Unit 5 → Momentum

Momentum

- An object's "stop-ability"
  - The more momentum, the starter to stop
- Two factors
  - Mass and velocity
- Examples
  - Nickel vs. bullet
  - Kickball vs. bowling ball
- Reference table and Equations
  - $p = mv$
    - $p = momentum\ (kg \cdot \frac{m}{s})$
    - Momentum and velocity are vectors
- Change of momentum
  - An individual object can have a change in momentum
  - $\Delta p_x = p_x - p_{x_0}$
  - $\Delta p_x = m\Delta v_x = m(v_x - v_{x_0})$

Impulse

- Means change in momentum
- When we change momentum, or impart an impulse, we change object velocity
  - How do we change an objects velocity?
    - Exert a force on it!
- Represented by Δp, I, or J
- Reference table and Equations
  - $\Delta p = F\Delta t$
    - $m\Delta v = m(v - v_0)$
  - Impulse is a vector
  - $kg \times \frac{m}{s} = kg\frac{m}{s}$
- When two objects interact…
  - Same F_{net} on each action/reaction
  - Same amount of time (t)
  - Each object receives the *same* impulse (change in momentum)
- Collision
  - Short duration interaction between objects
  - Time to *COMPRESS* and time to *EXPAND*
  - Perfectly elastic
    - Bounce apart
  - Perfectly inelastic
    - Stick together

Conservation of momentum

- Impulse and change in momentum
  - Exerts a force over time
  - Accelerate an object
  - Change the velocity
  - Change its momentum
- Conservation
  - 2 or more objects collide
    - Colliding
    - Exploding apart
  - Individual momentum changes
  - Total momentum remains the same
- Types of Collisions
  - *Perfectly* elastic collision
    - No object deformation
  - Inelastic collision
    - Object deforms to a certain degree
  - *Perfectly* inelastic collision
    - Objects stick together
- Conservation of momentum
  - Total momentum of an isolated system is constant
  - Interactions within the system *do not* change the toal momentum
- Equations and the reference table
  - $p_{total\ before} = p_{total\ after}$
- Scenarios
  - 1→2

$$p_{total\ before} = p_{total\ after}$$

$$p_{AB} = p_A + p_B$$

$$m_{AB}v_{AB} = m_Av_A + m_Bv_B$$

  - 2→1

$$p_{total\ before} = p_{total\ after}$$

$$p_A + p_A = p_{AB}$$

$$m_Av_A + m_Bv_B = m_{AB}v_{AB}$$

  - 2→2

$$p_{total\ before} = p_{total\ after}$$

$$p_A + p_B = p_A + p_B$$

$$m_Av_A + m_Bv_B = m_Av_A + m_Bv_B$$

Momentum Quiz

Multiple Choice

1)
2)
3)
4)
5)
6)
7)
8)
9)
10)

Short Response

11)
12)
13)
14)
15)