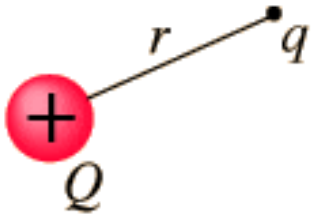
10.2 – Fields at work

Potential and potential energy

Electric potential
See previous section (electric potential and gravitational potential)

Electric potential energy
- The electric potential energy is given by:

$$U = \frac{kQq}{r}$$



were k is Coulomb's constant, Q is the fixed charge, q is the test charge, and r is the radius.

Electric potential energy can be defined as the capacity for doing work by a change in position of the positive test charge.

Gravitational potential
See previous section (electric potential and gravitational potential)

Gravitational potential energy

The gravitational potential energy of a system of two objects with mass M and m is given by…

$$U = -G\frac{m_1 m_2}{R}$$]

The gravitational potential energy of an object at a point P is equal to the work done required to take the object from infinity to the point P.

As gravitational forces are attractive, the work done required to bring an object from infinity to any point is negative. Thus, gravitational potential energy is always negative.

Gravitational potential gradient

- The gravitational potential gradient of a gravitational field is given by ΔV/Δr where ΔV is the change in gravitational potential between two points and Δr is the distance between those two points.
- It is the slope of a graph which plots the gravitational potential against the distance from the mass.
- Gravitational potential gradient is related to the gravitational field strength (g) by……

$$g = -\Delta V/\Delta r = GM/r^2$$

Electrical Potential difference

- The potential difference is defined as the work done per unit charge, when moving a positive test charge from one point to another in an electric field.

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

- Potential difference across an electrical component is required to make a current flow through it. Cells or batteries provide the potential difference required.