Phys1110 Exam 1 Review:

Math skills:
- unit conversion, algebra, trigonometry (sin, cos, tan, Pythagorean Theorem)

Motion in 1D
- graphing: $x$ vs. $t$, $v$ vs. $t$, $a$ vs. $t$
  - $v = \frac{dx}{dt} = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t}$ = slope of a graph of $x$ vs. $t$
  - $a = \frac{dv}{dt} = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t}$ = slope of graph of $v$ vs. $t$
- average vs. instantaneous value of velocity, acceleration
  - "acceleration is not velocity, ...."
- Constant acceleration ($a = \text{const}$) in 1D:
  (a) $v = v_o + a \, t$
  (b) $x = x_o + v_o \, t + (1/2) a \, t^2$
  (c) $v^2 = v_o^2 + 2 a (x - x_o)$
  (d) $\bar{v} = \frac{v_o + v}{2}$

Vector Math
- Addition of vectors:
  graphically (tip-to-tail)
  analytically (with components)
- Components of vectors, unit vectors $\vec{A} = A_x \hat{i} + A_y \hat{j}$

Motion in 2D
- $\bar{v} = \lim_{\Delta t \to 0} \frac{\Delta \bar{r}}{\Delta t}$
- $\vec{a} = \lim_{\Delta t \to 0} \frac{\Delta \vec{v}}{\Delta t}$, $\vec{v}_1 + \Delta \vec{v} = \vec{v}_2$
- direction of $\vec{a} = \text{direction of } \Delta \vec{v} = \vec{v}_2 - \vec{v}_1$
- **Projectile Motion**
  
  treat x- and y-motions independently

  \[
  a_x = 0 \Rightarrow v_x = \text{constant} \\
  a_y = -g \Rightarrow v_y = v_{oy} - g t, \text{ etc}
  \]

- **Circular motion with constant speed** \(v\),

  \[
  a = |\ddot{\alpha}| = \frac{v^2}{r}
  \]

  \(\ddot{\alpha}\) is toward the center (centripetal)

**Newton's Laws**

\[
\vec{F}_{\text{net}} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + .. = \sum_i \vec{F}_i
\]

NI: \(\vec{F}_{\text{net}} = 0 \iff \vec{v} = \text{constant} \)

NII: \(\vec{F}_{\text{net}} = m \ddot{\alpha} \)

NIII: \(\vec{F}_{AB} = -\vec{F}_{BA} \)

**Force and motion problems:**

1) Free-body diagram

2) Coordinate system with +direction of axis = direction of acceleration

3) \(\sum F_x = m a_x \), \(\sum F_y = m a_y \)

**To prepare for Exam 1:**

- Review Concept Tests, CAPA problems, Tutorial HW. (Read question and try to remember reasoning that gets to the answer)
- When reviewing CAPA 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.