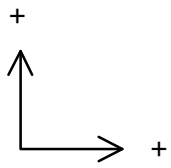
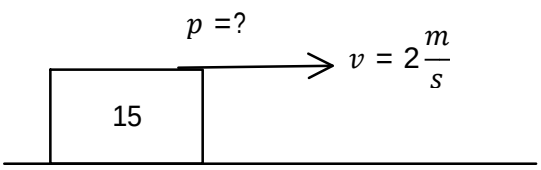
P11 - 5.1 - Momentum



What is the momentum of a $15kg$ *object moving at* $2\frac{m}{s}$.

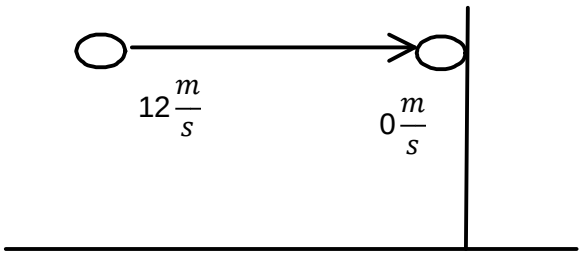


$p = mv$
$p = 15 \times 2$
$p = 30\ \frac{kgm}{s}$

$p = mv$

$\frac{kgm}{s} = Ns$

A $1kg$ *Snowball with a Velocity of* $12\frac{m}{s}$ *is thrown directly at a wall where it comes to a complete stop. What is the Snowball's Change in Momentum,* Δp *(Impulse).*

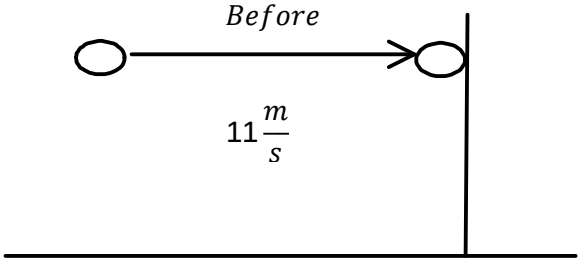


$\Delta p = m\Delta v$
$\Delta p = m(v_f - v_i)$
$\Delta p = 1(0 - 12)$
$\Delta p = -12\frac{kgm}{s}$

$\Delta p = m\Delta v$

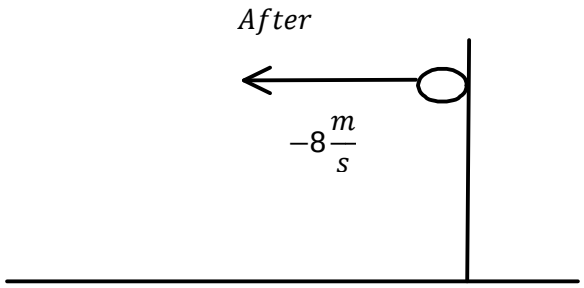
Notice the Δp *is Negative.*

A $2kg$ *Basketball with a Velocity of* $11\frac{m}{s}$ *is thrown directly at a Wall where bounces off the Wall at* $8\frac{m}{s}$.
What is the Snowball's Change in Momentum, Δp *(Impulse).*

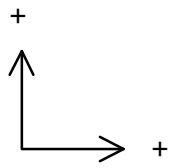


$\Delta p = m\Delta v$
$\Delta p = m(v_f - v_i)$
$\Delta p = 2(-8 - (11))$
$\Delta p = -38\frac{kgm}{s}$

$\Delta p = m\Delta v$



P11 - 5.2 - Momentum Notes



A $0.1kg$ *piece of Gum is thrown directly at a wall at* $5\frac{m}{s}$ *where it sticks to the wall and smushes in* $0.2s$. *What is the Net Force exerted on the Wall by the Gum.*

$$\Delta p = F_{net}t$$
$$m\Delta v = F_{net}t$$
$$F_{net} = \frac{m\Delta v}{t}$$
$$F_{net} = \frac{0.1 \times (0-5)}{0.2}$$
$$F_{net} = -2.5\ N$$

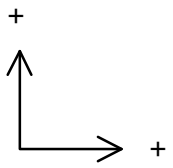
$$\Delta v = v_f - v_i$$

$$F_{net} = ma$$
$$F_{net} = m\frac{\Delta v}{t}$$
$$F_{net} \times t = m\Delta v$$
$$F_{net}t = \Delta p$$
$$\Delta p = F_{net}t$$

$$a = \frac{\Delta v}{t}$$

A Pitcher throws a $0.15\ kg$ *Ball at a Velocity of* $21\frac{m}{s}$ *directly at a Catcher who Stops the Ball exercting a Force of* $25\ N$ *on the Ball. How long does it take the ball to stop*?

$$\Delta p = F_{net}t$$
$$m\Delta v = F_{net}t$$
$$t = \frac{m\Delta v}{F_{net}}$$
$$t = \frac{0.15 \times (0-21)}{-25}$$
$$t = 0.126\ s$$

