UNIT 4

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Momentum

Formula: $p = m \times v$

Units: kg x m/s

A.k.a Fulmers (F)

Momentum is a

VECTOR

Basic Rules

- Objects with more momentum are harder to stop
- Collisions that involve objects with large momentum have greater impacts
- Increases in mass or speed are responsible for greater momentum

Impulse

Impulse (J) = Change in Momentum (□ p)

□ P = M □ □ V

J = F_{NET} □ T

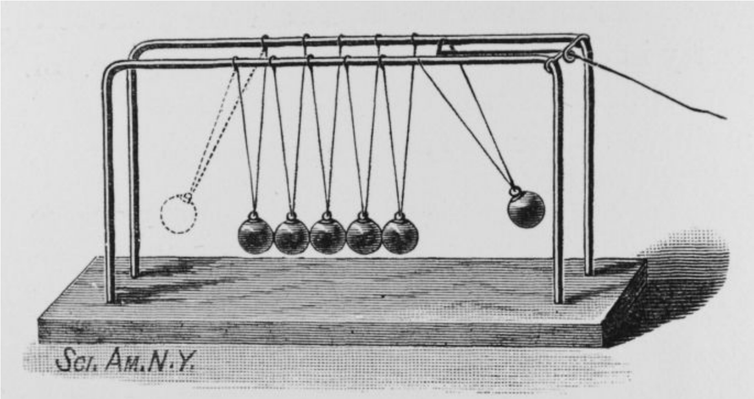
□ M (□ V) = F_{NET} (T)

Conservation of Momentum

<u>Conservation of Momentum:</u>
In an isolated system, momentum is conserved

Isolated System: No external unbalanced forces

$$M_1V_1 + M_2V_2 = M_1V_1' + M_2V_2'$$



Collision Balls.

Conservation of Energy

In theory: Elastic Equations:

Kinetic Energy is conserved

$\frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 = \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2$

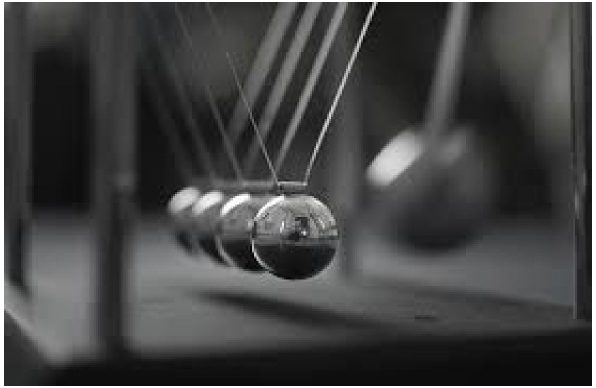
In practice: Inelastic Equations: Kinetic energy is not conserved because some energy is converted into heat energy

$KE_i = KE_f + TE$

$KE_f \leq KE_i$

Elastic Collision

- Elastic collisions occur when the total kinetic energy is conserved when two objects collide
- Nearly impossible to have a completely elastic equation
- Formula:



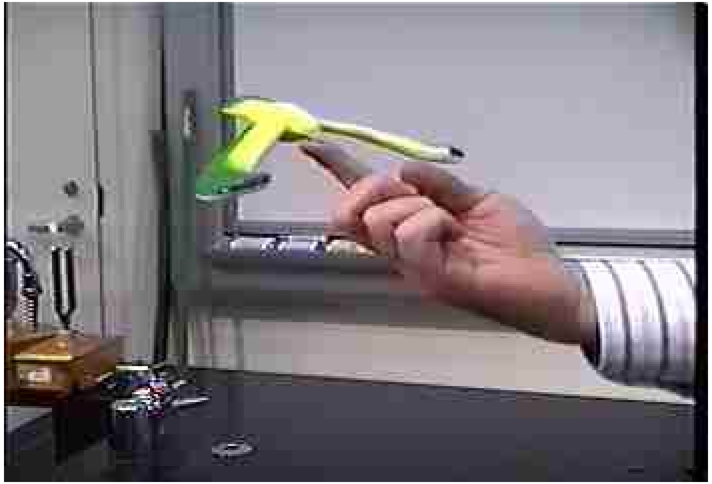
$$\frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 = \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2$$

Inelastic Collisions

- Occur when kinetic energy is not conserved.
  - The most common type of collision
- Initial kinetic energy is transfered into something else on impact
  - $KE_i = KE_f + TE$
  - $KE_f \leq KE_i$
- Perfectly inelastic equations stick together

Center of mass

- An object’s center of mass is the point where the mass is concentrated
- Center of gravity and center of mass are usually the same point
- Center of mass does not need to be inside an object
  - Boomerangs’ have theirs outside the object
  - Found experimentally



Examp

- Ki… at a co… mond ea… e ea… mas… ng's mas…

  Ans…

- Ho…

  Ans…

Example Problem: Kinetic Energy

If Car A was speeding at 40 m/s and bumped into Car B which was going at 26 m/s and Car A's mass was 1000 kg whereas Car B only had a mass of 850 kg, how fast would car B go if after the crash Car A's velocity was 10 m/s?

Answer: about 60 m/s

If the cars were 5 m away from a brick wall at the time of the crash, how fast would Car B have to break in order to stop in time? How much force would it have to apply?

Answer 3 s, -8500 N

Practice Problem

Assuming there is no energy lost, how much energy does Harry Potter use in the final battle against Voldemort?

Energy Exerted by Voldemort: 8368 kJ

KE of Wand towards Harry: 500J

Heat energy created by the clash: 20 kJ