Study Guide (Midterm I)

1. Intro and Math Concepts

A. Units and SI

1. Precisely descript quantities.
2. SI units (m, kg, s, K, A, cd, mole)
3. Metric System: Prefixes

tera10^{12} giga10^{9} mega 10^{6} kilo 10^{3} centi10^{-2} milli 10^{-3} micro 10^{-6} nano 10^{-9} pico 10^{-12}

4. Precision and significant figures.

Unit conversion doesn't change precision, ALWAYS use scientific expression.

B. Units conversion:

1. Do not adding or subtracting quantities with **different** units.
2. Multiplying or dividing is okay.
3. Orders of magnitude,
4. Converting units without a common zero point.

C. Read and draw graphs.

1. Axis has: directions, units, scales, and label!
2. Plot with graphic paper or Excel.

2. Scalars and Vectors

A. Definition of a vector.

What's the difference of a scalar and a vector?

Notation of the vector. $\vec{V}$

What math rules does the scalar algebra have to follow?

What about the vector algebra?

B. Vector calculation (Adding/subtracting two vectors):

Graphically: (parallel shifting, triangle)

Project into components: How to project a vector into components? What is the magnitude of a vector?

Subtracting

3. Kinematics (motions):

A. Displacement, speed and velocity, acceleration.

1. How are they defined? What are their units? What is average velocity (acceleration) and instant velocity (acceleration)?

2. What are position vs time graphs, velocity vs time graphs, and acceleration vs time graphs? What is the relation between those graphs?

3. Special case: for the constant acceleration:

$$v = v_0 + at$$

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$

$$v^2 - v_0^2 = 2a(x - x_0)$$

4. Applications:

Free fall.

4. Two dimensional kinematics (motions):

1. How to find out the component of a velocity (acceleration): *magnitude, sin or cos, what angle to pick, and the sign.*

2. What is the procedure to set up a question and solve it?

Draw free-body diagram, list known and unknown variables, choose correct equations, solve the equations, report your answer in correct precision.

3. Special case: for the constant acceleration:

$$v_x = v_{0x} + a_x t \qquad v_y = v_{0y} + a_y t$$

$$x = x_0 + v_{0x} t + \frac{1}{2} a_x t^2 \qquad y = y_0 + v_{0y} t + \frac{1}{2} a_y t^2$$

$$v_x^2 - v_{0x}^2 = 2a_x (x - x_0) \qquad v_y^2 - v_{0y}^2 = 2a_y (y - y_0)$$

4. Applications:

projectile motion.

5. Introduction of Forces

A. Gravitational force and mass

1. Units of the mass and force of gravity.

2. Acceleration of gravity **g**. (unity, number, **direction**)

B. Equilibrium state of multiple forces.

1. If there are multiple forces exerting on an object and the object is in rest or moving at constant velocity, **the total force is zero.** $\sum \vec{F} = 0$ which means $\sum F_x = 0$ and $\sum F_y = 0$