Newton's Third Law

What is Newton's third law of motion?

Newton's Third Law

Action-reaction forces propel the swimmer through the water. The swimmer pushes against the water, and the water pushes the swimmer.

DOK question:

Construct a visual representation of the below system.

Newton's Third Law

Action-Reaction Forces Do Not Cancel

For the swimmer, why do the action and reaction forces not cancel each other and produce a net force of zero?

Momentum

What is needed for an object to have a large momentum?

Momentum

Mass is –

Velocity is –

Momentum is –

Momentum Formula

$$\text{Momentum} = \text{Mass} \times \text{Velocity}$$

Momentum

Which has more momentum, a 0.046-kilogram golf ball with a speed of 60.0 meters per second, or a 7.0-kilogram bowling ball with a speed of 6.0 meters per second?

Conservation of Momentum

How is momentum conserved?

Conservation of Momentum

According to the **law of conservation of momentum,** if no –

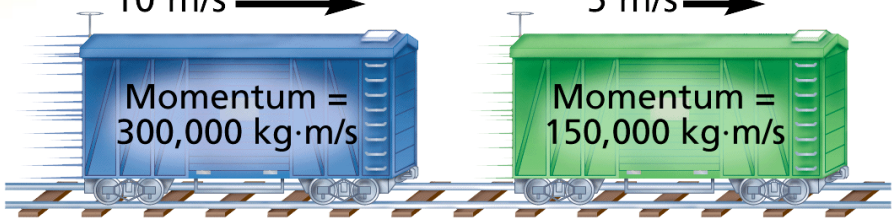
Conservation of Momentum

In each collision, the total momentum of the train cars does not change—momentum is conserved.

A

Both cars moving.

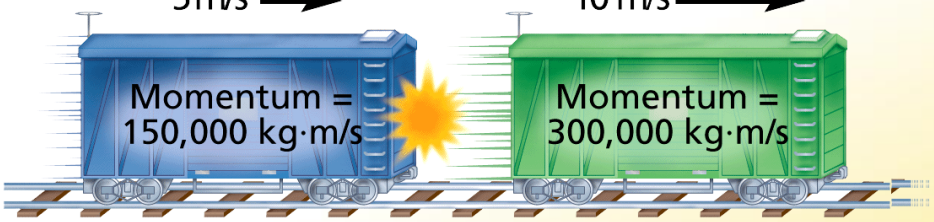
Before collision



Momentum before collision = 450,000 kg·m/s

Cars bounce off each other.

After collision



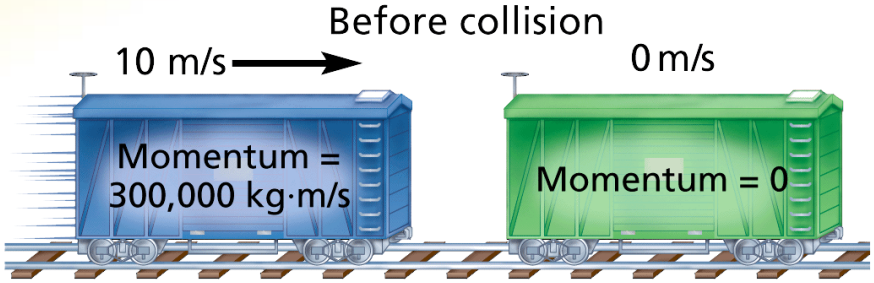
Momentum after collision = 450,000 kg·m/s

Conservation of Momentum

In each collision, the total momentum of the train cars does not change—momentum is conserved.

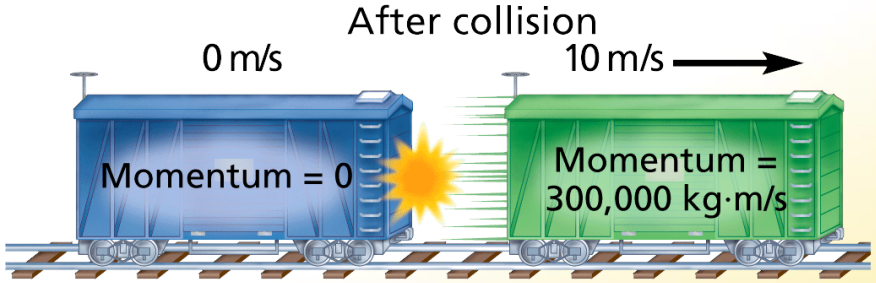
B

One car moving.



Momentum before collision = 300,000 kg·m/s

Cars bounce off each other.



Momentum after collision = 300,000 kg·m/s

Conservation of Momentum

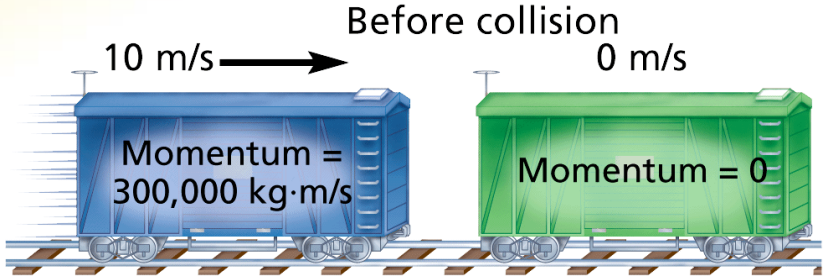
In each collision, the total momentum of the train cars does not change—momentum is conserved.

DOK question:

Assess the last three situations and describe what force is not taken into account.

