# Study Guide for Midterm 1

Dr. Jordan Hanson - Whittier College Dept. of Physics and Astronomy

September 20, 2017

## 1  Types of Problems on the Midterm

- There are three problems on estimation, approximation, and unit analyis. One of these involves kinematics, and another is multiple choice.
- There are two problems on kinematics with constant acceleration.
- There is one four-part problem on vectors.

## 2  Estimation, Approximation, and Unit Analysis

Remember our three techniques for establishing estimates:

- Choose the right *scale*. For example, don't work in meters if the distances are between planets. Work in $AU$ or light-minutes.
- Obtain complex quantities from simpler ones. For example, estimate lengths first, and then multiply them to estimate volumes and areas.
- Constrain the unknown with upper and lower limits. For example, the height of a child should not be 10 meters, or 0.1 meters.

## 3  Displacement, Velocity, and Constant Acceleration Vectors

The definition of average velocity is

$$\bar{v} = \frac{v_f - v_i}{t_f - t_i} = \frac{\Delta x}{\Delta t} \tag{1}$$

If the velocity is constant, the average velocity and the instantaneous velocity are the same. The numerator of Eq. 1 is in general a vector called *the displacement*: $\Delta \vec{x}$, describing the change in position of something. If the velocity is constant, then

$$\Delta \vec{x} = \vec{v} \Delta t \tag{2}$$

If the velocity is not constant, but the acceleration is constant, we have a system of equations relating displacement, time, velocity, and acceleration:

$$x(t) = x_0 + v_0 t + \frac{1}{2} a t^2 \tag{3}$$

$$v(t) = v_0 + at \tag{4}$$

$$a(t) = a \tag{5}$$

$$v^2 = v_0^2 + 2a \Delta x \tag{6}$$

## 4  Vectors

- Practice adding and subtracting vectors.
    1. Graphically
    2. As lists of numbers
- Practice breaking vectors into components: $\hat{x} \cdot \vec{v} = v \cos \theta$, $\hat{y} \cdot \vec{v} = v \sin \theta$ (if $\theta$ goes from x-axis to vector).
- Practice taking the magnitude of a vector: $\sqrt{\vec{v} \cdot \vec{v}}$, or Pythagorean theorem.