Physics 101
Midterm 1

1. (15 points) Describe the movement of the stars and the sun in the sky using a diagram of the earth-centered model of the ancient Greeks. Label the ecliptic, the spring and fall equinoxes, and the summer and winter solstices on your diagram.

2. (10 points) How is the apparent retrograte motion of the planets explained in Copernicus' system? Illustrate this with a diagram.

3. (10 points) Galileo gave several arguments for the heliocentric model of the solar system that were not previously given by Copernicus. Give one of these arguments.

4. (15 points) Briefly state Kepler's three laws of planetary motion. One of the laws involves a formula that you don't need to remember, but you should state what quantities are related by the law.

5. Sketch a graph of positition vs. time and velocity vs. time for the motions described below. Put the x and v graphs directly above each other so that a given time value corresponds to the same horizontal coordinate on each graph. (An example will be drawn on the board.) Your graph need not be numerically accurate, but it should correctly show where the function goes through zero, where the slope is positive or negative, and whether the slope is increasing, decreasing, or constant.

(a) (12 points) A stone is dropped from rest and falls to the ground, coming to rest.

(b) (13 points) A car is initially going at a constant speed of 60 mi/hr. It then gradually speeds up to a maximum speed of 80 mi/hr to pass a truck, then gradually slows down back to 60 mi/hr and continues at this speed.

6. (25 points) Two books are placed on top of each other on a horizontal table. A horizontal force is applied to the bottom book, causing the two books to slide across the table. Draw a diagram for each book separately, showing the horizontal and vertical forces on each. Don't ignore friction! Indicate which forces in your diagram are related by Newton's third law. Write Newton's second law for the horizontal and the vertical direction for each book.

Physics 101
"Cheat Sheet"

Right Triangles

$$\sin\theta = \frac{b}{c}$$
$$\cos\theta = \frac{a}{c}.$$

Velocity and Acceleration

$$\Delta t = t_f - t_i, \quad \Delta x = x_f - x_i, \quad \Delta v = v_f - v_i. \quad etc.$$

$$v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t},$$
$$a = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t}.$$

Constant acceleration

$$\Delta v = a\Delta t,$$
$$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$$

Newton's laws of Motion

$$F_{\text{net}} = ma$$
$$F_{\text{on A due to B}} = -F_{\text{on B due to A}}.$$

Circular Motion

$$a_{\text{in}} = \frac{v^2}{r}.$$

Newton's law of Gravity

$$F_{\text{grav}} = G_{\text{N}} \frac{m_A m_B}{r^2}.$$