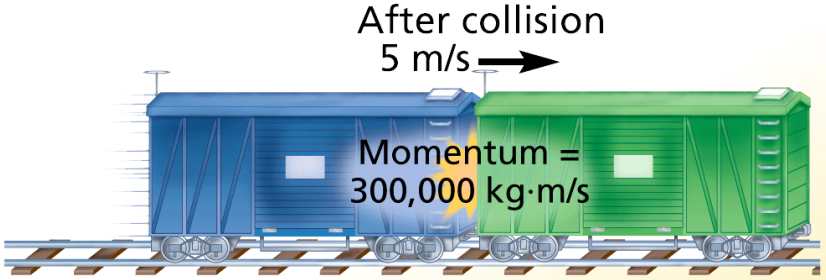
C

One car moving.



Momentum before collision = 300,000 kg·m/s

Cars couple.



Momentum after collision = 300,000 kg·m/s

Momentum

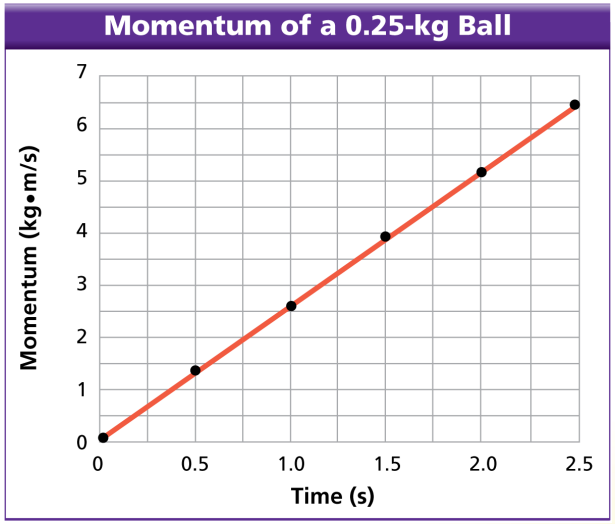
Data Analysis

A class studied the speed and momentum of a 0.25-kilogram ball dropped from a bridge. The graph shows the momentum of the ball from the time it was dropped until the time it hit the river flowing below the bridge.

Momentum

Data Analysis

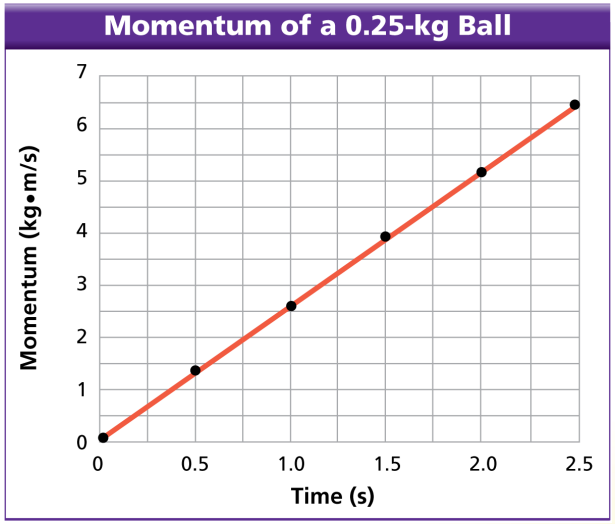
1. Applying Concepts At what time did the ball have zero momentum? Describe this point in the ball's motion.



Momentum

Data Analysis

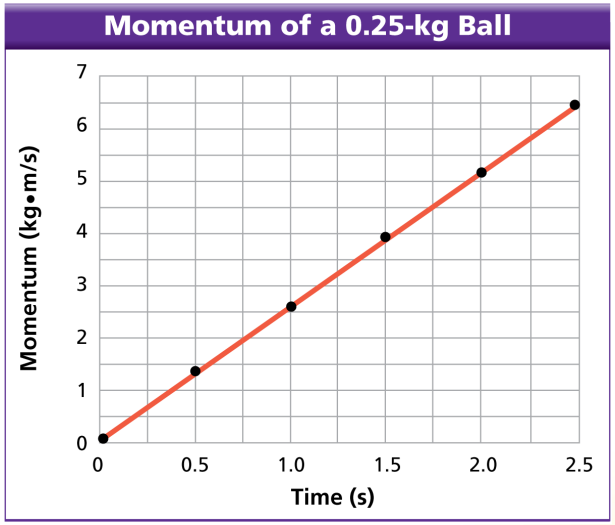
2. Using Graphs At what time did the ball have the greatest momentum? What was the peak momentum value?



Momentum

Data Analysis

3. Calculating What is the ball's speed after 1.25 seconds?
(*Hint:* Use the graph and the momentum formula.)



Assessment Questions

1. A stationary figure skater pushes off the boards around an ice skating rink and begins gliding backward, away from the boards. Which law explains why the figure skater moves backward?
   a. the law of conservation of energy
   b. the law of inertia
   c. Newton's second law
   d. Newton's third law

Assessment Questions

2. A red puck with Velcro on its side is sliding toward a stationary blue Velcro puck of the same mass. The pucks will stick together upon contact. After contact, how will the red puck's velocity compare to its initial velocity? (In this collision the law of conservation of momentum is obeyed, and friction is ignored.)

   a. The red puck's velocity is the same as before.
   b. The red puck's velocity is the same magnitude but in the opposite direction.
   c. The red puck's velocity is half its initial velocity and in the same direction.
   d. The red puck's velocity is double its initial velocity and in the opposite direction.