

# Physics 2321. Review for Exam I.

## 1. Chapter 23. Electric Potential.

- Electric Potential Energy.

- \* Relative  $\Delta U = -W_{field}$

- \* Absolute  $U = -W_{\infty}$

- \* Units: J

- Electric Potential,  $V$ .

- \* Relative  $\Delta V = -\frac{W_{field}}{q}$

- \* Absolute  $V = -\frac{W_{field,\infty}}{q}$

- \* Units: J/C or N·m/C

- Finding Potential from  $\vec{E}$ .

- \*  $\Delta V = V_f - V_i = -\int_i^f \vec{E} \cdot d\vec{s}$

- Finding  $\vec{E}$  from Potential.

- \*  $E_x = -\frac{\partial V}{\partial x}; E_y = -\frac{\partial V}{\partial y}; E_z = -\frac{\partial V}{\partial z}$

- \* When  $\vec{E}$  is uniform,  $E = -\frac{\Delta V}{\Delta s}$

- \* Examples: Example 23-12 and Prob. 51.

- Potential Due to Point Charges

- \*  $V = \frac{1}{4\pi\epsilon_0} \sum_{i=1}^n \frac{q_i}{r_i}$

- \* Examples: Ch. 23 Prob 28.

- Potential Due to continuous charge distributions

- \*  $V_{tot} = \frac{1}{4\pi\epsilon_0} \int_{charge} \frac{dq}{r}$

- Potential Energy of an arrangement of Point Charges

- \*  $U_E = k \sum_{i=1, j>i}^n \frac{q_i q_j}{r_{ij}}$

- \* Examples: Ch. 23 Test Bank 2.

## 2. Chapter 21. Electric Charge.

- Unit: Coulomb
- Unit: C/s=1 Amp (for current, I)
- Charges come in discrete pieces; electrons, protons.
- Coulomb's Law:  $F = \frac{1}{4\pi\epsilon_0} \frac{|q_1||q_2|}{r^2}$
- Shell theorems.

## 3. Chapter 21. Electric Fields.

- Definition:  $\vec{E} = \frac{\vec{F}}{q_0}$
- Rules of Electric field lines.
- Field due to point charge:  $\vec{E} = \frac{1}{4\pi\epsilon_0} \frac{|q|}{r^2}$
- Field above or below a Electric Dipole:  $E = \frac{1}{2\pi\epsilon_0} \frac{p}{z^3}$  [SKIP]
  - \* Dipole moment:  $\vec{p} = q\vec{a}$
  - \* Torque on Dipole:  $\vec{\tau} = \vec{p} \times \vec{E}$
- Field Due to Continuous Charge Distributions.
  - \* Line charge,  $\lambda$  C/m.
  - \* Surface charge,  $\sigma$  C/m<sup>2</sup>.
  - \* Volume charge,  $\rho$  C/m<sup>3</sup>.
  - \* Find  $dq = \lambda ds$  or  $\sigma dA$  or  $\rho dV$
  - \* Find  $dE$
  - \* Integrate  $E = \int_{allcharge} dE$

## 4. Chapter 22. Gauss' Law.

- $\oint \vec{E} \cdot d\vec{A} = \frac{q_{enc}}{\epsilon_0}$
- A Gaussian surface should be chosen to be parallel and/or perpendicular to the E-field. (But any surface obeys Gauss' Law.)
- Examples of E-fields we derived:
  - \* Near a uniformly charged sheet/plane:  $E = \frac{\sigma}{2\epsilon_0}$
  - \* Near a conducting plate with  $\sigma$  the charge density on *both* sides:  $E = \frac{\sigma}{\epsilon_0}$
  - \* Electric field outside spherical shell of total charge q:  $E = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2}$
  - \* Electric field near a line of charge:  $E = \frac{\lambda}{2\pi\epsilon_0 r}$