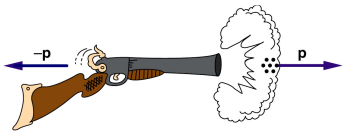
Conservation of Momentum

Learning Target	Description
9.2	I can define, interpret, and solve problems involving the Law of Conservation of Momentum.



Review Momentum and Impulse

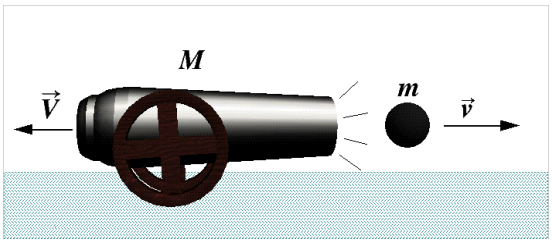
Momentum

$\mathbf{p = m\,v}$

Impulse-Momentum Theorem

$F\,\Delta t = \Delta p = p_f - p_i$

Newton's 3rd Law



Momentum

What if $F_{net} = 0$?

$F\,\Delta t = \Delta p = p_f - p_i$

Law of Conservation of Momentum

- If the net force acting on an object is zero, its momentum is conserved.
- In any closed system, the total momentum of the system remains constant.

$$p_{initial} = p_{final}$$

Recoil

A cannon fires a 19.0 kg ball from its 4.00 m long barrel with a muzzle velocity of 125 m/s. If the cannon has a total mass of 855 kg, what is the resulting recoil speed of the cannon?

Momentum Tables

In analyzing momentum problems, a momentum table can be a powerful tool for problem solving. To create a momentum table, follow these basic steps:

1. Identify all objects in the system. List them vertically down the left-hand column.
2. Determine the momenta of the objects before the event. Use variables for any unknowns.
3. Determine the momenta of the objects after the event. Use variables for any unknowns.
4. Add up all the momenta from before the event, and set them equal to the momenta after the event.
5. Solve your resulting equation for any unknowns.

Recoil

A cannon fires a 19.0 kg ball from its 4.00 m long barrel with a muzzle velocity of 125 m/s. If the cannon has a total mass of 855 kg, what is the resulting recoil speed of the cannon?

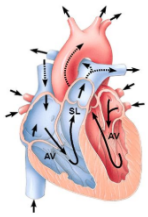
OBJECTS	MOMENTUM BEFORE (kg·m/s)	MOMENTUM AFTER (kg·m/s)
CANNON	$(855+19)(0)$	$(855)V_{f,c}$
BALL		$(19)(125)=2375$
TOTAL	0 kg·m/s	0 kg·m/s

$(855)V_{f,c}+2375=0$

$V_{f,c}=\frac{-2375}{855}$

$V_{f,c}=-2.78\ m/s$

Examples of Recoil



Ballistocardiograph

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PRACTICE PROBLEMS (9-12)