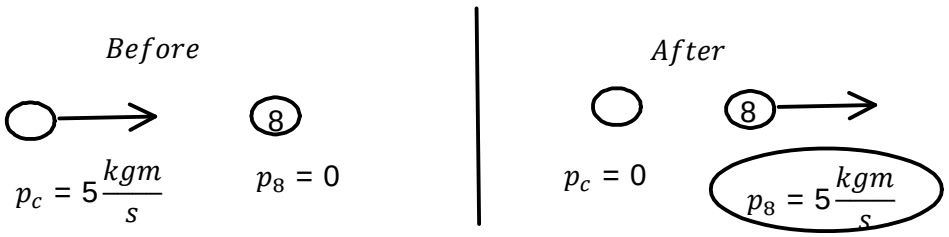


P11 - 5.3 - Conservation of Momentum Notes

The Law of the Conservation of Momentum: Momentum must be conserved!

A Pool Player shoots the Cue Ball with a Momentum of $5\frac{kgm}{s}$ *at the Eight Ball at Rest. The Cue Ball comes to a complete Stop, the Eight ball will continue with a Momentum of* $5\frac{kgm}{s}$.

What is the Change in Momentum on the Cue Ball?
What is the Change in Momentum of the Eight Ball?



$\Delta p_c = p_{fc} - p_{ic}$
$\Delta p_c = 0 - 5$

$$\Delta p_c = -5\frac{kgm}{s}$$

$\Delta p_8 = p_{f8} - p_{i8}$
$\Delta p_8 = 5 - 0$

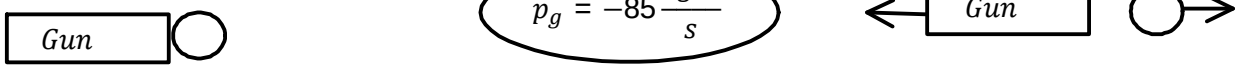
$$\Delta p_8 = 5\frac{kgm}{s}$$

$$\Delta p_c = \Delta p_8$$
$$p_{fc} - p_{ic} = p_{f8} - p_{i8}$$
$$0 - 5 = 5 - 0$$
$$5\frac{kgm}{s} = -5\frac{kgm}{s}$$

Equal and Opposite

Momentum Before = Momentum After

A Bullet is fired from a Gun with a momentum of $85\frac{kgm}{s}$. *What is the recoil Momentum of the Gun.*

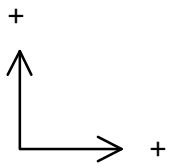


$$\Delta p_g = \Delta p_b$$
$$p_{fg} - p_{ig} = p_{fb} - p_{ib}$$
$$p_{fg} - 0 = 0 - 85$$

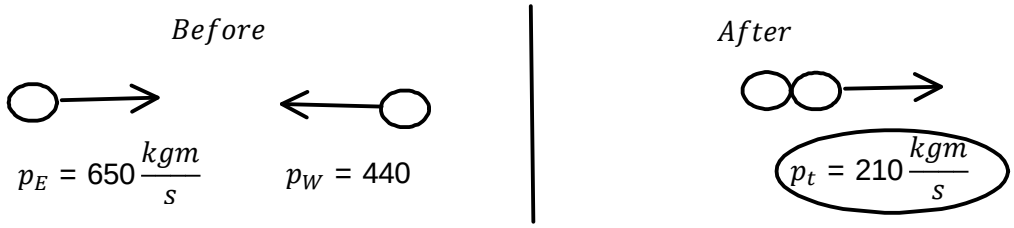
$$p_{fg} = -85\frac{kgm}{s}$$

Momentum Left = Momentum Right

P11 - 5.3 - Conservation of Momentum Notes



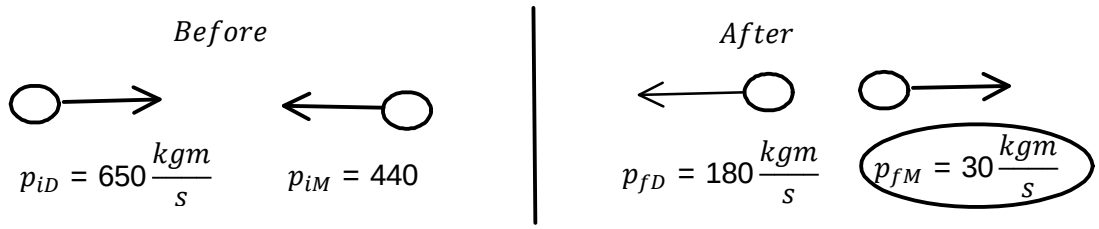
A Hockey Player with a Momentum of 650 *N East, collides with a Hockey Player with a Momentum of* 440 *N East. If they Stick together, What is their Final Momentum?*



$$\Delta p_b = \Delta p_t$$
$$p_{fb} - p_{wb} = p_{ta}$$
$$650 - 440 = p_{ta}$$
$$p_{ta} = 210\ N\ East$$

Momentum Before = Momentum After

A Hockey Player Doug with a Momentum of 650 *N East, collides with a Hockey Player Mike with a Momentum of* 440 *N East. If they Bounce off each other, and Dougs Final Momentum is* $180\frac{kgm}{s}$*, What is Mikes Final Momentum?*



