## Momentum Conservation Problems 3 –THREE TYPES

Important notes on momentum:

- Like energy, momentum is conserved, therefore the momentum after an event is equal to the momentum after the event.
- Momentum is a vector, therefore the direction is important.

1 – Recoil tems start form rest:

A 100 kg cannon loaded with a 15 kg cannon ball is sitting on a hilltop at rest. When the cannon is fired, the ball leaves the cannon with a speed of 20 m/s. What is the recoil velocity of the cannon?

1. Calculate total momentum before the explosion.
2. Momentum after the explosion = total momentum before.
3. Calculate the momentum of the cannon ball after the explosion
4. Determine the momentum of the cannon $P_{cannon} + P_{ball} = P_{total}$
5. 5. Calculate V cannon

BEFORE

	m	v	p
Cannon	100	0	0
ball	15	0	0
	total	0	
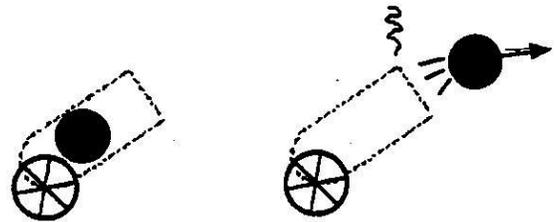
AFTER

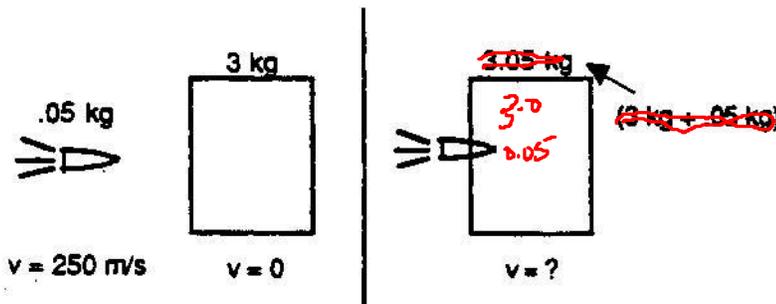|	m	v	p
Cannon	100	v	$100 \cdot v$
ball	15	20	300
	total	0	

SAmE

Find the velocity of the cannon

$$100 \cdot v + 300 = 0$$
$$100 \cdot v = -300$$

$$v = -\frac{300}{100} = -3.0 \cdot \frac{m}{s}$$

2 - Items stick together:

A .05 kg bullet is fired at a speed of 250 m/s. It imbeds itself in a 3 kg block of wood initially at rest. How fast do the bullet and wood move after the collision?

BEFORE

	m	v	p
Bullet	0.05	250	12.5
Block	3.0	0	0
	total	12.5	stay the same

AFTER

	m	v	p
Bullet	0.05	v	$0.05 \cdot v$
Block	3.0	v	$3.0 \cdot v$
	total		12.5

Using Conservation of momentum:

$$0.05 \cdot v + 3.0 \cdot v = 12.5$$
$$v \cdot (0.05 + 3.0) = 12.5$$
$$3.05 \cdot v = 12.5$$
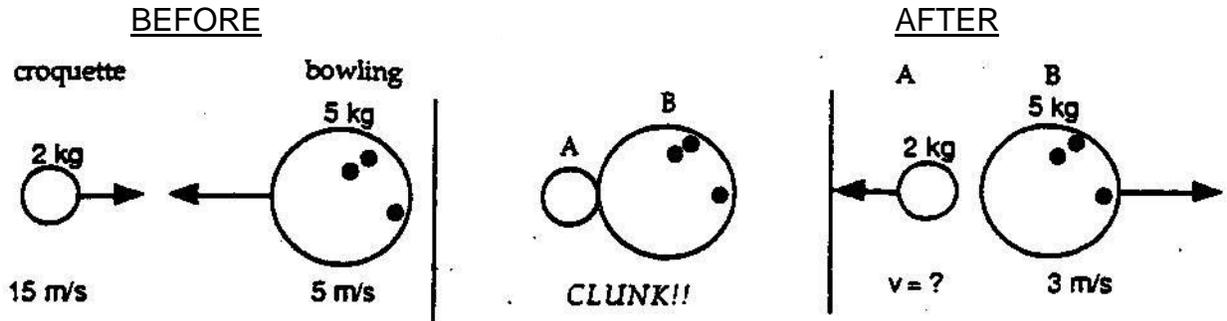$$v = \frac{12.5}{3.05} = 4.09 \cdot \frac{m}{s}$$

3 - Items bounce:

A 5 kg bowling ball moving at 5 m/s to the left collides with a 2 kg croquette ball moving at 15 m/s to the right. After the collision, the bowling ball is moving 3 m/s to the right. How fast is the croquette ball moving?

1. Decide on +/- directions (usually right, East is + and left west is -)

BEFORE   AFTER

	m	**V**	**p**		**m**	**V**	**p**
Bowling ball	5.0	- 5.0	- 25	Bowling ball	5.0	3.0	15.0
Croquette ball	2.0	15	30	Croquette ball	2.0	v	$2.0 \cdot v$
		total	5.0	say the same		total	5.0

By conservation of momentum

$15 + 2 \cdot v = 5.0$

$2 \cdot v = 5.0 - 15 = -10$

$v = -\dfrac{10}{2} = -5.0 \cdot \dfrac{m}{s}$