Hewitt, 11th edition
Section 2-Answers by R.E.Tremblay-Please don't just copy my answers.
Think about them. Ask me to explain if you are confused or disagree.

Ch. 6 Review Questions p. 96

1. Which has a greater momentum, a heavy truck at rest or a moving skateboard?

Ans. The skate board. Momentum = mass x velocity. Since the truck is not moving, it has zero velocity and therefore has zero momentum.

2. How does impulse differ from force?

Ans. Impulse is the product of force and time. It is not just force.

3. What are the two ways to increase impulse?

Ans. Increase force or increase the time that the force is applied.

4. For the same force, which cannon imparts the greater speed to a cannonball--a long barrel or short barrel cannon?

Ans. A long barrel cannon imparts more speed than a short barrel because the projectile is in the barrel for more time. Remember, impulse = $F\Delta t$. More time means more impulse, which means a larger change in momentum, which means a faster moving cannon ball.

9. Why would it be a bad idea to have the back of your hand against the outfield wall when you catch a fly ball?

Ans. The wall would prevent your hand from moving backward as it applies the force to stop the ball. The result is a short stopping time, which would produce a large force on your hand. It would probably sting and may pop the ball out of your glove.

From $F\Delta t = \Delta p$ we get $F = \Delta p/\Delta t$. There is an inverse relationship between Force and time. A small stopping time results in a large force applied to the hand.

16. What does it mean to say that a quantity is conserved?

Ans. A quantity is conserved when its total amount never changes. Even if you can't find all the pieces, you know that they are somewhere.

Plug and Chug ch.6

1. What is the momentum of an 8-kg bowling ball rolling at 2 m/s?

   $P = mV = 8\ kg \times 2\frac{m}{s} = 16\frac{kg\ m}{s}$
2. What is the momentum of a 50-kg carton that slides at 4 m/s across an ice surface?

   $P = mV = 50\ kg \times 4\frac{m}{s} = 200\ \frac{kg\ m}{s}$
3. What impulse occurs when an average force of 10 N is exerted on a cart for 2.5 s?

   $Impulse \equiv F\Delta t = 10\ N\ x\ 2.5\ s = 25\frac{kg\ m}{s}$
4. What impulse occurs when the 10 N force acts on a cart for twice the amount of time?

   $Impulse \equiv F\Delta t$ If you double the time that the force is applied, you have doubled the impulse. 2 x 25 kg m/s = 50 kg m/s.
5. What is the impulse on an 8-kg ball rolling at 2 m/s when it bumps into a pillow and stops?

   Because impulse equals change in momentum, we will calculate the change in momentum to determine the impulse.

   $\Delta P = m\Delta V = 8$ kg x (- 2 m/s) = - 16 kg m/s. Therefore, the impulse is 16 kg m/s backward.

Extra: Why might a wine glass survive a fall onto a carpet floor but not onto a concrete floor?
Ans. The carpet provides a larger stopping time than a concrete floor. This will result in a smaller force for any given change in momentum.

From $F\Delta t = \Delta p$ we get $F = \Delta p/\Delta t$. There is an inverse relationship between Force and time. A large stopping time results in a small force applied to the glass.

Extra: Why can we say that when we fire a bullet from a gun, that momentum is conserved.
Ans. The total momentum of the gun and bullet before the trigger is pulled is zero. If we add the momentum of the bullet to the momentum of the gun after the trigger is pulled, we expect to get zero. Remember that momentum is a vector, meaning that it has both magnitude $F\Delta t = M\Delta V$ and direction. As an example, pretend that the bullet has momentum of
+ 2 kg m/sec. The gun will have - 2 kg m/sec. +2 -2 = 0

Ch. 6 Exercises p. 98; 11th edition

1. To bring a supertanker to a stop, its engines are typically cut off about 25 km from port. Why is it so difficult to stop or turn a supertanker?

Ans. A moving supertanker will have a lot of momentum even when it is moving slowly because it has a lot of mass. Momentum is found by multiplying the objects mass times its velocity.

2. In terms of impulse and momentum, why do padded dashboards make automobiles safer?
Ans. Padded dashboards are safer than unpadded dashboards because the padded dashboard will increase the time required to stop your head from moving forward during an accident. The increased stopping time results in a smaller force being applied to the person's head. Algebraically we can see that the force 'F' is inversely proportional to the stopping time.
If we solve $F\Delta t = M\Delta V$ for 'F', we get:

$$F = \frac{M\Delta V}{\Delta t}$$

3. In terms of impulse and momentum, why do air bags in cars reduce the chances of injury in car accidents?
Ans. The air bag increases the stopping time and therefore decreases the force applied to your face.
5. In terms of impulse and momentum, why are nylon ropes, which stretch considerably under tension, favored by mountain climbers?
Ans. If the climber falls, he hopes that the rope will apply the force that stops him. The stretching of the nylon rope increases the stopping time, which decreases the force on his body. Again, we can say that the force is inversely proportional to the time that the force is applied.

