Momentum

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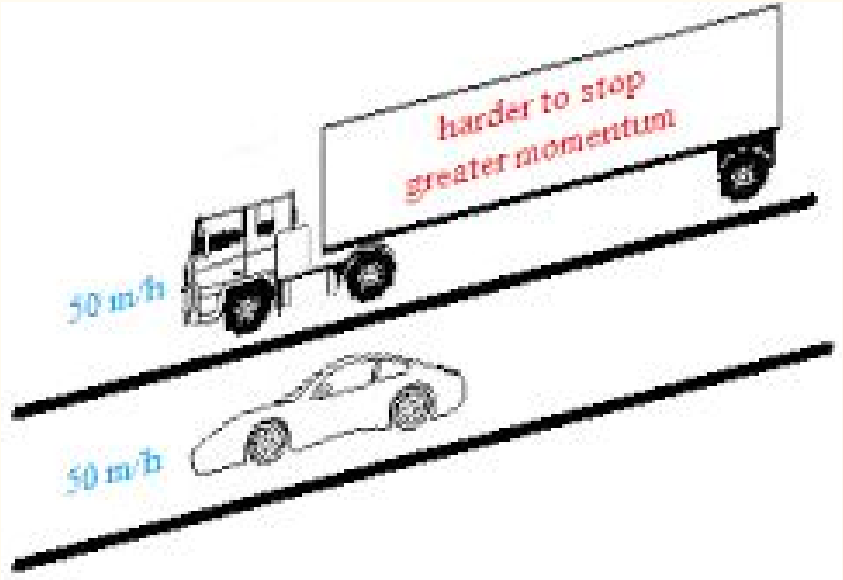
Period 6

What is momentum?

- a way to think about objects in motion
- a vector
- dependent on frame of reference
- represented with p
- Formula: $p=mv$
- Units: $kg \cdot m/s$

- A faster moving object has a greater momentum than a slower object of the same mass.
- A heavier object has greater momentum than a lighter object moving at the same speed.
- The greater the momentum, the harder it is to stop and therefore has stronger force of impact when brought to an abrupt stop or in a collision.



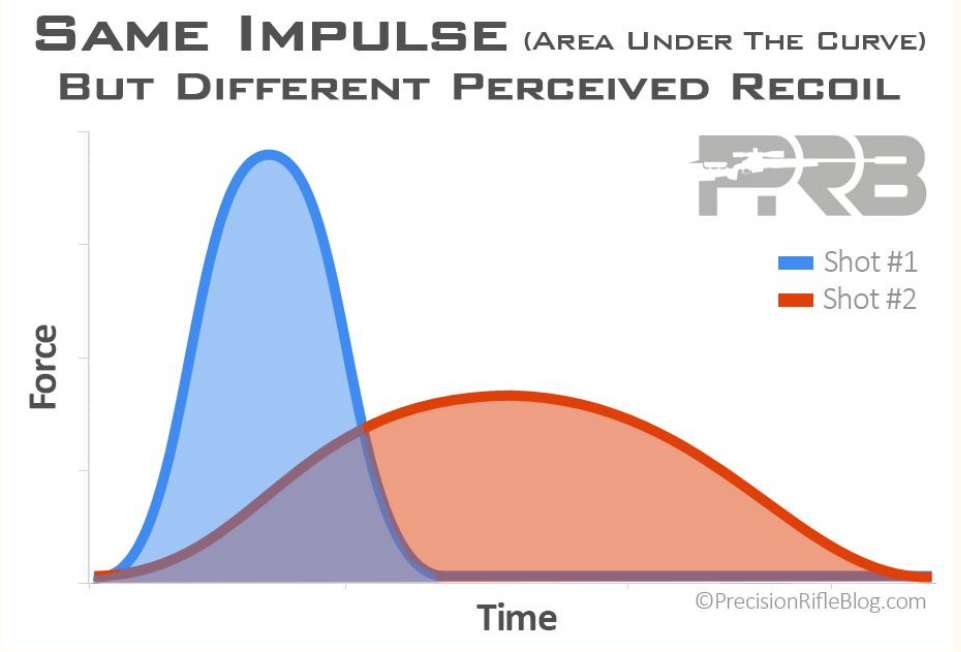
What is impulse?

- the change in momentum
- represented with J or Δp
- Formula: $\Delta p = F_{net}\Delta t$
- Units: kg•m/s

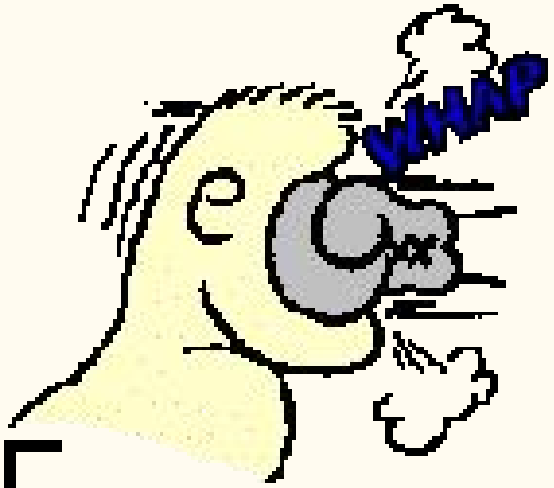
al momentum before a collision is equal to
total momentum after a collision
$v1 + m2v2 = m1v1' + m2v2'$
y true if in an isolated system
solated system-no outside forces present

