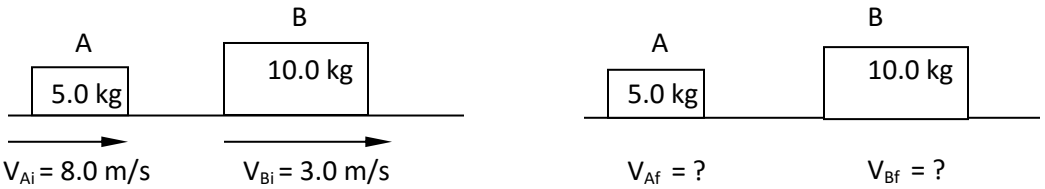
Conservation of Linear Momentum

Name: _____ Date: _____

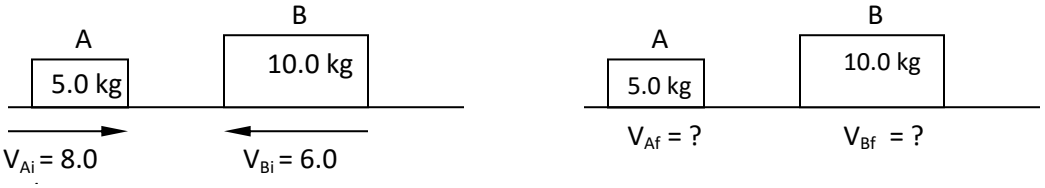
In each of the following **ELASTIC COLLISIONS** determine:

1. Predict the result of each collision
2. The final velocity of each mass
3. The impulse
4. The kinetic energies

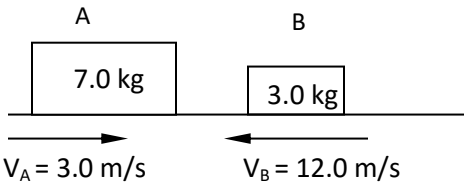
1.



2.



3.



V_{Af} = ?

V_{Bf} = ?

5. A sphere, A, of mass 2.4 kg, moving in a straight line with velocity 10 m/s makes a head-on collision with sphere B, of mass 3.6 kg, which is initially at rest. The collision is cushioned by a perfectly elastic bumper.
   a) What is the velocity of each sphere after the collision?
   b) What percent of A's kinetic energy is transferred to B by the collision?
   [Ans: -2.0 m/s, 8.0 m/s; 96%]

6. A truck of mass 3000 kg, moving at 5.0 m/s on a level, icy road, bumps into the rear of a car moving at 2.0 m/s in the same direction. After the impact the truck has a velocity of 3.0 m/s and the car a velocity of 6.0 m/s, both forward.
   a) What is the mass of the car?
   b) Calculate the total kinetic energy before and after the collision.
   c) Was the collision elastic?
   [Ans: 1.5×10^3 kg; 4.1×10^4 J, 4.1×10^4 J]

7. Two air track gliders of mass 300 g and 200 g are moving towards each other in opposite directions with speeds of 50 cm/s and 100 cm/s respectively. Take the direction of the more massive glider as positive.
   a) If the collision is elastic, find the velocity of each glider after the collision.
   b) The most "inelastic" collision would occur if the two gliders stuck together on impact. If this were the case, find the velocity of the pair after the collision and the kinetic energy lost as a result of the collision.
   [Ans: -70 cm/s, 80 cm/s; -10 cm/s, 0.135 J]

In each of the following **SITUATIONS (inelastic collisions – 1D)** determine:

1. Two gliders on an air track are pushed such that glider 1 with a mass of 300g is moving with a speed of 50 cm/s [right] and it collides with glider 2 which has a mass of 100g and is moving at 10 cm/s [right]. The collision is inelastic. Determine the speed of the coupled gliders after the collision.
   [Ans: 40 cm/s [right]]

2. Two gliders are on an air track. Glider 1 is moving at 20 cm/s [right] and has a mass of 100g. Glider two is moving at 10 cm/s [left]. The two gliders collide and stick together. Their combined final speed is 8 cm/s [right]. Determine the mass of glider 2.
   [Ans: 67g]

3. A 5000 kg boxcar moving at 5.2 m/s on a level, frictionless track, runs into a stationary 8000 kg tank car. If they hook together in the collision, how fast will they be moving afterwards?
   [Ans: 2.0 m/s (forward)]

4. A 75 kg girl running at 3.0 m/s jumps onto a sled that has a mass of 10 kg and that is already moving in the same direction as the girl, at 2.0 m/s. What will be the final velocity of the girl and the sled, assuming that the sled is on level snow and that there is no friction?
   [Ans: 2.9 m/s (forward)]

5. A 1.5 kg wooden trolley on wheels is stationary on a horizontal, frictionless track. What will be the final velocity of the trolley if a bullet of mass 2.0 g is fired into it with a kinetic energy of 90 J, and then approximately a minute or so later another bullet of mass 2.0 g traveling at the same velocity hits the trolley. (Assume that the bullets remain embedded in the trolley).
   [Ans: 0.8 m/s]

6. You (mass 70 kg) are standing on a skateboard (mass 2 kg) holding two bowling balls each of mass 8 kg. What will be your final velocity if you threw the bowling balls
   a) Off at the same time with a velocity of 10 m/s with respect to the skateboard?
   b) Off one at a time, each with a velocity of 10 m/s with respect to the skateboard?
   [Ans: a) 1.82 m/s [left] b) 1.91 m/s [left]]