

MOMENTUM AND IMPULSE

Regents Physics

Momentum

- Can be defined in words as “inertia in motion”
- Can be defined mathematically as the product of mass and velocity
- $p = mv$
- Don't ask me why they use “p” to represent momentum. If you can find out and prove it, I'll give you a point on your next test.

Impulse

- Can be defined in words as the change in momentum
- Can be defined mathematically as the product of an object's mass and its CHANGE in velocity or the product of the force applied to that mass and the time it is applied for
- $J = m\Delta v = Ft = \Delta p$
- Any two of these formulas can be set equal to each other.

Why is impulse important?

- Airbags in a car?
- “Crumple zones” in a car?
- Boxing?
- A “belly flop” vs. an olympic style dive?
- Any other examples?

Conservation of Momentum

- The momentum of a system must always be conserved...ALWAYS!!!
- $P_{before} = P_{after}$

Answer This

- How do you think a rocket works?
- Revisit when we spoke about shooting a rifle. How does the conservation of momentum law apply here?
- Any others?

Momentum

- What is the momentum of a 1200 kg car traveling at 15 m/s due east?
- A 0.60 kg softball initially at rest is hit with a bat. The ball is in contact with the bat for 0.2 seconds and leaves the bat with a speed of 25 m/s. What is the magnitude of the average force exerted by the ball on the bat?

Momentum

- Satellite A has a mass of 1.5×10^3 kg and is traveling east at 8.0×10^3 m/s. Satellite B is traveling at 6.0×10^3 m/s. The satellites collide head on and come to rest. What is the mass of satellite B?

Momentum

- As an object falls freely toward Earth, what happens to its momentum?

Momentum

- What is the magnitude of the velocity of a 25-kg object that has a momentum of 100-kg*m/s?

Momentum

- What is the momentum of a 1200-kg car traveling at 15-m/s due east?

Momentum

- A constant unbalanced force acts on an object for 3.0-s, producing an impulse of 6.0-N*s east. Determine the magnitude and direction of the force.

Momentum

- A 10-N force acts on an object for 0.01-s.
What force would produce the same impulse in 0.05-s?

Momentum

- A 2.0-kg cart moving due east at 6.0-m/s collides with a 3.0-kg cart moving due west. The carts stick together and come to rest after the collision. Determine the initial velocity of the 3.0-kg cart before the collision.

Momentum

- A 0.180-kg cart traveling at 0.80-m/s to the right collides in-elastically with a 0.100-kg cart initially at rest. Determine the final velocity of the carts.

Momentum

- A 1000-kg car traveling with a velocity of +20-m/s decelerates uniformly at -5.0-m/s^2 until it comes to rest.
 - What is the total distance the car travels as it decelerates to rest?
 - What is the magnitude of the impulse applied to the car to bring it to rest?