Name: _____ Ch.3:3

Period: _____

Momentum and Conservation of Momentum

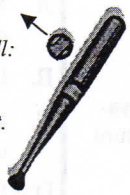
Momentum

Momentum (in kgm/sec) → $p = mv$ ← Mass (in kg), Velocity (in m/sec)

Momentum equals mass times velocity.

A house that is not moving has no momentum.

Something has to be moving to have momentum.



A fast baseball: a lot of momentum; light, but fast.

Slow bowling ball: little momentum; heavy, but slow.

Something with more momentum would hurt worse if it hit you.

Ex. How much momentum does a 30 kg object going 4 m/s have?		*Ex. An object going 3 m/s has 36 kgm/s of momentum. Find mass.*		*Ex. How fast is a 15 kg object going if it has 45 kgm/s.*	
Variables: 30 kg = m 4 m/s = v p = ? Equation: p = mv	Solve: p = mv = (30kg)(4m/s) = 120 kgm/s *Just put together the units for m and v.*	Variables: 3 m/s = v 36 kgm/s = p m = ? Equation: p = mv	Solve: If p = mv Then m = p/v = (36kgm/s)/(3m/s) = 12 kg	Variables: 45 kgm/s = p 15 kg = m v = ? Equation: p = mv	Solve: If p = mv Then v = p/m = (45kgm/s)/(15kg) = 3 m/s

---

Newton's Third Law says that when you throw a ball, the ball pushes on you, too. Using momentum, you can describe what happens between pairs of forces.

Law of Conservation of Momentum

"Momentum is conserved in a closed system" OR "The total amount of momentum does not change."

Law of Conservation of Momentum:

$p_{change} = 0$

$p_{left} = p_{right}$

$m_L v_L = m_R v_R$

Ex. A 40 kg boy on a skateboard throws a 2 kg, 20 m/s to the left. Find how fast the boy is going afterward.

ball = 2 kg

v_L = 20 m/s

boy = 40 kg

v_R = ?

$P_{ball} = m_L v_L$

$P_{boy} = m_R v_R$

Use The Law of Conservation of Momentum

Solution:

$P_{change} = 0 = P_R - P_L$

$P_L = P_R$

$P_{ball} = P_{boy}$

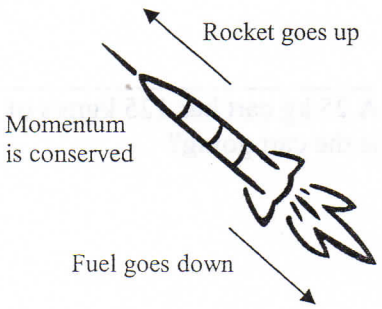
$m_L v_L = m_R v_R$

$$\frac{m_L v_L}{m_R} = v_R$$

$$\frac{(2\cancel{kg})(20 m/s)}{40\cancel{kg}} = \frac{40 m/s}{40} = (1 m/s)$$

The boy ends up going 1 m/s to the right.

Conservation of momentum is also how rockets fly. A rocket expels gases at very fast velocity and the rocket goes the opposite direction.



$p_{rocket} = p_{fuel}$

1. Momentum	A. Momentum does not change in a closed system OR $m_L v_L = m_R v_R$
2. kgm/sec	B. Units for momentum
3. Law of Conservation of momentum	C. Measure of the product of an object's mass and velocity.
4. Weight	D. Changes when gravity changes.
5. Inertia	E. Doesn't change with gravity.

1. Newton's First Law	____ For every action there is an equal an opposite reaction.
2. Newton's Second Law	____ Objects at rest stay at rest and objects in motion stay at motion unless acted on by a net force.
3. Newton's Third Law	____ Force equals mass times acceleration.

Which of Newton's Three Laws Applies?

___ A rocket moves forward because gases are pushed out the back.

___ More force creates more acceleration.

___ A magician pulls out the tablecloth from under the plates on a table and the plates stay put.

___ You pull back on the paddle and the canoe goes forward.

___ A larger car takes a bigger engine to move it.

___ Once the engines stop, a rocket coasts through space.

Find the momentum of a 25 kg object going 4 m/s.

An object is going 22 m/s and is 3 kg. Find momentum.

A pingpong ball has 2 kgm/s of momentum when thrown 8 m/s. Find the mass of the ball.

A 25 kg cart has 125 kgm/s of momentum. How fast is the cart going?

A 50 kg boy on ice skates throws a 5 kg ball to the left. If the ball ends up going 20 m/s. How fast is the boy going?

Two astronauts push off of each other in space. The 80 kg astronaut ends up going 10 m/s. The other one ends up going 8 m/s. What is the mass of the other

Find the weight of a 25 kg table. (Use $g = 10\ m/s^2$)

A 20 N force pulls to the right and friction pulls 5 N. If the mass is 5 kg, find acceleration.