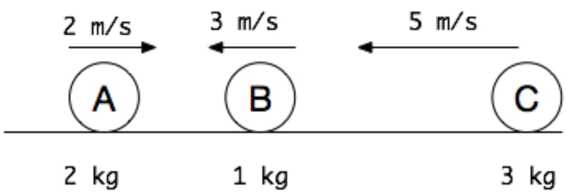
If there are no outside forces in a collision,

The total momentum before the collision must equal the total momentum afterward.

1. a) Find the total momentum of the system.
   b) If B were to collide with A, and then rebound and collide with C, what would the total momentum be?



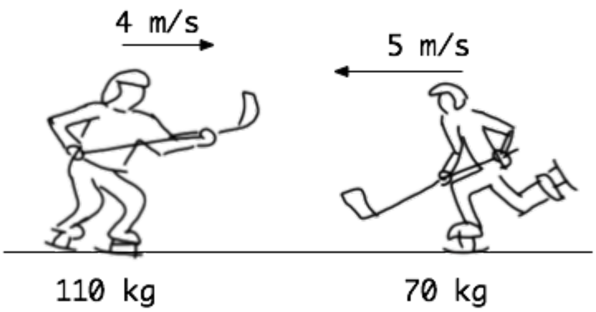
$$m_1 v_1 + m_2 v_2 + \dots$$

$$p_{sys} = (2)(+2) + (1)(-3) + (3)(-5)$$

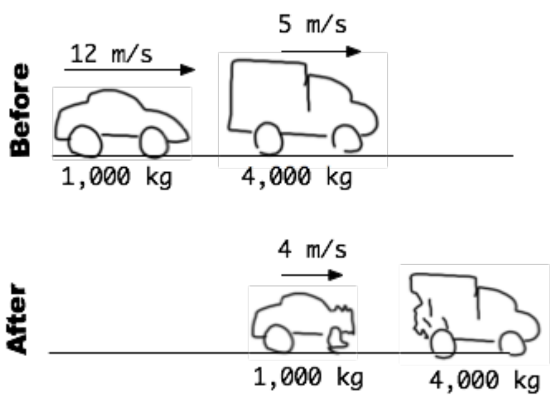
$$= 4 + -3 + -15$$

$$= -14 \text{ kg m/s}$$

2. a) Find the total momentum.
   b) If they were to collide and hold on to each other, what would their combined momentum be?
   c) What would their velocity be?



3. a) Find the total momentum before the collision.
   b) What should the total momentum after the collision be?
   c) Calculate the momentum of the car after the collision and deduce what the truck's momentum must be.
   d) What is the truck's velocity afterward?



In any system of objects where there are only internal forces...

Momentum is Conserved.

$$p_{total} = p_{total}$$

(before) (after)

Doesn't matter what kind of collision.

Range of Possible Collisions

Total Splat!

(Stick)

Completely

Inelastic

The Perfect Bounce

Completely

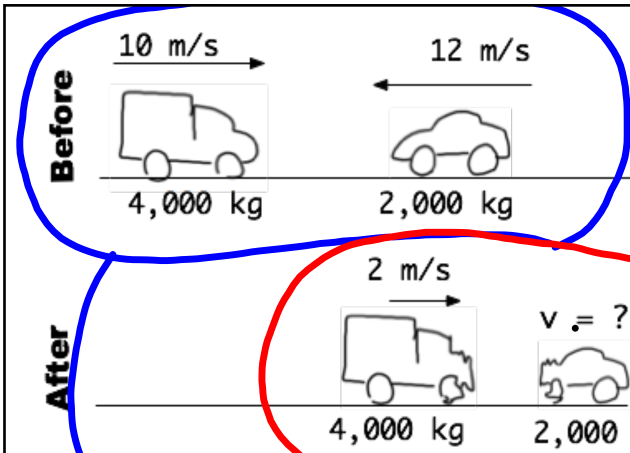
Elastic

← less bounce more bounce →

← More Inelastic More Elastic →

It doesn't have to be a collision, either. Any situation with no external forces works.

