Momentum Review

1. What was Newton's Third Law? Why is it important?

2. You are holding an apple that weighs 1 N in your hand. What is the reaction force to the weight of the apple?

3. If action and reaction forces are equal and opposite, why don't they cancel out?

4. Define the following terms:
   Momentum

   Impulse

   Inelastic Collision

   Elastic Collision

5. What are the units for momentum and impulse? Show that they are the same thing.

6. Imagine you are standing still in the hallway. Do you have any momentum? Then you decide to walk down the hall. Do you have any momentum now? If momentum is conserved, how did you suddenly gain momentum?

Momentum Review

7. If you drop a glass onto a tile floor it will likely break, but if it fell the same distance onto a carpeted floor it might not. In terms of impulse and change in momentum, why is that? What does the cushioning of the carpet change? What doesn't it change?

8. What impulse is needed to stop a 2000 kg car traveling at 30 m/s?

9. A firecracker at rest explodes into two pieces. One piece has a momentum of 0.3 kg•m/s to the right. What is the momentum of the second piece?

10. A ball of clay has a momentum of 2 kg•m/s when it collides and sticks to another ball of clay at rest. What is the momentum of the clay blob when they are stuck together?

11. A force of 12 N is exerted on a cart with a mass of 0.5 kg for a time of 2.5 seconds.
    a. If the cart was initially at rest, what is the final velocity of the cart?

    b. If the cart had an initial velocity of 4 m/s in the <u>same</u> direction as the force, what is the final velocity of the cart?

    c. If the cart had an initial velocity of 4 m/s in the <u>opposite</u> direction as the force, what is the final velocity of the cart?

Momentum Review

12. A 250 kg astronaut is floating next to a satellite. The astronaut pushes off the satellite, causing the two to fly apart. The speed of the astronaut is 1.2 m/s and the speed of the satellite is 0.3 m/s.
    a. What is the mass of the satellite?

    b. Who experiences the greater change in momentum?

    c. Who experiences the greater impulse?

    d. Who experiences the greater acceleration?

    e. What is the total momentum of the astronaut and satellite before they fly apart? How about after they fly apart?

13. A 1.5 kg cart traveling at 3 m/s collides and sticks to a cart with a mass of 2 kg initially at rest.
    a. What is the speed of the carts after the collision?

    b. Which cart experienced a greater force during the collision?

    c. Which cart experienced a greater impulse during the collision?

    d. Which cart experienced a greater change in momentum during the collision?

    e. Which cart experienced a greater change in velocity during the collision?

Momentum Review

14. A 16 kg object traveling at 4 m/s East has a collision with a 9 kg object traveling at 3 m/s West. After the collision, the 16 kg object has a velocity of 1 m/s East.
    a. What is the velocity of the 9 kg object after the collision?

    b. To be clear, which direction is the 9 kg object going after the collision?

    c. What was the change in velocity of the 16 kg object due to the collision?

    d. What was the change in velocity of the 9 kg object due to the collision?

    e. Why (hopefully) are your answers to c and d different?

    f. What was the change in momentum of the 16 kg object due to the collision?

    g. What was the change in momentum of the 9 kg object due to the collision?

    h. Why (hopefully) are your answers to f and g equal and opposite?

    i. If the collision lasted only 0.03 seconds, what was the average force on the 16 kg object?

Momentum Review

Answers:

8) (–)60,000 Ns *9) 0.3 kg•m/s to the left* *10) 2 kg•m/s*

11. a) 60 m/s *b) 64 m/s* *c) 56 m/s*

12. a) 1000 kg *b) same* *c) same* *d) astronaut* *e) both = 0*

13. a) 1.29 m/s *b) same* *c) same* *d) same* *e) the 1.5 kg cart*

14. a) 2.33 m/s *b) East* *c) –3 m/s* *d) 5.33 m/s*

e) because the masses were different; smaller mass affected more by collision

f) –48 kg•m/s *g) 48 kg•m/s*

h) because momentum is conserved; the momentum lost by one object was gained by the other

i) –1600 N