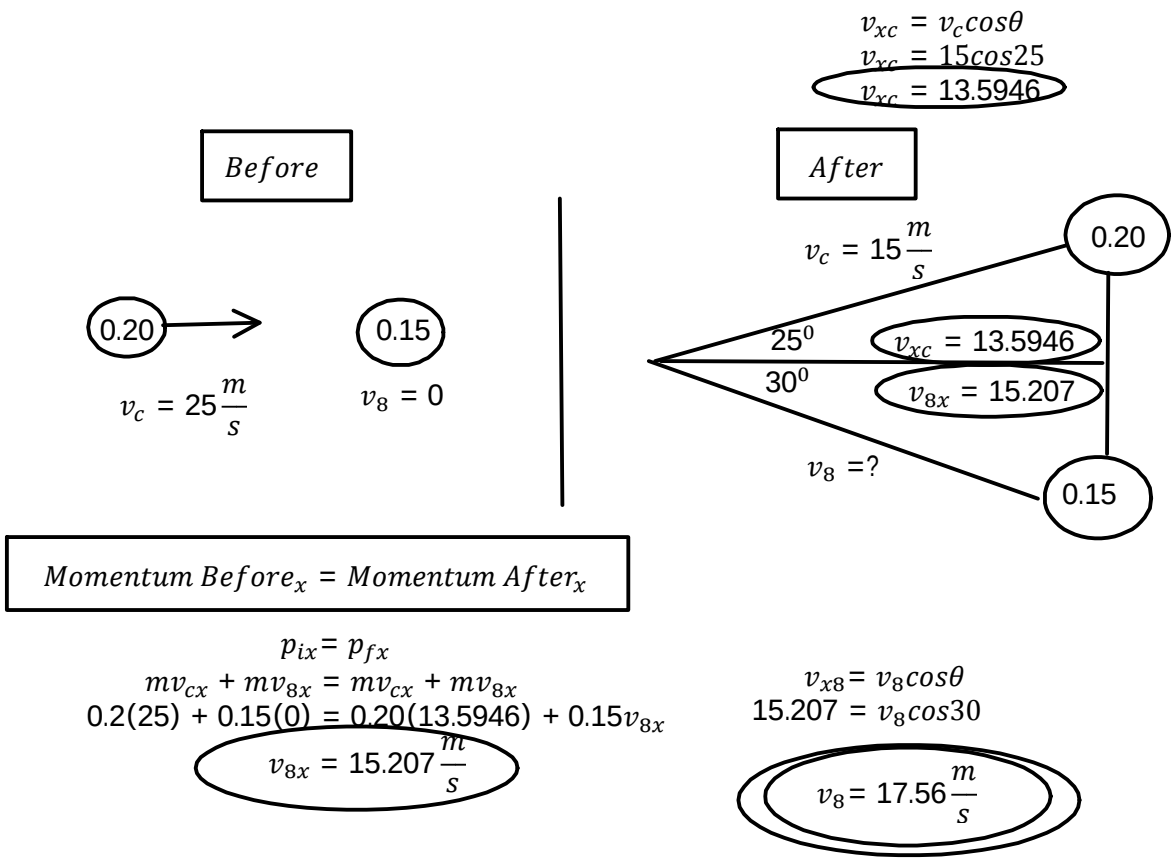
$$p_{iD} + p_{iM} = p_{fD} + p_{fM}$$
$$650 - 440 = -180 + p_{fM}$$
$$p_{fM} = 30\frac{kgm}{s}$$

$$p_i = p_f$$
$$p_{1i} + p_{2i} = p_{1f} + p_{2f}$$

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

P12 - 5.4 - Momentum Trig Notes

A Pool Player shoots the Cue Ball with a mass of 0.2 *kg with a velocity of* $25\frac{m}{s}$ *at the Eight Ball with a mass of* 0.15 *kg at Rest. The Cue Ball deflects at a velovity of* $15\frac{m}{s}$ *at an angle of* 25^0 *above the horizontal and the Eight ball deflects at an angle of* 30^0 *below the horizontal. What is the velocity of the Eight ball.*



$Momentum\ Before_x = Momentum\ After_x$

$p_{ix} = p_{fx}$

$mv_{cx} + mv_{8x} = mv_{cx} + mv_{8x}$

$0.2(25) + 0.15(0) = 0.20(13.5946) + 0.15v_{8x}$

$v_{8x} = 15.207\frac{m}{s}$

$v_{x8} = v_8 cos\theta$

$15.207 = v_8 cos30$

$v_8 = 17.56\frac{m}{s}$

P12 - 5.4 - Momentum Trig Notes

A Pool Player shoots the Cue Ball with a mass of 0.2 *kg with a velocity of* $25\frac{m}{s}$ *at the Eight Ball with a mass of* 0.15 *kg at Rest. The Cue Ball deflects at a velovity of* $15\frac{m}{s}$ *at an angle of* 25^0 *above the horizontal and the Eight ball deflects at an angle below the horizontal. What is the reultant velocity and direction of the Eight ball.*