Physics 2321. Review for Exam I.

1. **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.**

2. **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,** λ **C/m.**
     - **Surface charge,** σ **C/m^2.**
     - **Volume charge,** ρ **C/m^3.**
     - **Find** $dq = \lambda ds$ **or** σdA **or** ρdV
     - **Find** dE
     - **Integrate** $E = \int_{allcharge} dE$

3. **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** σ **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:** $E = \frac{\lambda}{2\pi\epsilon_0 r}$

4. **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.**