Prof Vidya Sagar (Department of physics)
B. Sc (Part - II) (Hons)

Electric potential and Electric field:-

Electrostatic field:- The electric potential at a point in an electric field is defined to be numerically equal to work done by an external agent in moving a unit positive test charge from infinity to that point against the electrical force or field.

Thus if W is the work done in bringing a positive test charge q_0 from infinity to a point, then the potential V at that point is

$$V = \frac{W}{q_0} \qquad \text{—— (1)}$$

If W is in Joules, q_0 in Coulombs then V is in volts.

$$\therefore 1\,\text{volt} = \frac{1\,\text{Joule}}{1\,\text{Coulomb}}$$

$$\therefore 1V = 1\,J/C$$

V is positive near an isolated positive charge, and negative near an isolated negative charge.

Since both w and q_0 are scalar quantities, the potential v is scalar. The work done in moving a unit positive test charge from one point to other is called the potential difference between the two points. Thus the potential difference between two points A and B is defined as

$$V_B - V_A = \frac{W_{AB}}{q_0}$$

Electric field :— The space surrounding a charged body in which an electric charge experiences a force is called an electric field.

The electric intensity at a point in an electric field is numerically equal to the force experienced by a unit positive charge placed at that point. It is assumed that the unit charge does not affect the field. The electric intensity is a vector quantity and its direction is the same as that of the force experienced by the unit charge.

If a positive test charge q_0 experiences a force $\vec{F}$ at a point in an electric field, then the electric intensity $\vec{E}$ at the point is given by

$$E = \frac{\vec{F}}{q_0}$$

This unit of $\vec{E}$ is Newton per Callomb