AP Physics I
Electric Potential and Electric Potential Energy

Ben Feuer

Contents

Chapter 1

Page 2

Chapter 1

1.1 Equations for Electric potential and electric potential energy

- $V = \frac{U_{elec}}{q}$
- $K_f + U_f = K_i + U_i$
- $\Delta K = -q\Delta V$
- $\mathrm{U}_{elec} = \frac{kq_1q_2}{r}$
- $V = k\frac{q}{r}$
- $V = \sum_i \frac{kq_i}{r_i}$
- $V = \frac{x}{d}\Delta V_c$

1.2 Electric potential Energy

Definition 1.2.1: Electric Potential Energy

Electric potential energy is $\Delta \mathrm{U}_{elec}$
$\mathrm{U}_{elec} = qV$

1.3 Electric potential

Definition 1.3.1: Electric Potential

Ratio of electric potential energy to charge.

Definition 1.3.2: Voltage

Voltage is a measure of electric potential.

- symbol Voltage $= V$
- unit Volt $= \mathrm{V} = \frac{\mathrm{J}}{\mathrm{C}}$

1.4 Conservation of Energy for a charged particle moving in an electric Potential V

$\Delta K = -q\Delta V$
$K_f + q\,V_f = K_i + q\,V_i$
$\frac{1}{2}mv_f^2 = \frac{1}{2}mv_i^2 + (q\,V_i - q\,V_f)$
$v_f^2 = v_i^2 + \frac{2}{m}(q\,V_i - q\,V_f) = v_i^2 = \frac{2q}{m}(V_i - V_f)$

1.5 Electric potential in a parallel-plate capacitor

Parallel Plate Capactitor giving you:

- Charges Q plus/minus
- $E = \frac{Q}{\epsilon_0 A}$
- Plate seperation - d
- Displacement - x

Equations:

- W = forcexdisplacement = $F_{hand}x = qEx$
- $U_{elec} = W = qEx$

1.6 Equipotential lines

Definition 1.6.1: Equipotential lines

Equipotential lines are lines that show equal voltage constantly.
Electric field lines point in the direction of decreasing potential.
Electric field strength in terms of the potential difference between two ΔV Between two equipotential surfaces a distance d apart.

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

1.7 Capacitance and capacitors

Definition 1.7.1: Capacitor

Two conductors with equal but opposite charge. The two conductors are called its electrodes, or plates.
The potential difference between the electrodes is directly proportional to their charge.
The charge of a capacitor is directly proportional to the potential difference between its electrodes.

$$Q = C\Delta V_C$$

Charge on a capacitor with a potential difference ΔV_C

Definition 1.7.2: Capacitance

The constant of proportionality C between Q and ΔV_C is called the capacitance of the capacitor.
The SI unit for capacitance is called the farad 1 farad = $1F = 1\frac{C}{V}$