Momentum Problems

Due _____, _____ **pts**

Name _____ **Hour** _____

$p = mv$ | **explosions:** $m_1 v_1 = m_2 v_2$

$I = F\Delta t = m\Delta v$ | **elastic collisions:** $m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$

inelastic collisions: $m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2) v_f$

Conceptual Questions:

1. **a.** What is unit for momentum *(what it's measured in)*? _____

b. What is the variable *(letter)* we use for momentum? _____

c. If you divide momentum by velocity, what variable will you end up with? _____

d. The reason air bags are used is because they increase the _____ which decreases the force felt.

e. If you double the force needed to stop an object and $m\Delta v$ remains constant, what happens to Δt? ___

f. If you divide momentum by mass, what unit do you end up with? _____

g. If you triple the velocity and mass remains constant, what happens to the momentum? _____

h. What are the 2 units of Impulse that are equal to each other? _____ and _____

2. What is the momentum of a Rudolph (mass 42 kg) running down a hill at 5 m/s? *(ans. 210 kgm/s)*

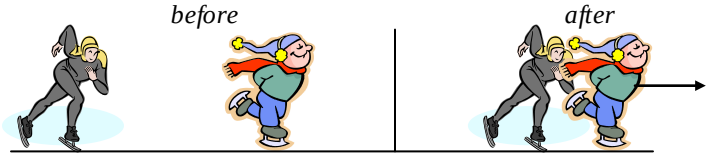
3. A snowball with a mass of 50 **grams** is fired with a velocity of 12m/s from a snowball cannon with mass of 11 kg. What would be the recoil velocity of the snowball cannon? *(ans. 0.05m/s,* ***Hint:*** *Use the explosion equation and don't forget to put the mass in kg.)*

4. What impulse would need to be applied to Papa Smurf in order to stop him from sliding across the ice if he has a mass of 8 kg and an initial speed 12 m/s? *(ans. -96 kgm/s)*

5. A skater with a mass of 50 kg glides at 7 m/s and collides with a stationary skater (mass 75 kg). If the two skaters hold onto each other, with what velocity will they move after colliding? *(ans. 2.8 m/s)*

Sketch:

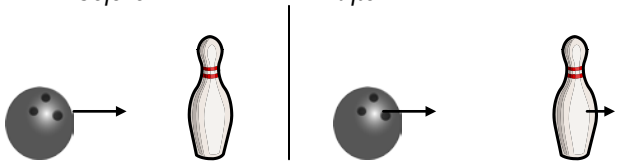
before *after*



6. An 8-kg bowling ball traveling at 2 m/s strikes a stationary 2.5-kg pin which moves off in the same straight line at 6 m/s. What is the speed of the bowling ball after the collision? *(ans. 0.125 m/s)*

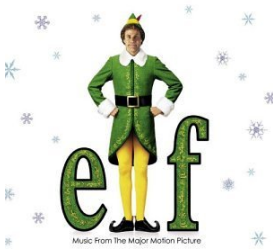
Sketch:

before *after*



7. Small rockets are used to make small adjustments in the speed of Santa's sleigh. One such rocket has a thrust of 535 N. If it is fired to change the velocity of the 900 kg sleigh from 5 m/s to 16 m/s, how long should it be fired? *(ans. 18.5 sec.)*

8. Elf throws a snowball of mass 0.20 kg is and is hit back at him by a bully with a change in velocity of 10 m/s. If the snowball and the hand of the bully were in contact for 0.025 seconds, what force was exerted by the bully on the snowball? *(ans. 80 N)*



9. A 92 kg man drops from rest from a diving board that is 5.2 m above the water and comes to rest 1.25 sec after reaching the water.

a. Solve for the velocity he hits the water with using both: (10.1 m/s)

a 1-D motion equation: **Conservation of energy:**

b. Solve for the force it takes to stop him once he hits the water using both: (743 N)

Newton's 2nd Law: **$F\Delta t = m\Delta v$**

10. A train of teddy bears, traveling at 56 **mph** and weighing 108,182 kg collides with a stationary car full of angry bird stuffed animals that weighs 6,095 **lbs**. *(Make sure to convert!)*

a. Calculate the momentum of the train before the collision. *(ans. about 2.71×10^6 kgm/s)*

b. Calculate the speed of the train with the car after the collision assuming the train and the car move in a straight line and stick together after the collision. *(ans. about 24.37 m/s)*

11. A 0.2 kg ball is thrown straight up into the air with an initial speed of 35 m/s. Find the momentum of the ball when it is **halfway to its maximum height**. (Find Δy first, then cut in ½ to find new v at that height) (4.95 kgm/s)