Name: _____ Block: _____ Unit 4 Problems: Momentum

4A:Momentum

1. A skateboard has a mass of 3 kg and is moving at 4 m/s.
    a. How much does the skateboard weigh?
    b. What is its momentum?
    c. If the skateboard hits a rough patch of cement and slows from 4 m/s to 2 m/s what is the change in momentum of the skateboard?
    d. If someone pushes the skateboard as is moving at 4 m/s and gives the skateboard 3 N*s of momentum what is new momentum?

2. A light car and a heavy truck crash into each other. Which one experiences a greater impulse?

3. When catching a ball, coaches advise players to reach out for the ball and to move their arms back as they catch it (baseball catcher - Method 1). They advise against holding their arms stiff against their body (football player - Method 2).

    a. Does the impulse of the caught ball change depending on the catching method used? Explain.
    b. Does the time in contact with the ball change depending on the method used? Explain.
    c. Does the impact force from the ball change depending on the method used? Explain.
    d. Explain why method one is better using the impulse momentum equation.
    e. What happens to the impact force from the ball if time in contact with the ball is tripled?

4. A flower pot falls on your head. Will it hurt more if the flower pot breaks or if it bounces off of your head? Explain using impulse. (Assume the time of the impact is the same in either case.)

5. The internet says that if you drop your phone and it is about to hit the ground you should put out your foot so that it hits your foot instead of the ground.This will reduce the likelihood of your phone breaking. (A iPhone 7 has a mass of 138 g)
    a. If you drop your phone out of your hands (about 1.5 m above the ground), what will be the speed of the phone as it hits the ground?

b. If it takes the phone one hundredth of a second to come to a stop what will be the impact force on the phone?
c. If your phone takes 4 hundredths of a second to come to a stop by how many times have you reduced the impact force on your phone?

6. In a Looney Tunes cartoon the Roadrunner (60 kg) sneaks up behind Wile E. Coyote (70 kg) and says "Beep, Beep". Wile E. Coyote is scared and jumps into the air. It takes him about 10 seconds for the complete up and down motion.
   a. How high did Wile E. Coyote jump into the air?
   b. How fast is he moving when he hits the ground?
   c. If his collision with the ground takes .01 s how much force is applied to him?

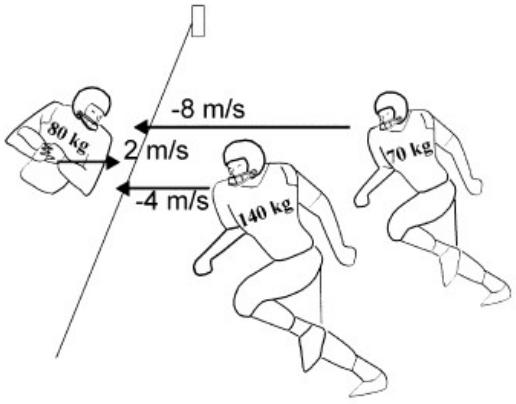
4B:Collisions

7. A blue block (3 kg) is moving to the right at 10 m/s. It runs into a red block (2 kg) that is initially at rest. How fast will each of the blocks be moving if...
   a. They stick together?
   b. They bounce off of each other and the blue block moves to the right at 4 m/s?

8. Collisions are an integral part of the game of billiards.
   a. The stationary 8-ball on a pool table is hit by a moving cue ball. Is it possible for both balls to be at rest immediately after their collision? Explain why or why not.
   b. Now suppose that the 8-ball and 7-ball were rolling **towards each other** and collide. Is it possible for both balls to be at rest immediately after their collision? Explain why or why not.

9. If you are in car accident is it more dangerous to be in an elastic or an inelastic collision? Why?

10. You are a football player running down the field about to score a touchdown. Between you and the end zone there are two opposing players trying to stop you, a large player moving slower and a small player moving faster. You have to run through one of them.
    a. Which player has more inertia?
    b. Which player(s) has most momentum?



c. What will be your resulting velocity if you run into the smaller player?
d. What will be your resulting velocity if you run into the larger player?
e. Assuming the collision with either player will last the same amount of time, which player will hurt less? (Hint: Use the impulse-momentum equation)

11. You are a consultant for the MLB who has been hired to determine the ideal bat weight for Matt Barnes. You are doing an analysis where Matt is testing out two different bats to determine which one will result in a faster batted ball speed. One bat is the Black Magic at 0.567 kg (20 oz) and the second bat is the Louisville Slugger at 0.737 kg (26 oz). Matt Barnes tests each bat against a pitching machine that will pitch a standard 145 g baseball at a speed of 33.53 m/s (75 mph). (1 mi = 1600 m)
    a. Which bat will be easier to swing? Explain why using the concept of inertia.
    b. What type of collision can you assume is happening?
    c. What will be the baseball's batted speed if Matt can swing the Black Magic at 17.89 m/s and bat recoils backwards at 3 m/s?
    d. What will be the baseball's batted speed if Matt can swing the Louisville Slugger with at 13.41 m/s and bat recoils backwards at 2 m/s?
    e. Convert the two batted ball speeds to miles per hour.
    f. In general should Matt stick to lighter bats or heavier bats? Explain why using the following terms: mass, velocity, momentum.

12. "If everyone in the world stood close to each other and jumped at the same time would the Earth move?" (earth's population = 7.5 billion people, mass of Earth = Mass of Earth: $5.972*10^{24}$ kg)
    a. The average person can jump about 36 cm high. How fast is the average person moving when they hit the Earth?
    b. If the average person has a mass of 80 kg how much momentum do they have right before they hit the Earth?
    c. How fast would the Earth be moving once everyone landed back on Earth? Would we notice this motion?