$$F = \frac{M\Delta V}{\Delta t}$$

12. It is generally much more difficult to stop a heavy truck than a skateboard when they move at the same speed. State a case where the moving skateboard could require more stopping force. (Consider relative times.)
Ans. The skateboard could require a larger stopping force than the truck if the stopping time for the skateboard was very small.

$$F = \frac{M\Delta V}{\Delta t}$$

16. Would you care to fire a gun with a bullet that is ten times as massive as the gun? Explain.
Ans. This is answered in Tremblay's 'Impulse and change in momentum lesson.

Ch. 6 Exercises ; 11th edition
p. 101 continued

18. If a ball is projected upward from the ground with 10 kg m/s of momentum, what is the momentum of recoil of the world? Why do we not feel this?
Ans. The earth must recoil with 10 kg m/s of momentum. The earth has so much mass that it would have a very tiny change in its velocity.

$\Delta P \equiv M \Delta V$

Solving for ΔV, $\Delta V = \frac{\Delta P}{M}$

The Earth's change in velocity is inversely proportional to its mass.

27 A fully dressed person is at rest in the middle of a pond on perfectly frictionless ice and must get to shore. How can this be accomplished?
Ans. The person could take off their shoe and throw it in the opposite direction that they want to go in. Conservation of momentum demands that they will move slowly in the opposite direction on the frictionless ice. This is discussed in Tremblay's 'Momentum' lesson.

46. When you are traveling in your car at highway speed, the momentum of a bug is suddenly changed as it splatters onto your windshield. Compared to the change in momentum of the bug, by how much does the momentum of your car change?
Ans. The car has the same amount of change in momentum as the bug does. This is discussed in Tremblay's lesson on momentum. So why does the bug die?

48. If a massive Mack truck and a small mass Ford Escort have a head-on collision, which vehicle will experience the a) greater force of impact? b) the greater change in momentum? c) the greater acceleration.
Ans. a) Same size force on the truck and the Ford Escort-Newton's 3rd law.
b) Same size impulse on the truck and Ford Escort- FΔt. The same size impulse tells us that they will experience the same size change in momentum of the Mack truck and Ford Escort-

$Impulse = \Delta P$

c) The Ford Escort will have a much larger change in Velocity than the massive Mack truck. $\Delta V = \frac{\Delta P}{M}$; and from the definition of acceleration, $a \equiv \frac{\Delta V}{\Delta t}$, the Escort will have a much larger acceleration. Acceleration kills! From Newton's second law of motion, we can see that acceleration is inversely proportional to the object's mass. Small mass, larger acceleration.

49. Would a head-on collision between two cars be more damaging to the occupants if the cars stuck together or if the cars rebounded upon impact?
Ans. The occupants in a head on collision will experience an impulse equal to their change in momentum. If the vehicles bounce, there is a larger change in momentum and therefore a larger impulse.

Ch. 6 Problems; 11th edition
Pg. 100

1. What is the impulse to stop a 10-kg bowling ball moving at 6 m/s?
Ans.
Because $Impulse = \Delta P$, to answer the question, we will calculate the change in momentum of the bowling ball.

$$\Delta P = M \Delta V = 10\ kg \times \left(-6\ \frac{m}{s}\right) = -60\ \frac{kg\ m}{s}$$

Therefore the impulse is 60 kg m/sec backward

2. Joanne drives her car with a mass of 1000 kg, moves at 20 m/s. What braking force is needed to bring the car to a halt in 10 seconds?

Ans. We start with the impulse equals the change in momentum equation
we see that ,

$$F \wedge t = M \wedge V$$

Next, solve it for force,

$$F = \frac{M \Delta V}{t} = \frac{1000\ kg \left(-20\ \frac{m}{s}\right)}{10\ s} = -2000\ \frac{kg\ m}{s^2}$$

The breaking force must be 2,000 newtons backward.

6. Lillian (mass 40 kg) standing on slippery ice catches her leaping dog (mass 15 kg) moving horizontally at 3 m/s. What is the speed of Lillian and her dog after the catch?

Ans. Conservation of linear momentum is the key concept that allows us to solve this problem. The total momentum before Lillian catches her dog and the total momentum after Lillian catches her dog must remain unchanged. This problem is solved in the 'Momentum' lesson on my website, retremblay.net

7. A 5-kg fish swimming 1 m/s swallows an absent minded 1-kg fish swimming toward it at a velocity that brings both fish to a halt immediately after they collide. What is the velocity v of the smaller fish before lunch?
Ans. Conservation of linear momentum is the key concept that allows us to solve this problem. This problem is solved in the 'Momentum' lesson on my website, retremblay.net