

10.2 – Fields at work

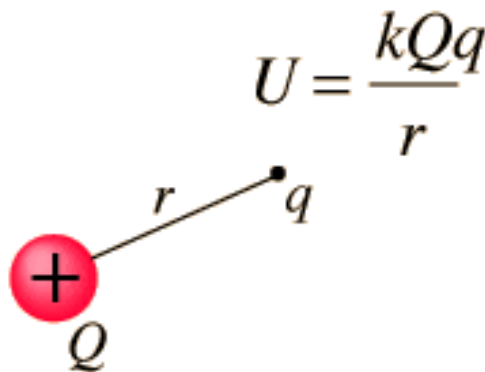
Potential and potential energy

Electric potential

See previous section (electric potential and gravitational potential)

Electric potential energy

- The electric potential energy is given by:



The diagram illustrates the concept of electric potential energy. It features a large red circle on the left containing a black plus sign, representing a fixed positive charge labeled Q . A line segment extends from this circle to a smaller black dot on the right, representing a test charge labeled q . The line segment is labeled with the variable r , indicating the distance between the two charges. Above the diagram, the formula for electric potential energy is given as $U = \frac{kQq}{r}$.

where 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 $\Delta V/\Delta r$ 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.