Hewitt, 11th edition
Section 2-Answers by R.E.Tremblay

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.

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 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.

$$F\Delta T = \Delta P \text{ therefore } F = \frac{\Delta P}{\Delta T}$$

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.

$$F\Delta T = \Delta P \text{ therefore } F = \frac{\Delta P}{\Delta T}$$

Again, we can say that the force is inversely proportional to the time that the force is applied.

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.

$$F\Delta T = \Delta P \text{ therefore } F = \frac{\Delta P}{\Delta T}$$

16. Would you care to fire a gun with a bullet that is ten times as massive as the gun? Explain.
Ans. Ask in class.

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 units of momentum. The earth has so much mass that it would have a very tiny change in its velocity.

$\Delta P = M\Delta V$ therefore $\Delta V = \frac{\Delta P}{M}$

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.

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. Ask for a more detailed explanation in class. So why does the bug die?

48. If a Mack truck and a Ford Escort have a head-on collision, which vehicle will experience the greater force of impact? The greater change in momentum? The greater acceleration.
Ans. Same size force on the truck and the Ford Escort. Same size impulse on the truck and Ford Escort. Same size change in momentum of the truck and Ford Escort.
The Ford Escort will have a much larger acceleration than the truck. Acceleration kills!
$a = \frac{f}{m}$
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.

$$F\Delta T = \Delta P = M\Delta V$$

$= 10kg(-6\frac{m}{s}) = -60\frac{kgm}{\sec} = 60$ 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. Using the impulse equals the change in momentum equation

$$F\Delta T = \Delta P = M\Delta V$$

we see that ,

$$F = \frac{M\Delta V}{\Delta T} = \frac{1000kg(-20m/s)}{10\sec.} = 2000\ newtons\ backward$$

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?
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. Ask in class.