More on Impulse

- impulse graphs are force vs time
- $J = \Delta p = F_{\Delta t} = F\Delta t$
- this is illustrated on the graph to the right since both have the same impulse
  - Blue has a very large force over a short amount of time
  - Red has a small force over a long amount of time



Ft = change in momentum



Ft = change in momentum

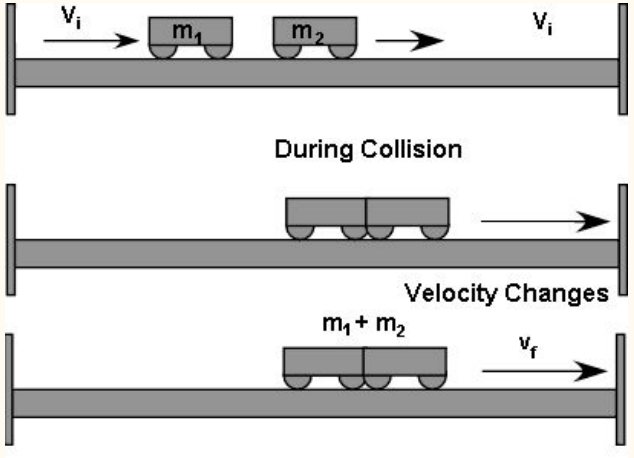
- This is the same idea as before.
- The right punch has less force and thus less painful if the time it takes is greater.
- The left punch has more force and is more painful if the hand is faster and takes less time to hit the face.

Elastic Collisions

- A perfectly elastic collision occurs when two objects collide and they bounce apart.
- Kinetic Energy is conserved
- $\frac{1}{2}m_1v_1^2 + \frac{1}{2}m_2v_2^2 = \frac{1}{2}m_1v_1'^2 + m_2v_2'^2$

Inelastic Collisions

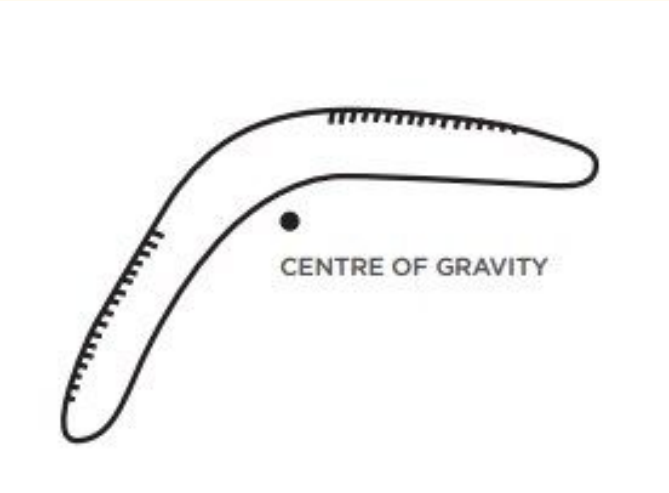
- In a perfectly inelastic collision the two objects stick together after a collision.
- Kinetic Energy is not conserved
- $m_1v_1 + m_2v_2 = (m_1 + m_2)\,v_f$



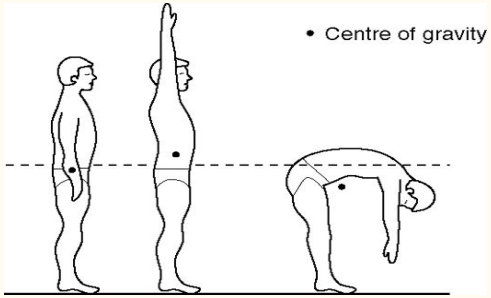
Center of Mass

- unique point at which mass is “concentrated”
- motion acts like all mass is at one point

- does not necessarily have to be inside the object



Center of Gravity



- Center of Gravity is a similar concept to center of mass. (CG)
- Center of Gravity is the point at which the force of gravity can be considered to act.
- Really only used to determine translation motion.
- For most cases, CM (Center of Motion) and CG are usually the same point

Common Misconceptions

1. Angular momentum and Linear momentum do not share the same values as angular momentum deals with moving in a circle and angles.
2. Elastic Collisions and Inelastic collisions are different in that elastic means the objects bounce apart and in an inelastic collision the objects stick together.
3. It takes more for something small to move something much larger but less for the opposite. The amount of momentum depends on the mass of the object.

Strategies

1. Determine whether the problem is elastic or inelastic
    a. If it is elastic
        i. The objects will bounce off each other either
            1. In the same direction
            2. In opposite directions
            3. One will stop and the other will continue
    b. If it is inelastic
        i. The objects will attach together
2. Write out all of the information you know
3. Copy the equation you need to use
4. Plug and chug
5. Don’t forget units on your answer

Drawing from previous units

- In impulse (J=Ft) we have to recall that F=ma (N)