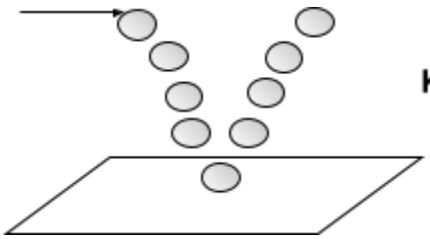
**Momentum Worksheet #3 – Elastic/Inelastic Collisions**

In all collisions, momentum is always conserved. There are three types of collisions:

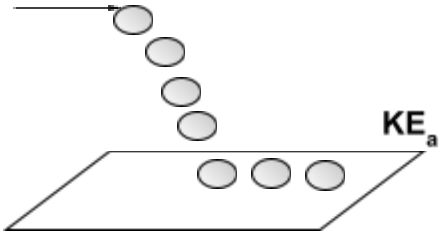
**Elastic Collisions** – A collision where energy is also conserved. Dropping a ball to the ground and seeing it rebound to the exact same height would be an example of an elastic collision. Of course, this is impossible. Elastic collisions are generally uncommon except on a molecular level such as the interaction of gases in a closed container.



$$p_a + p_b = p_a + p_b$$

$$KE_a + KE_b = KE_a + KE_b$$

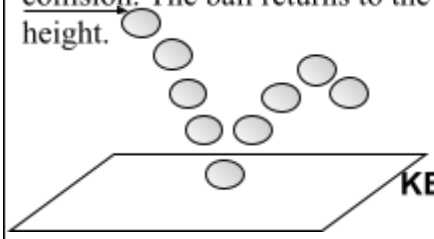
**Inelastic Collisions** – A collision where objects colliding stick together. Kinetic energy is not conserved, but momentum still is. Excess energy that comes from kinetic energy is turned primarily into heat. In the picture, the ball does not rebound!



$$p_a + p_b = p_a + p_b$$

$$KE_a + KE_b = KE_a + KE_b + Heat$$

**Partially Inelastic Collisions** – Collision where objects bounce off each other. Some energy is still lost to heat. Most common type of collision. Dropping a ball is an example of this collision. The ball returns to the air after hitting the ground, but does not reach the original height.



$$p_a + p_b = p_a + p_b$$

$$KE_a + KE_b = KE_a + KE_b + Heat$$

**Inelastic Collisions**

1. Suppose that you have a mass of 45.7 kg and are standing on frictionless roller skates. Someone then throws you a 2.50 kg mass with a velocity of 14.5 m/s and you catch it. What will be your resultant velocity? (0.75 m/s)

2. A 1250 kg car is moving down the highway with a velocity of 32.0 m/s when it bumps into the car ahead of it which has a mass of 875 kg and a velocity of 25.0 m/s. After the collision, the two cars stick together. What will be the resulting velocity of the two cars together? How much energy will be lost in this collision? (29.1 m/s, 13702 J)

3. A 9.00 kg mass is moving to the right with a velocity of 14.0 m/s. A 12.0 kg mass is moving to the left with a velocity of 5.00 m/s. Assuming that these two balls have a head on collision and stick together, what will be the final velocity of the combination? (3.1 m/s)

**Elastic Collisions**

4. An astronaut at rest in space with mass 84 kg fires a thruster that expels 35 g of hot gas at 875 m/s. What is the velocity of the astronaut after firing the thruster? (-0.36 m/s)

5. A 4.0 kg model rocket is launched, shooting 50.0 g of burned fuel from its exhaust at an average velocity of 625 m/s. What is the velocity of the rocket after the fuel has burned? (7.8 m/s)

6. A thread holds two carts together on a frictionless surface. A spring is compressed between the two carts. After the thread between the two carts is cut the cart on the left with a mass of 1.5 kg moves away with a velocity of 27 cm/s. What is the velocity of the cart on the right that has a mass of 4.5 kg? ( 0.09 m/s)

7. Two campers dock a canoe. One camper steps onto the dock. This camper has a mass of 80 kg and moves forward at 4.0 m/s. With what speed and direction do the canoe and the other camper move if their combined mass is 110 kg? (2.9 m/s backwards)

8. A 50.0 kg woman, riding on a 10 kg cart, is moving east at 5.0 m/s. The woman jumps off the front of the cart and lands on the ground at 7.0 m/s eastward. What is the final velocity of the cart? (4.6 m/s westward or -4.6 m/s)

9. A 45.0 kg ice skater stands at rest on the ice. A friend tosses the skater a 5.0 kg ball. The skater and the ball then move backwards across the ice with a speed of 0.5 m/s. What was the speed of the ball at the moment just before the skater caught it? ( 5 m/s).

Answer key:
1. (0.75 m/s)
2. (29.1 m/s, 13702 J)
3. (3.1 m/s)
4. (-0.36 m/s)
5. (7.8 m/s)
6. ( 0.09 m/s)
7. (2.9 m/s backwards)
8. (4.6 m/s westward or -4.6 m/s)
9. ( 5 m/s).