Momentum *NOTES*

- *Momentum is simply another property of an object that we can measure.*
- *Objects have **temperature, volume, mass** (properties we can measure)…*
- **Momentum** *is just another one of these properties*

Definition of Momentum:

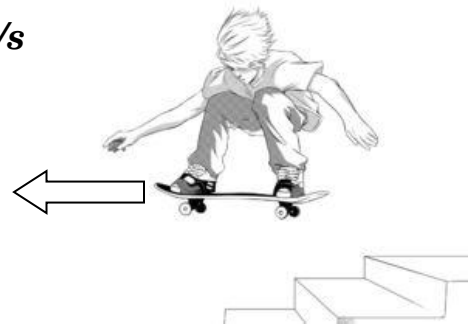*Momentum is defined as an object's mass times its velocity*

Momentum = mass x velocity

$$\vec{p} = m \; x \; \vec{v}$$

*p = momentum in **kg • m/s***

*m = mass in **kg***

*v = velocity in **m/s***

Momentum is a <u>vector</u> Quantity – it has a direction!

Question: Does momentum have a direction?
Answer:

Momentum can be an important and useful property of matter because it is a **conserved** *quantity*

This means an object's momentum <u>will not change</u> over time (if it is not subject to any <u>external</u> forces).

$$Momentum_{before} = Momentum_{after}$$

<u>*Example:*</u> *the product of a baseball's mass and velocity will not change until it experiences an external force.*

Conservation of momentum also applies to **systems of objects**.

If **a group** *of objects does not come in contact with external forces (meaning they can apply forces to each other, but are not affected by external pushes or pulls) the net momentum of the group will remain constant.*

$$Momentum_{before} = Momentum_{after}$$

<u>*Example:*</u>

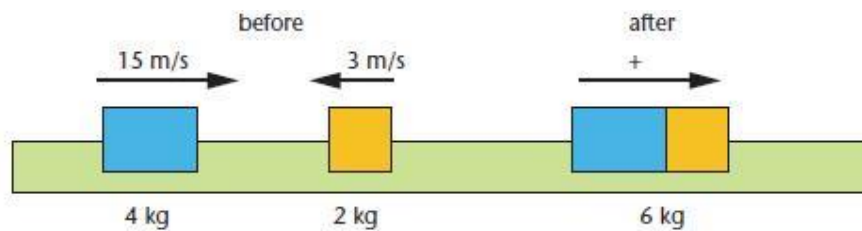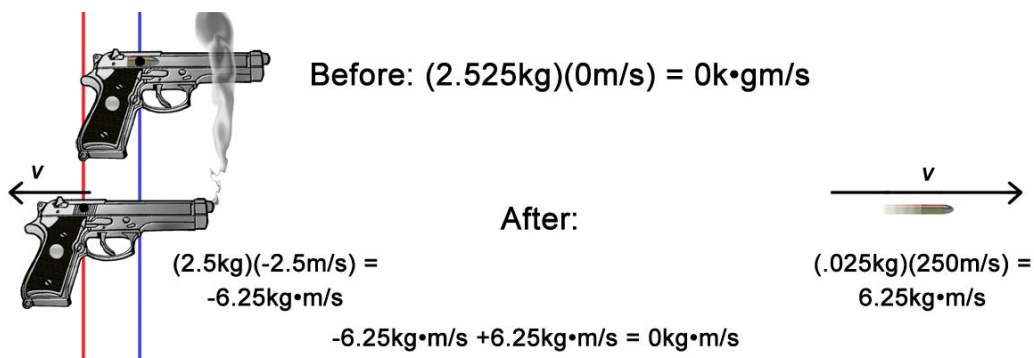*Any* **collision** *or* **explosion** *demonstrates <u>conservation of momentum</u> among objects.*

before   after

15 m/s   3 m/s   +

4 kg   2 kg   6 kg

Fig. 9.13 Two objects colliding and sticking together.

