Phys 410
Spring 2013
Lecture #1 Summary
23 January, 2013

We reviewed the 6-step process for solving problems involving Newton's laws of motion, and the process for solving problems involving conservation laws. The statement that $\vec{a} = \vec{F}_{net}/m$, where $\vec{a}$ is the acceleration, and $\vec{F}_{net}$ is the net force acting on the object of mass m, is a bridge between the world of kinematics (the description of motion) on the left and the world of dynamics (understanding *why* motion occurs) on the right. It is also a statement of cause ($\vec{F}_{net}$) and effect ($\vec{a}$).

We talked about basic properties of space and time, including the use of vectors and their derivatives, typically taken with respect to time. We also reviewed the scalar and vector products of two vectors. The Cartesian coordinate system is particularly convenient because the 3 unit vectors $(\hat{\imath}, \hat{\jmath}, \hat{k})$ do not vary in direction as the position vector $\vec{r}(t) = x(t)\hat{\imath} + y(t)\hat{\jmath} + z(t)\hat{k}$ evolves in time *t*. This is not the case for other coordinate systems such as polar, cylindrical, spherical, etc.

We shall assume that time *t* evolves smoothly and that all observers agree on timing and the evolution of time. This assumption will be re-examined later when we discuss relativity. Also, the uniformity of time means that we can freely chose the zero of time to be anywhere in the evolution of a system.

A reference frame is a choice of origin, a coordinate system, coordinate axes and directions, and a choice for the origin of time. The physics that we describe should be independent of the choice of reference frame, as long as it is not accelerating, or compared to another reference frame moving at speeds approaching that of light. These two qualifications will be examined in more detail later.