

**Momentum Problems & Calculations**  
**Honors physics**

Name \_\_\_\_\_

**Impulse Problems**  $\Delta p = Ft$  (Remember that “change in momentum” is just another name for “impulse”.)

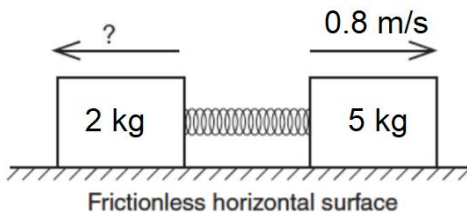
- An 8.0 kg bowling ball is initially rolling at 5.0 m/s when it strikes a bunch of pins and slows down to 2.0 m/s. Determine the following quantities.  
Initial momentum = \_\_\_\_\_ Final momentum = \_\_\_\_\_  
Change in momentum = \_\_\_\_\_ Impulse = \_\_\_\_\_
- A 75-kilogram hockey player is skating across the ice at a speed of 6.0 meters per second. What is the magnitude of the average force required to stop the player in 0.65 second?  
Initial momentum = \_\_\_\_\_ Final momentum = \_\_\_\_\_  
Change in momentum = \_\_\_\_\_ Average Force = \_\_\_\_\_
- A 0.149-kilogram baseball, initially moving at 32 meters per second, is brought to rest in 0.040 second by a baseball glove on a catcher’s hand. Calculate the magnitude of the average force exerted on the ball by the glove.  
Initial momentum = \_\_\_\_\_ Final momentum = \_\_\_\_\_  
Change in momentum = \_\_\_\_\_ Average Force = \_\_\_\_\_

**Conservation of Momentum (use when doing any sort of recoil or collision problem)**

$p_i = p_f$  which means *total momentum of system initial = total momentum of system final*

**Recoil Problems**

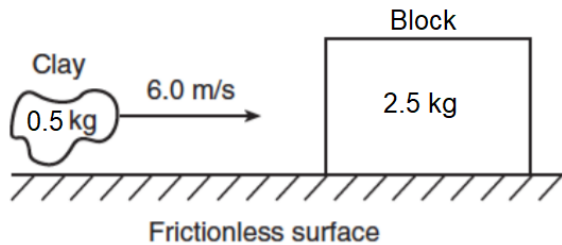
- A 50. kg student is initially at rest on ice skates while holding an 8 kg medicine ball. The student throws the medicine ball horizontally at 2 m/s. What is the recoil velocity of the student?
- Two blocks are sitting initially at rest as seen in the diagram below when the spring between them is fired. If the 5 kg cart moves to the right at 0.8 m/s, what is the recoil velocity of the other cart?



- The Mark 45 is a US Naval Artillery gun found on battleships. The 21,700 kg artillery gun is initially fired from rest, and the gun fires a 32 kg shell with a speed of 762 m/s. What is the recoil velocity of the gun?

### Perfectly Inelastic collisions where objects stick together

7. A 0.50 kg blob of clay is initially traveling at 6.0 m/s when it strikes a 2.5 kg block that is at rest. If the clay sticks to the block, what is the velocity of the clay-block system after the collision?



8. A 1200-kilogram car moving at 12 meters per second collides with a 2300-kilogram car that is waiting at rest at a traffic light. After the collision, the cars lock together and start sliding together. Calculate the speed of the locked cars immediately after the collision.

### Collisions where objects bounce off each other

9. A 3.0 kg block moving at 4.0 m/s has a head-on collision with a stationary block of mass 2.0 kg. After the collision, the 2.0 kg block is moving at 3.5 m/s. What is the velocity of the 3.0 kg block after the collision?
10. A 25.0 kg bumper car moving to the right at 5.0 m/s collides with a 35.0 kg bumper car moving to the left at -1.0 m/s. After the collision, the 25.0 kg bumper car is going 1.50 m/s to the right. What is the final velocity of the 35.0 kg bumper car after the collision?

**Answers**

1. Impulse = 24 kgm/s
2.  $F = 692 \text{ N}$
3.  $F = 119 \text{ N}$
4.  $0.32 \text{ m/s}$
5.  $2 \text{ m/s}$
6.  $1.12 \text{ m/s}$
7.  $1 \text{ m/s}$
8.  $4.1 \text{ m/s}$
9.  $1.67 \text{ m/s}$
10.  $1.5 \text{ m/s}$  (to right)