Before: (2.525kg)(0m/s) = 0k•gm/s

After:

v

(2.5kg)(-2.5m/s) =
-6.25kg•m/s

v

(.025kg)(250m/s) =
6.25kg•m/s
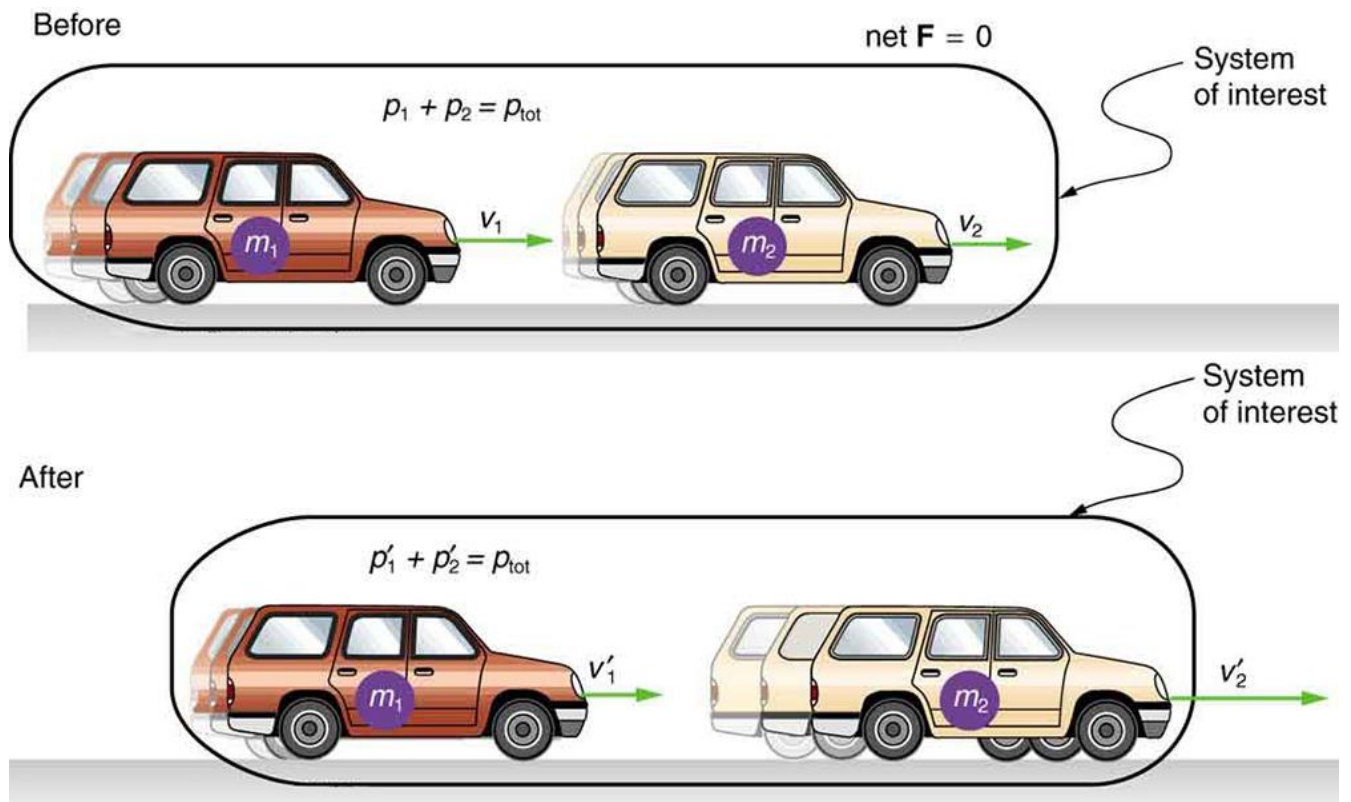
-6.25kg•m/s +6.25kg•m/s = 0kg•m/s

Conservation of Momentum

$$Momentum_{before} = Momentum_{after}$$

$$p_{before} = p_{after}$$

$$m_1 v_1 + m_2 v_2 = m_1 v_1' + m_2 v_2'$$

The symbol ' is called "prime" it means <u>after</u>

IMPULSE NOTES:

- *When an external force <u>is</u> applied to an object, its momentum <u>will</u> change.*
- *Impulse is a measurement of change in momentum. It therefore has the same units as momentum. **(kg • m/s)***
- *As an external force is applied to an object, the following is true:*

$$F \bullet \Delta t = \Delta p$$

In other words, if one applies a force to an object for a certain amount of time (∆t) then the object's momentum with change.

More force…more change in momentum
More time….more change in momentum

The symbol for impulse is capital I or sometimes J…

Impulse = I

$I = F \bullet \Delta t = \Delta p$

$$\Delta p = mv_2 - mv_1$$

$$F \bullet \Delta t = mv_2 - mv_1$$

Impulse is a Vector Quantity!