Momentum is conserved when things push apart, too (explosions).



$$P_i = P_f$$

$$(4000)(+10) + (2000)(-12) = (4000 + 2000)\,v$$

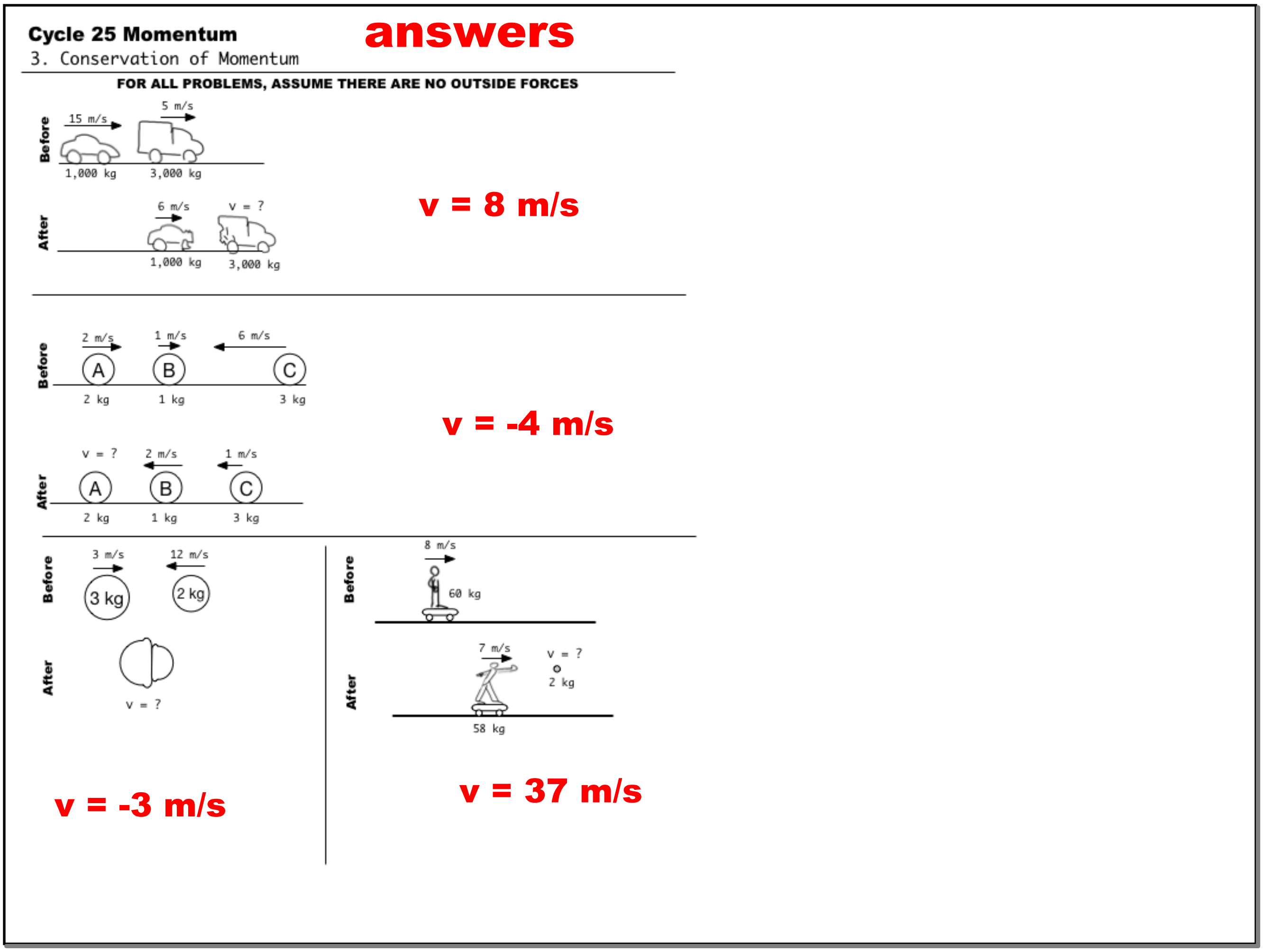
$$40{,}000 + {}^{-}24{,}000 = 8{,}000 + 2000v$$

