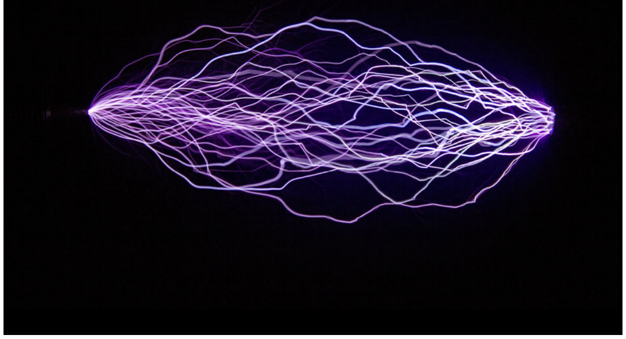
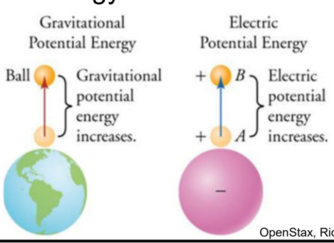
# Electric Potential Energy



- Gravitational potential energy is the work that a mass can potentially do by virtue of its position in a gravitational field.
- Similarly, by virtue of its position in an electric field, a charge has an electric potential energy.






- The change in electric potential energy is the work done by the electric field to move a charge $q$ from an initial position $x_i$ to a final position $x_f$.

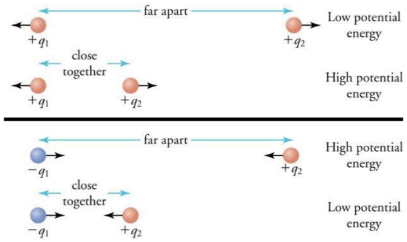
$$\Delta E_e = W = Fd$$

- Force is due to a constant electric field is $F = qE$.
- Substituting into the equation for work gives

$$\boxed{\Delta E_e = qE\Delta d}$$

- If the electric field is not constant, then the electric potential energy is given by

$$E_e = \frac{kq_1q_2}{r}$$

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# Electric Potential


gomolach (Adobe Stock)

- Electric potential is defined as the electric potential energy per unit charge.

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

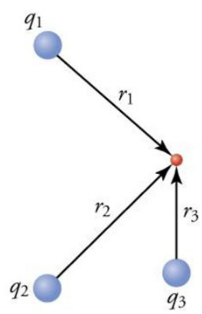
- Normally electric potential is called potential or voltage.
- Electric potential is measured in volts (V).

- The electric potential a distance r from a point charge is

$$V = \frac{kq}{r}$$

- This equation gives energy required to bring a positive test charge from infinity (very far away) to a distance $r$ near a charge $q$.

- To electric potential at a point due to multiple charges is the sum of the individual electric potentials.




$$V = \frac{kq_1}{r_1} + \frac{kq_2}{r_2} + \frac{kq_3}{r_3}$$



- The potential difference from a point $x_i$ to a point $x_f$ in a uniform electric field is

$$\Delta V = E\Delta x$$

- A uniform electric field can therefore be calculated from the potential difference from one point to another.

$$E = \frac{\Delta V}{d}$$

Where $d$ is the distance between two points in the field.