PHYS1120 Exam I review

Things to remember for PHYS1110:

- algebra, trig (sin, cos, ..)
- vector math, especially vector addition
- \( \mathbf{F}_{\text{net}} = m \mathbf{a} \) problems, free-body diagrams

Ch.21 Charges and Fields

- Coulomb's Law: \( \mathbf{F} = \frac{k|q_1 q_2|}{r^2} \)
- Definition of electric field: \( \mathbf{E} = \frac{F_{\text{on } q}}{q} \), \( \mathbf{F}_{\text{on } q} = q \mathbf{E} \)
- E-field due to a point charge: \( \mathbf{E} = k \frac{Q}{r^2} \hat{r} \) (derived from Coulomb + definition of \( \mathbf{E} \))
- E-field due to many charges: \( \mathbf{E}_{\text{tot}} = \sum_i \mathbf{E}_i = \mathbf{E}_1 + \mathbf{E}_2 + \mathbf{E}_3 + ... \)
  (fields add like vectors, not numbers)
- Know how to set up an integral: \( \mathbf{E}_{\text{tot}} = \int \mathbf{E} \cdot d\mathbf{E} \), \( \mathbf{E}_{\text{tot,x}} = \int \mathbf{E}_x \cdot d\mathbf{E}_x \), \( d\mathbf{E} = \frac{k}{r^2} dQ \)
  \( dQ = \lambda dx \) or \( \sigma dA \) or \( \rho dV \) depending on geometry
- Field line diagrams

Ch.22 Gauss's Law

- Electric flux: \( \Phi = \mathbf{E} \cdot \mathbf{A} \) (if \( \mathbf{E} \) constant, surface flat), \( \Phi = \int \mathbf{E} \cdot d\mathbf{A} \)
- Gauss's Law: \( \oint \mathbf{E} \cdot d\mathbf{A} = \frac{Q_{\text{enclosed}}}{\varepsilon_0} \)
- Main results for spherical, cylindrical, and planar symmetry
  - \( \mathbf{E} \) inside charged spherical shell = 0
  - \( \mathbf{E} \) outside charged spherical charge = same as point charge
  - \( \mathbf{E} \) outside cylindrical charge distribution \( \propto \frac{1}{r} \)
  - infinite plane: \( \mathbf{E} = \frac{\sigma}{2 \varepsilon_0} \)
• Metals in equilibrium:

\[ E = 0 \text{ inside metal, } q_{\text{net,inside}} = 0, \text{ } q_{\text{net on surface only}}, \text{ } E \perp \text{ surface, } E_{\text{outside}} = \frac{\sigma}{\varepsilon_0} \]

**To prepare for Exam 1:**

- Review Concept Tests, MP problems, Tutorial HW. (Read question and try to remember reasoning that gets to the answer)
- When reviewing MP problems, know how to derive *algebraic* formula for answer.
- Prepare your formula sheet.
- Take the practice exam.
- It is no good to memorize answers. You have to understand and remember how you construct the answers.