Momentum & Energy Conservation Review

Name: _____ Date: _____

1. Explain the difference between and inelastic and elastic collision. (Discuss in terms of momentum and kinetic energy)

2. Miles Tugo and Ben Travlun are riding in a bus at highway speed on a nice summer day when an unlucky bug splatters onto the windshield. Miles and Ben begin discussing the physics of the situation. Miles suggests that the momentum change of the bug is much greater than that of the bus. After all, argues Miles, there was no noticeable change in the speed of the bus compared to the obvious change in the speed of the bug. Ben disagrees entirely, arguing that that both bug and bus encounter the same force, momentum change, and impulse. Who do you agree with? Support your answer.

3. In an effort to exact the most severe capital punishment upon a rather unpopular prisoner, the execution team at the Dark Ages Penitentiary search for a bullet that is ten times as massive as the rifle itself. What type of individual would want to fire a rifle that holds a bullet that is ten times more massive than the rifle? Explain.

4. Calculate the speed of an 1800 kg car with a momentum of 30,000 kg m/s. [17 m/s]

5. A 1500 kg car accelerates from rest at 4.0 m/s/s for 6.0 s. Calculate the change in momentum and impulse acting on the car. [3.6×10^4 kg m/s]

6. A golf club exerts an average net force of 7200 N on a ball for the 0.0005 s they are in contact.
   a) Calculate the impulse of the impact on the ball. [3.6 Ns]
   b) If the ball has a mass of 45 g, what velocity will it have as it leaves the club face? [80 m/s]

7. A puck (m = 0.115 kg) slides along frictionless ice at 16 m/s. It encounters a rough patch of ice that is 3 m in distance and slows down to a speed of 12 m/s. Calculate the change in momentum as well as the time it takes to travel through the rough patch and the average force acting on the puck.

8. A 1.2×10^4 kg railroad car is coasting along a level, frictionless track at a constant speed of 25 m/s, when a 3000 kg load is dropped vertically onto the car from above. Calculate the new speed, assuming the load stays on the car and that there is no slipping. [20 m/s]

9. A 45 kg boy is running at 4.0 m/s when he jumps onto a new 15 kg sled, at rest on a frozen lake. Calculate the velocity of the boy and sled, if he hangs on. [3.0 m/s]

10. A 125 kg astronaut (with all of her equipment) pushes off from her 2500 kg space capsule, acquiring a velocity of 2.0 m/s. (Assume both were initially at rest). A) Calculate the velocity of the space capsule, after she pushes off. B) If she is tethered to the space capsule with a 25 m line, what time will elapse before the line becomes taut? [a) -0.10 m/s b) 12 s]

11. A 24 g bullet is fired horizontally, embedding itself in a 10 kg block initially at rest on a horizontal ice surface. The block slides along the ice, coming to rest in 2.0 s at a distance of 60 cm from its original position. Assuming that the frictional force stopping the block was constant, calculate the velocity of the bullet. [250 m/s]

12. A) A polar bar of mass 999.9 kg lies sleeping on a horizontal sheet of ice. A hunter fires a 0.10 kg bullet at the bear with a speed of 1000 m/s. How fast does the bear (with the bullet embedded in a non-vital area) slide, after being hit? [0.10 m/s]
    B) Another polar bear, of mass 990 kg, is wearing a 10 kg bulletproof vest, and is hit by the same hunter. In this case, the bullet bounces straight back with negligible change in speed. How fast does the bear slide, after being hit? [0.20 m/s]

13. A 2000 kg car travelling east at 24 m/s enters an icy intersection and collides with a 3600 kg truck travelling south at 10 m/s. If they become coupled together in the collision, calculate their velocity immediately after impact. [11 m/s [E37^{o}S]]

14. A steel ball of mass 0.50 kg, moving with a velocity of 2.0 m/s, strikes a second ball of mass 0.30 kg, initially at rest. The collision is a glancing one, causing the first ball to be deflected at an angle of 30^{o}, with a speed of 1.50 m/s. Determine the velocity of the second ball after the collision, giving both its speed and direction. [1.7 m/s [R47^{o}D]]

15. A 3000 kg space capsule is travelling in outer space with a velocity of 200 m/s. In an effort to alter its course, it fires a 25.0 kg projectile perpendicular to its original direction of motion at a speed of 2000 m/s. Calculate the new speed of the space capsule and the new angle. [202 m/s [4.76^{o}]]

16. Two bumper cars are moving towards each other. Bumper car one is moving at 5 m/s to the right and has a mass of 120 kg. Bumper car two is moving at 8 m/s to the left and has a mass of 45 kg. Predict the final state then calculate the final speeds of both cars if the collision is completely elastic. Which car would you rather be in an explain why! [Solve using which ever method you wish] – compare your prediction to the calculation. [-2.1 m/s and 10.9 m/s for car 1 and 2 respectively]