Physics 303K Handout 10

1. **Chapter 10.4 to 10.6 Angular Momentum**

   (a) **Conservation of angular momentum** can be written as $\sum \vec{\tau_{ext}} = \frac{d\vec{L}}{dt}$. This means if there exist no external torques on the system of particles, then $\vec{L} = constant$.

   (b) **Spinning Top** Using $d\vec{L} = \vec{\tau}dt$, we can see $\vec{\tau} = \vec{\omega}_{precession} \times \vec{L}$.

2. **Chapter 11 Kinetic Energy and the Work-Energy Theorem**

   (a) **The Dot Product** of two vectors $\vec{a} \cdot \vec{b} = |\vec{a}||\vec{b}|cos(\theta)$. Note that the dot product of two vectors yields a scalar.

   (b) **The Force** of a spring is $\vec{F} = -k\vec{x}$. For a gravitational field, $\vec{F} = m\vec{g}$.

   (c) **Work** is the change of energy, $W = \Delta(Energy)$.

      i. For translation, work is $W = \int \vec{F} \cdot d\vec{s}$.

      ii. For rotation then, work is $W = \int \vec{\tau} \cdot d\vec{\theta}$.

   (d) **Power** is the time rate that work is done, $P = \frac{dW}{dt}$.

      i. For translation, this means $P = \int \vec{F} \cdot d\vec{v}$.

      ii. For rotation, this means $P = \int \vec{\tau} \cdot d\vec{\omega}$.

   (e) **Kinetic Energy** is the potential to do work associated with motion.

      i. Translational kinetic energy is $K = \frac{1}{2}mv^2$.

      ii. Rotational kinetic energy is $K = \frac{1}{2}I\omega^2$.

   (f) **The Work-Energy Theorem** states that *The total work done by the forces on an object is equal to the change of kinetic energy.* Note that this theorem is a consequence of our definitions of work and energy; it is not a new physical law. This applies to equally to translation and to rotation. This applies to all inertial reference frames.

   (g) **Collisions**

      i. For an elastic collision, energy is conserved, meaning $K_{final} = K_{initial}$.

      ii. For an inelastic collision, $K_{final} < K_{initial}$. Some energy is lost via sound, deformation, heat, etc.

Matt Thrasher, thrasher@physics.utexas.edu, 3/04