Grade 12 physics V2

SPH4U

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Contents

Chapter 1

Electricity and Magnetism

1.1 Electric Potential Energy & Electric Potential

1.1.1 Electric Potential Energy

Definition 1.1.1 (Electric Potential Energy)
The energy stored in a system of two or more objects due to the electrical force acting in between the charges.

Formula

Formula for electrical potential energy stored in a system of two charges:

$$E_E = \frac{kq_Aq_B}{R}$$

Remark. Remember, always input the sign of q_A and q_B

You may notice, there is no negative sign for the formula of electrical potential energy compare to gravitional potential energy.

Gravity is always a force of attraction (this is what causes the negative in the formula)

However, electrical forces can either be forces of attraction or repulsion, which means that electrical energy can either be negative or positive.

Repulsion:+
Attraction:−

Now we have a new type of mechancial energy to add to our expression!

$$E_M = E_g + E_k + E_s + E_E$$

Remark. Gravitational Potential Energy is typically negligible in compression to electric Potential Energy

1.1.2 Electric Potential for Point Charges

Definition 1.1.2 (Electric Potential)
The electrical Potential per coulomb of charge at a location.

Let's discuss the difference between *electric field* and *electric potential*

Electric Field

- Can exist without there being an electrical force
- To have an electric force, a charge needs to be at a location where there is an electric field
- $\mathcal{E}$
- $\frac{N}{C}$

Electric Potential

- Can exist without there being electrical potential energy
- To have elctric potential energy, a charge needs to be at a location where there is electrical potential
- V
- $\frac{J}{C}$

Formula

Electric Field:

$$\vec{F_E} = \vec{\mathcal{E}} \times q \tag{1.1}$$

Remark. Do not substitue the sign of the charge

Electric Potential:

$$E_E = Vq \tag{1.2}$$

Remark. Substitue the sign of the charge

Calculate the electrical potential around a point charge

$$\begin{gathered} E_E = Vq_1 \\ \frac{k \times q \times q_1}{R} = Vq_1 \\ V = \frac{k \times q}{R} \end{gathered} \tag{1.3}$$

V is the elec potential (of q) at a distance of R away from q