Edgenuity

Warm-Up | Momentum

Lesson Question

Lesson Goals

Define and **calculate** _____ .

Explain how momentum is _____ .

Apply Newton's _____ to momentum.

Words to Know

Fill in this table as you work through the lesson. You may also use the glossary to help you.

	a quantity that has both a size and direction
	the total momentum of all interacting objects is the same before and after an event
	the measure of the motion of an object found by multiplying the object's mass and velocity

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Newton's Third Law of Motion

- Newton's [ ] of motion states that forces come in pairs that are equal in strength and opposite in direction.
- Man [ ] on car ←→ Car pushes on man
- Ball pushes on racket [ ] Racket pushes on ball
- Books push on desk ←→ Desk [ ] on books

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Momentum

$$p = mv$$

- _____ is the measure of the motion of an object found by multiplying the object's mass and velocity.
  - Symbol: p
  - _____: a quantity that has both a size and direction.
  - Units: kg • m/s

Momentum of a Hammer

EXAMPLE

What is the _____ of a 2 kg hammer swung at 0.8 m/s?

- _____:
  - $M = 2$ kg
  - $V = 0.8$ m/s
- _____: p
- _____ to use: $p = mv$

Solve the equation:

- $p = mv$ = (2 kg)(0.8 m/s)
- $p = 1.6$ kg • m/s

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Mass, Velocity, and Momentum

- If two objects have the same _____, the object with the greater velocity will have the greater momentum.
- If two objects have the same _____, the object with the greater mass will have the greater momentum.

Equal Momentum

Car:

- $p = mv$
- $p = (1{,}000\ \text{kg})(25\ \text{m/s})$
- $p =$ _____ kg • m/s

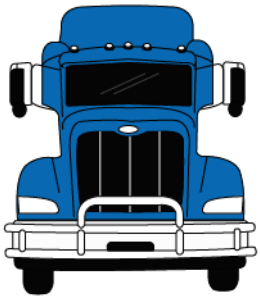


$m = 1{,}000\ \text{kg}$

$v = 25\ \text{m/s}$

Truck:

- $p = mv$
- $p = (5{,}000\ \text{kg})(5\ \text{m/s})$
- $p =$ _____ kg • m/s



$m = 5{,}000\ \text{kg}$

$v = 5\ \text{m/s}$

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Law of Conservation of Momentum

- The _____ states that the total momentum of interacting objects does not change.

$$p_i = pf$$

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Collisions in Which Objects Stick Together

- Two or more objects collide and [ ] to become one object with one velocity.
  - They individual masses [ ] .
  - All objects have the [ ] .

Before Collision

Green train car:

- $p = mv$
- p = (600 kg)(10 m/s)
- p = [ ] kg • m/s

Purple train car:

- $p = mv$
- p = (400 kg)(−5 m/s)
- p = [ ] kg • m/s

Total momentum before collision:

- 6,000 kg • m/s + (−2,000 kg • m/s) [ ] kg • m/s

Before Collision



$m_1 = 600$ kg
$v_1 = 10$ m/s

$m_2 = 400$ kg
$v_2 = -5$ m/s

After Collision

Total momentum after collision:

- $p = mv$
- p = (1000 kg)(4 m/s)
  = [ ] kg • m/s

After Collision



$m_f = 1{,}000$ kg
$v_f = 4$ m/s

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Collisions in Which Objects Bounce Apart

- Two or more objects collide together and [ ] with separate velocities.
  - They [ ] their original masses.
  - The velocities may [ ] .

Before Collision

Green train car:

- $p = mv$
- p = (600 kg)(2 m/s)
- p = [ ] kg • m/s

Purple train car:

- $p = mv$
- p = (400 kg)(−4 m/s)
- p = [ ] kg • m/s

Total momentum before collision:

- 1,200 kg • m/s + (−1,600 kg • m/s) = [ ] kg • m/s

Before Collision



$m_1 = 600$ kg, $v_1 = 2$ m/s

$m_2 = 400$ kg, $v_2 = -4$ m/s

After Collision

Green train car:

- $p = mv$
- p = (600 kg)(−2 m/s)
- p = [ ] kg • m/s

Purple train car:

- $p = mv$
- p = (400 kg)(2 m/s)
- p = [ ] kg • m/s

Total momentum after collision:

- −1,200 kg • m/s + (800 kg • m/s) = [ ] kg • m/s

After Collision



$m_1 = 600$ kg, $v_1 = -2$ m/s

$m_2 = 400$ kg, $v_2 = 2$ m/s

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Newton's Third Law of Motion and Momentum

- Newton's [ ] of motion can be applied to the conservation of momentum.
- Newton's third law describes action and reaction [ ].
  - Cannon [ ] cannonball ←→ Cannonball pushes cannon
  - $m_c(-v_c)$ [ ] $m_{cb}v_{cb}$ (The momentum of the cannon moving left equals the momentum of the cannonball moving right.)

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Force, Momentum, and Collision Time

- [ ] or transferring momentum requires a force.
  - Faster objects require greater changes in momentum to [ ].
- Minimizing the force exerted in action-reaction force pairs [ ] damage.
- Reducing the force exerted by action-reaction force pairs is done by extending the [ ] of a collision.

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Summary | Momentum

Lesson Question What is momentum?

Answer

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Review: Key Concepts

- [ ] [ ] is the product of an object's mass and velocity, found by the [ ] $p = mv$.
- The [ ] states that the total momentum of all objects in a collision or explosion must be the same before and after the collision or explosion.
- Newton's [ ] of motion about action and reaction forces means that objects will also have equal and opposite momenta when momentum is conserved.
- Forces cause [ ] in momentum.
- The [ ] exerted on an object during a collision decreases if the time of the collision increases.

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Summary | Momentum

Use this space to write any questions or thoughts about this lesson.

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