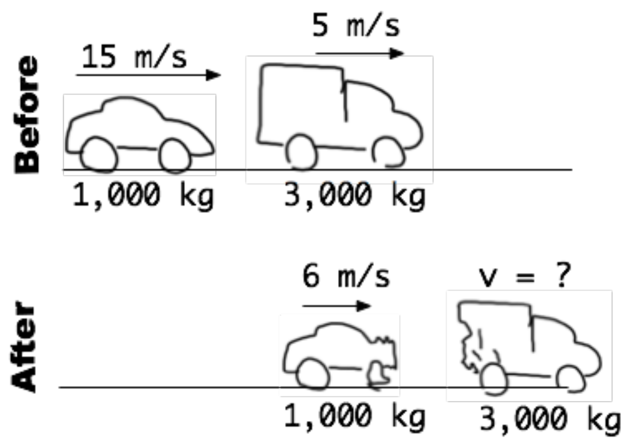
$$16{,}000 = 8{,}000 + 2{,}000v$$

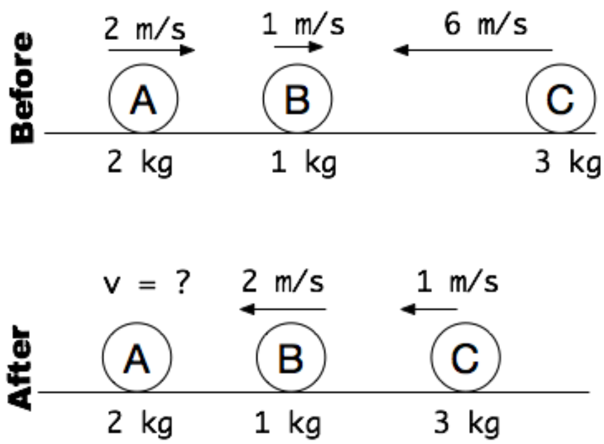
$$-8{,}000 \qquad -8{,}000$$

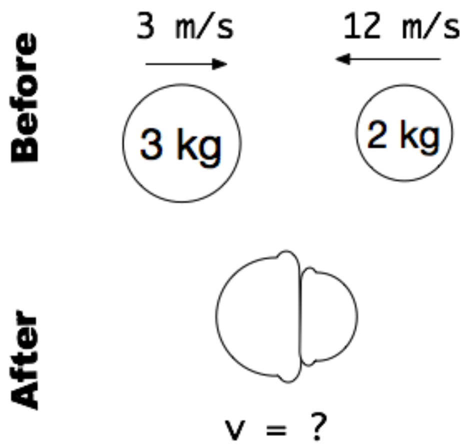
$$\frac{8{,}000}{2{,}000} = \frac{2{,}000v}{2{,}000}$$

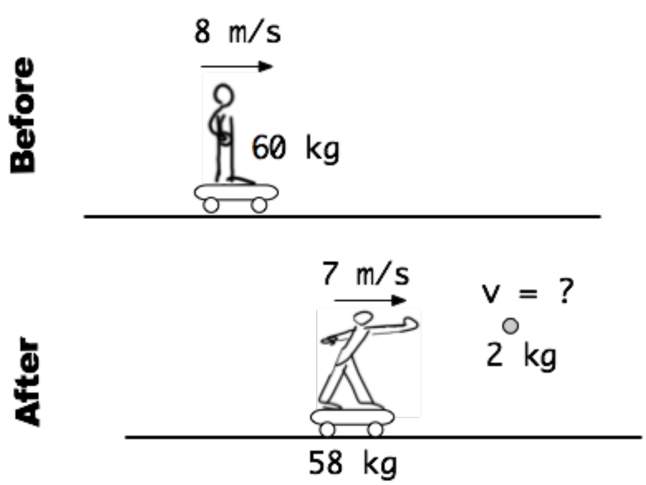
$$+4\ \text{m/s} = v$$


Cycle 25 Momentum
answers
3. Conservation of Momentum
FOR ALL PROBLEMS, ASSUME THERE ARE NO OUTSIDE FORCES
Before
15 m/s
5 m/s
1,000 kg
3,000 kg
After
6 m/s
v = ?
1,000 kg
3,000 kg
v = 8 m/s
Before
2 m/s
1 m/s
6 m/s
A
B
C
2 kg
1 kg
3 kg
After
v = ?
2 m/s
1 m/s
A
B
C
2 kg
1 kg
3 kg
v = -4 m/s
Before
3 m/s
12 m/s
3 kg
2 kg
After
v = ?
v = -3 m/s
Before
8 m/s
60 kg
After
7 m/s
v = ?
2 kg
58 kg
v = 37 m/s


Before
15 m/s
5 m/s
1,000 kg
3,000 kg
After
6 m/s
v = ?
1,000 kg
3,000 kg


Before
2 m/s
1 m/s
6 m/s
A
B
C
2 kg
1 kg
3 kg
After
v = ?
2 m/s
1 m/s
A
B
C
2 kg
1 kg
3 kg


Before
3 m/s
12 m/s
3 kg
2 kg
After
v = ?


Before
8 m/s
60 kg
After
7 m/s
v = ?
2 kg
58 kg