Module #9: Momentum

* Definition of Momentum
  + When an object is in motion, it has momentum
  + Momentum (p) = mv
    - Units: (kg\*m)/sec
    - Vector quantity
  + The momentum vector is always pointed in the same direction as the velocity vector.
  + Ex 9.1 p.288
  + OYO #9.1 p.288
* Impulse
  + In order for an object’s momentum to change, there must be a force applied
  + F = Δp / Δt
  + Final momentum minus initial momentum = Δp
  + Therefore Δp = F\* Δt
    - F\* Δt is often called “impulse”
    - The change in momentum which an object experiences is equal to the impulse imparted to the object
    - Often called “impulsive forces”
    - Useful when you deal with forces that are applied over a short time interval
  + Ex 9.2 p.292
  + OYO #9.2-9.3 p.294
* Conservation of Momentum
  + If there are no forces acting on the objects, then the force in our equation would be zero
    - 0 = Δp / Δt
    - So, Δp = 0
  + If Δp = 0 the total momentum of the system cannot change
  + This means that momentum must be conserved in a system which has no forces working on it, or when the forces working on it cancel each other out.
  + Law of Momentum Conservation = when the sum of the forces working on a system is zero, the total momentum in the system cannot change.
    - Very few systems where this is true
    - Even though friction applies to all systems, sometimes the effect of friction is so small that it can be ignored.
    - Sometimes the outside forces acting on a system can be so small that they can be ignored, allowing us to approximate the fact that the Law of Momentum Conservation applies.
  + Ex 9.3 p.295
  + OYO #9.4-9.5 p.297
  + Experiment 9.2 (Newton Balls)
* Mathematics of Momentum Conservation
  + Ex 9.4 p.300
  + Recoil velocity = the velocity that an object develops in response to launching another object, which is a result of the Law of Momentum Conservation
  + Ex 9.5 p.302
  + OYO #9.6-9.8 p.304
* Angular Momentum
  + When an object moves on a circular path, we study its angular momentum
  + When an object is in rotational motion, the most convenient way to keep track of its position is by the angle between its initial location and its current location
  + Angular velocity = the rate at which the position angle of an object changes in rotational motion
  + The angular momentum of an object traveling in a circle is equal to the linear momentum times the radius of the circle:
    - L = m\*v\*r
    - Units = (kg\*m2)/sec
  + Law of Angular Momentum Conservation = if the sum of the torques on a system is equal to zero, the angular momentum never changes
  + Ex 9.6 p.308
  + OYO #9.9-9.10 p.309