PHYS 212, Honors Section – Review Material

Chapter 25: Electric Potential

- Possibility to define electric potential energy: The electric force is conservative.
- Electric potential energy: The negative of the work done by the electric force when a charge is moved (along any path) from a reference point O to a given point P, $U = -W_{PO}$. (The reference point can be arbitrarily chosen in any given problem, and it is often convenient to choose it at infinity.)
- Electric potential: Defined as $V = U/q = -W_{PO}/q$.
- Units: New unit for an electric field, 1 N/C = 1 V/m. Energy unit for particles, 1 eV = 1.60×10^{-19} J.
- Equipotential surfaces: The general concept; How to draw them for simple charge arrangements; How they provide information on the direction and magnitude of the electric field.
- Calculating the potential from the field: In general, integrate

$$V(P) = -\int \mathbf{E} \cdot d\mathbf{s} \ .$$

- Potential due to a point charge: From the electric field, at choosing $V = 0$ at infinity,

$$V = k\,q/r \ , \quad \text{so the potential energy of a 2-point-charge system is} \quad U = k\,q_1 q_2/r \ .$$

- Potential due to a charge distribution: Add the single-charge contributions, or set up an integral,

$$V = k \int dq/r \ .$$

- Calculating the field from the potential: In any direction s (for example, x, y, or z),

$$E_s = -\partial V/\partial s \ .$$

- Potential on a charged insulator: Because the electric field must be zero inside the conductor, without current flows, the potential is constant throughout the conductor. (Remember that there can be a field and a charge density only on the surface.)

Note: You are not required to know the topics and equations inside square brackets.

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