^{-1}$$

18. Define potential difference also tell its SI unit.** ***(ALP)

The energy supplied by a unit charge as it moves from one point to the other in the direction of the field is called potential difference between two points.

****19. Define capacitor and dielectric?** ***(ALP)***



Capacitor: It is a device used to store electric charge.

Constriction: Capacitor consists of two thin metal plates, parallel to each other separated by a very small distance. The medium between the two plates is air or a sheet of some insulator. This medium is known as dielectric. It works on principal of electrostatic induction.

Dielectric: The medium between the two plates of a capacitor is called dielectric. It may be air or sheet of some insulator.

20. How does capacitor store a charge?** ***(ALP)

If a capacitor is connected to a battery of V volts, then the battery transfers a charge +Q from plate B to plate A, so that -Q charge appears on plate B and +Q charge appears on plate A.

The charges on each plate attract each other and thus remained bound within the plates.

In this way, charge is stored in a capacitor for a long time. Also, the charge Q stored on plates is directly proportional to the potential difference V across the plates i.e.,

$$Q \propto V$$
$$Q = CV$$

****21. What do you mean by the capacitance of a capacitor? Define units of capacitance.** ***(ALP)***

Capacitance: Capacitance of the capacitor and is defined as the ability of the capacitor to store charge. It is given by the ratio of charge and the electric potential as:

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

Units of Capacitance: SI unit of capacitance is farad (F), defined as:

Farad: If one coulomb of charge given to the plates of a capacitor produces a potential difference of one volt between the plates of the capacitor, then its capacitance would be one farad.

Note: Farad is a large unit, usually, we use a smaller unit such as micro farad (μF), nano farad (nF) and pico farad (pF) etc.

22. Write the formulas of equivalent capacitance of parallel and series combination of capacitors.

Equivalent Capacitance for Parallel Combination:

$$C_{eq} = C_1 + C_2 + C_3 + \cdots + C_n$$

Equivalent Capacitance for Series Combination:

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \cdots + \frac{1}{C_n}$$

***23. Discuss different types of capacitors.**

Capacitors are generally of two types:

(i) Fixed Capacitors

(ii) Variable Capacitors

(i) Fixed Capacitors: If the plates of capacitor are immovable then such a capacitors are called fixed capacitors. Fixed capacitors are further types:

(a) Parallel plate capacitors (b) Paper capacitor (c) Mica capacitor (d) Electrolytic capacitor

(ii) Variable Capacitors: In variable type of capacitors, the value of capacitance can be increased or decreased. In the capacitors some arrangement is made to change the area of the plates facing each other. It is generally a combination of many capacitors with air as dielectric.

24. What is meant by electrolytic, mica, paper, radio and parallel plate capacitors?

Electrolytic Capacitor: An electrolytic capacitor is often used to store large amount of charge at relatively low voltages.

Mica Capacitor: It is another example of fixed capacitors. In these capacitors, mica is used as dielectric between the two metal plates.

Paper Capacitors: Paper capacitor is an example of fixed capacitors. The paper capacitor has a cylindrical shape. Usually, an oiled or greased paper or a thin plastic sheet is used as a dielectric between two aluminium foils.

Radio Capacitor: It is generally a combination of many capacitors with air as dielectric. It consists of two sets of plates. One set remains fixed while the other set can rotate so the distance between the plates does not change and they do not touch each other.

Parallel Plate Capacitors: A parallel plate capacitor has a dielectric between its plates and is made of a flexible material that can be rolled into the shape of a cylinder.

25. Enlist some uses of capacitors. *(ALP)*

Capacitors have wide range of applications in different fields.

(i) Capacitors are used in different electrical and electronic circuits. For example, they are used for tuning transmitters, receivers and transistor radios.

(ii) Capacitors are also used for table fans, ceiling fans, exhaust fans, fan motors in air conditioners, coolers, motors washing machines, air conditioners and many other appliances for their smooth working.

(iii) Capacitors are also used in electronic circuits of computers etc.

***26. What is meant by filter circuit?** *(ALP)*

Capacitors are used in the resonant circuits that tune radios to particular frequencies. Such circuits are called **filter circuits**.

27. Write the uses of electrostatics.

Static electricity has an important place in our everyday lives which include photocopying, car painting, extracting dust from dirty carpets and from chimneys of industrial machinery etc.

***28. What are the hazards of static electricity?**

Hazards of static electricity are

(i) Lightning

(ii) Fires or explosions

Lightning: The phenomenon of lightning occurs due to a large quantity of electric charge which builds up in the heavy thunderclouds.

Fires or explosions: Static electricity can spark a fire or explosions.

***29. Write a brief note on electrostatic air cleaner?**

An electrostatic air cleaner is used in homes to relieve the discomfort of allergy sufferers (الرجی کا شکار).

30. What are the factors which effect the ability of capacitor to store a charge?

Three factors affect the ability of a capacitor to store charge.

(i) Area of the plates

(ii) Distance between the plates

(iii) Type of insulator used between the plates.

31. How much negative charge has been removed from a positively charged electroscope, if it has a charge of $7.5 \times 10^{-11}\ C$?

$$Charge = q = 7.5 \times 10^{-11} C$$
$$Charge\ on\ one\ electron = e = 1.6 \times 10^{-19} C$$
$$No.\ of\ electrons\ removed = n = ?$$

We know that

$$q = ne$$
$$n = \frac{q}{e}$$
$$n = \frac{7.5 \times 10^{-11}}{1.6 \times 10^{-19}}$$
$$n = 4.7 \times 10^{8}$$

Important Long Questions

(1) How nature of charge can be detected using electroscope.

(2) State and explain Coulomb's law.

(3) How does a capacitor work?

(4) Explain the parallel combination of capacitors with the help of circuit diagram.

(5) Describe characteristics of series combination of capacitors.
(6) Write a note on different types of capacitors.
(7) Write uses of capacitors.
(8) Explain relation between electric field lines and electric intensity.
(9) Explain application of static electricity and hazard of static electricity.