Lecture 7, Sep 23, 2021

Momentum Continued

- Momentum is a vector: $\vec{p} = m\vec{v}$ with units of $\text{kg} \cdot \text{m/s}$
- The momentum of a system is the sum of all the momentum of its pieces, and this quantity is conserved
- Momentum is only conserved inside an isolated system, i.e. all the pieces in the interaction are included
  - e.g. momentum is conserved in a collision if both carts are in the system, but it is not if only one cart is in the system, since the other cart would be an external
- The change in momentum is impulse: $\Delta\vec{p} = \vec{J}$ (this quantity is only nonzero when external forces act on the system)
- This even works when the speed of particles is near c, such as in Compton scattering
- To choose the right system, identify the interactions, then eliminate objects if interactions cause no acceleration
  - e.g. for two carts sliding without friction, the surface is eliminated, since the interaction with the surface does not create a force/acceleration
- When the two objects stick together, the momentum is still conserved
- If the two carts stick together, they will both move together at the same slower velocity
- $\Delta p_1 + \Delta p_2 = 0 \implies m_1\Delta v_1 + m_2\Delta v_2 = 0 \implies \dfrac{\Delta v_2}{\Delta v_1} = -\dfrac{m_1}{m_2} \implies \Delta v_2 = -\dfrac{m_1\Delta v_1}{m_2}$