

Section 1 - True/False - Write the word "true" or "false" in the space provided (3 pts. Each)

1. If the *net force* on a system of objects is zero, then the *change in momentum* of the system is zero. _____
2. In any collision, the *force* on an object is equal to the *change in momentum* of the object. _____
3. If an elephant and a canary are travelling at the same velocity, they both have the same *speed* and *momentum*. _____
4. A ball that bounces off the floor experiences a greater change in momentum than a ball of equal mass that sticks to the floor. _____
5. When a baseball bat hits a ball, the bat and the ball experience the same *change in momentum*. _____
6. A rocketship is pushed forward by the gases that are forced out the back of the ship. _____
7. In order to make a cart move forward, a horse *must pull harder* on the cart than the *cart pulls on the horse*. _____
8. If you consider the "action" force to be the *Earth pulling on you*, then the "reaction" force is the *ground pushing up on you* with an equal and opposite force.

9. Newton pulls an object across the floor with *increasing velocity*. The force that Newton exerts on the object is *greater than the friction force* on the object.

10. An automobile airbag works primarily because it lowers the *change in momentum* of the driver. _____

Section 2 - Definitions - Define each term (3 pts)

1. Momentum
2. Impulse
3. Impact

4. Inertia

5. Acceleration

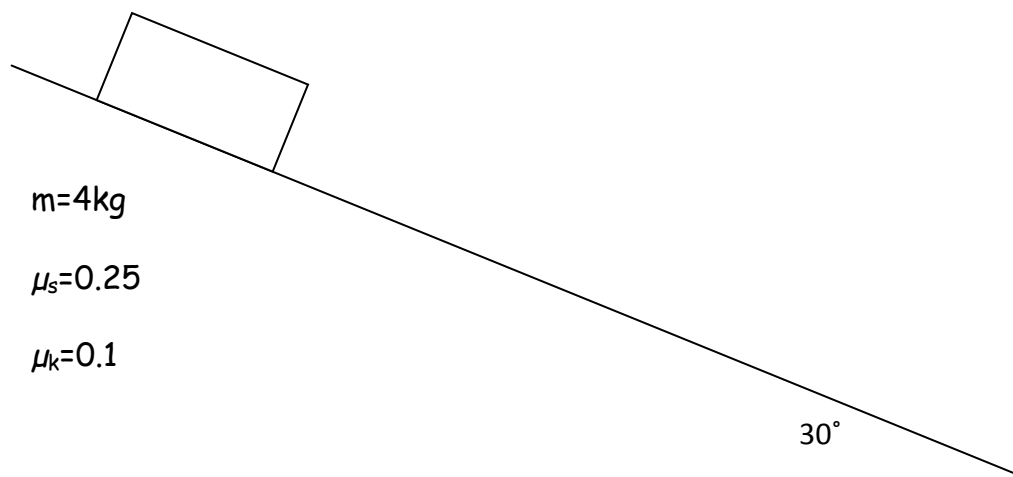
Section 3 - Short Answer - Answer each in complete sentences (4 pts. Each)

1. What is the main difference between an *elastic* and an *inelastic* collision?
2. What is the Law of Conservation of Momentum, and how does it apply to collisions?
3. If a rifle fires a bullet to the right, why **must** the rifle move to the left?
4. If you crash your car into a tree, why is it advantageous for the front end of the car to crumple?
5. Let's say a large vehicle, travelling very fast, has a head on collision with a small vehicle, travelling very slowly. Compare the momenta of the vehicles. Now compare the **changes** in their momenta.

Section 4 - Problems - Show all of your work neatly and completely, and be sure to include correct units in your answer (5 pts each)

1. A 5,000kg spaceship is travelling through space at a constant velocity of 200m/s. The captain of the ship decides to go faster, and fires the booster rocket for 20s. The booster produces an average thrust of 10,000N of thrust. After the booster firing, how fast is the spaceship travelling?

2. Cart A has a mass of 4kg, and is travelling 4m/s to the right, when it collides elastically with Cart B, with a mass of 3kg, and travelling 3m/s to the left. After the collision, cart B travels to the right at 5m/s. What is the post-collision velocity of Cart A?
3. A 3.0kg rifle fires a 0.030kg bullet with a speed of 300m/s. What is the recoil velocity of the gun?
4. A fan cart is released from rest on a smooth, horizontal, aluminum track (assume no friction). The cart has a mass of 1.5kg, and it takes the cart 2.0 seconds to reach the end of the 2.0m-long track. How much thrust is produced by the fan?
5. In the figure below, a wooden block is released from rest on a smooth incline. Calculate the acceleration of the block



Section 5 - Take-Home Essay - Answer on a separate sheet (10 pts)

In the Mythbusters Episode titled, "Hammer Drop," Adam and Jamie dropped Buster from 150 ft. into water. Adam placed an accelerometer in Buster's head to analyze his fall. Explain what an accelerometer is, and how it was used to assess the "damage" to Buster. Compare this to how accelerometers are used in the automobile industry to analyze car crashes.