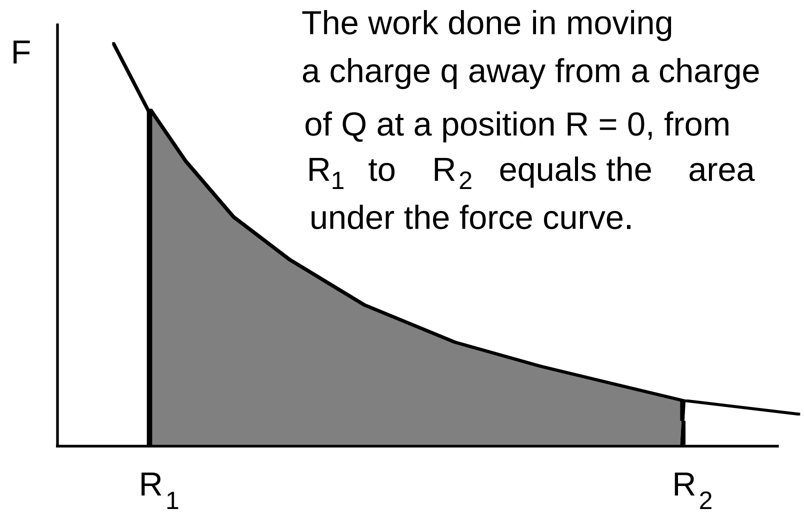
Electrical Potential Energy : Notes-5

It requires energy to separate two opposite charges. The attractive (coulomb) force can be represented by the curve below. The situation is similar to the work required to separate two bodies attracted by the force of gravity.



Using the calculus, the area under the curve (work) is given by the formula:

$$\text{Work} = kQq\left[\frac{1}{R_2} - \frac{1}{R_1}\right]$$

In the above formula, Q is positive and q is negative. Since work equals the change in the electric potential energy, we have: Work = ΔEPE = EPE_2 - EPE_1, we define the electrical potential energy for the charge q as:

$$E.P.E. = \frac{kQq}{R}$$

The sign of the electrical potential energy can be positive or negative depending on the sign of Q and q. A negative potential energy means that there is an attractive force. A positive potential energy means that there is a repulsive force.

We define the **electrical potential** (**V**) near a charge Q, as being equal to the electrical potential energy per coulomb.

$$V = \frac{kQ}{R}$$

The electrical potential is a scalar. It may be positive or negative. The total potential at a point is equal to the sum of the individual potentials due to various nearby charges, Q_1, Q_2, ... and so on.

The electrical potential energy of a charge q, in an electrical potential **V**, is given by:

$$E.P.E. = qV$$

The work done in moving a charge q equals the change in its electrical potential energy. Since W = ΔE.P.E. = $E.P.E._2$ - $E.P.E._1$, we have the formula:

$$Work = q(V_2 - V_1) = q\Delta V$$

In an electric field, there is a force on a charge. It may accelerate. The change in speed can be found using the formula below. If the external force is zero, then, for a small charge, the total energy is conserved, therefore:

$$EPE_1 + \frac{1}{2}mv_1^2 = EPE_2 + \frac{1}{2}mv_2^2$$