Chapter 25 The Electric Potential

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Electric Potential Energy

A charged particle q in an electric potential V has electric potential energy

$$U = qV$$

The change in potential energy is $\Delta U = -W$ where W is the work being done. If the force is not constant, the work can be calculated by dividing the path into many small segments of length dx, finding the work done in each segment, and then integrating over it.

$$W = \int_{x_i}^{x_f} F(x) \cos\theta dx$$

Parallel-Plate Capacitor

The electric potential energy of charge q in a parallel-plate capacitor is

$$U_{\text{elec}} = qEs$$

where s is the distance from the negative plate.

Two Point Charges

The potential energy of the system of two charges q_1 and q_2 is

$$U_{\text{elec}} = \frac{kq_1q_2}{r}$$

Multiple Point Charges

If more than two charges are present, their potential energy is the sum of the potential energies due to all pairs of charges.

Electric Dipole in a Uniform Electric Field

$$U_{\text{elec}} = pE\cos\phi = \vec{p} \cdot \vec{E}$$

Electric Potential

In the absence of other appleid forces, a charged particle speeds up or slows down as it moves through a potential difference.

Parallel-Plate Capacitor

The electric potential inside a capacitor is

$$V_{\text{cap}} = \frac{s}{d}\Delta V_C$$

where s is the distance from the negative plate, d is the distance between the plates, and $\Delta V_C = Ed$ is the potential difference between the plates.

Point Charge

The electric potential of charge q is

$$V_{\text{point}} = \frac{kq}{r}$$

Charged Sphere

Outside a uniformly charged sphere, the electric potential is identical to that of a point charge Q at the center

$$V_{\text{sphere}} = \frac{kQ}{r}$$

A sphere is charged to a certain potential when that potential is on the surface of the sphere, such that a sphere of radius R that is charged to potential V_0 has total charge

$$Q = \frac{RV_0}{k}$$

Using this for Q in the electric potential equation results In

$$V_{\text{sphere}} = \frac{R}{r}V_0$$