Worksheet: Conservation of Momentum

CHAPTER 10: Momentum

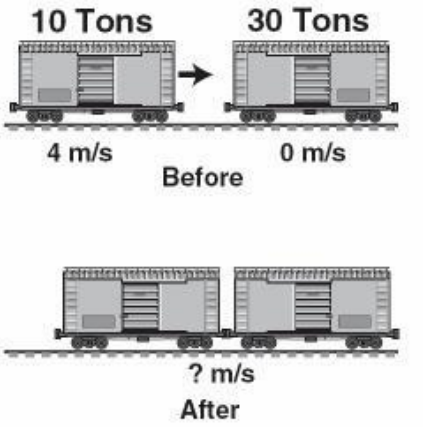
$$p = mv$$

$p_{before} = p_{after}$ **net momentum *before* = net momentum *after***

$$(m_1v_1 + m_2v_2)_{before} = (m_1v_1 + m_2v_2)_{after}$$

1. When these two freight cars of different mass collide and couple, what will be their resultant velocity?

*P before = (10,000kg*4.0m/s) + (30,000kg*0.0m/s) = 40,000kg*m/s*



*P before = P after = 40,000kg*m/s*

*P after = Combined mass*velocity*

*P after = (10,000kg + 30,000kg)*v*

v = (40,000kg---m/s) / 40,000kg = 1.0m/s

2. A 2 kg blob of putty moving at 4 m/s slams into a 6 kg blob of putty at rest. What is the speed of the two stuck-together blobs immediately after colliding?

*P before = (2.0kg*4.0m/s) + (6.0kg*0.0m/s) =*

*8.0kg*m/s*

P before = P after

AND

P after = Combined mass*velocity….. **P after = (2.0kg + 6.0kg)*v = 8.0kg*m/s**

THEREFORE

Velocity= P after /combined mass …. ***v = (8.0kg*m/s) / 8.0kg***

v= 1.0m/s

3. A football player runs at 8 m/s and plows into a 80 kg referee standing on the field causing the referee to fly forward at 5.0 m/s. What would the mass of football player be?

What do we know??? $P_{before} = P_{after}$

*P of referee before = 80kg*0m/s=0kg*m/s*

*P of player before =mass*8m/s= ?kg*m/s*

We cannot figure out the total momentum (before) of the system with this information.

Therefore, let's look at after.

$P_{before} = P_{after}$

*P of referee after = 80kg*5.0m/s=400kg*m/s*

*P of player after = mass*0.0m/s = 0kg*m/s*

P_{total} *= 400kg*m/s + 0.0kg*m/s = 400kg*m/s*

*NOW we know that the total momentum of the system before is 400kg*m/s because* $P_{before} = P_{after}$ *Now lets go back and see if we can figure out the players mass.*

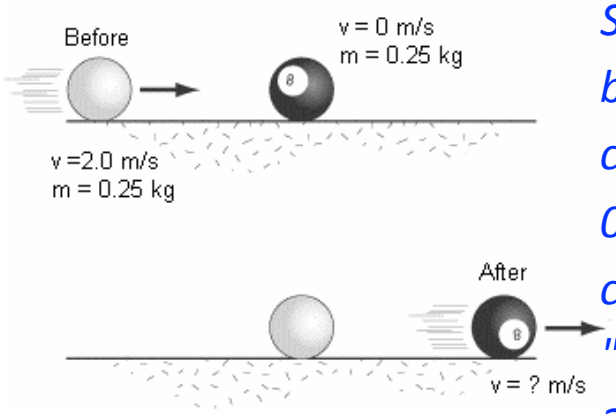
We know the $p_{total} = p_{player} + p_{referee}$ *We know that* $p_{referee}$ *is 0kg*m/s and the* p_{total} *is 400kg*m/s so let's plug it in.*

$400kg*m/s = p_{player} + 0kg*m/s \rightarrow p_{player} = 400kg*m/s$

Because we know $p_{player} = m_{player} + v_{player} \rightarrow 400kg*m/s = m_{player} + 8m/s \rightarrow$

$m_{player} = \frac{400kg*m/s}{8m/s} = 50kg$

What is the velocity of the "8" ball after the collision below?



Since the balls have the same mass, the "8" ball has a velocity of 0.0m/s before the collision, AND the cue ball has a velocity of 0.0m/s after the collision, then 100% of the cue ball's momentum is transferred to the "8". Therefore, the "8" ball has a velocity of 2.0m/s.