Name: _____
Hour: ____ Date: _____

Physics: *Momentum HW*

Set 1: Momentum

1. Your 32 kg dog is running toward you at 4.2 m/s. You are facing north. Find the dog's momentum.

G:

U: S:

E: S:

2. What velocity must a 1.84×10^3 kg truck have in order to have a momentum of 4.2×10^4 kg-m/s west?

G:

U: S:

E: S:

3. A 31.5 kg child rides a 6.2 kg bike at 3.7 m/s southwest. Find the total momentum of the child/bike system.

4. Two masses, m_1 and m_2, are attached to each other. The combined mass is moving and has momentum p. In terms of m_1, m_2, and p, find the magnitude v of the combined mass's speed.

Set 2: Force and Impulse

5. A pitcher throws a 0.16 kg baseball at 19 m/s to the right. The catcher brings the ball to rest in 0.024 s. What force (magnitude and direction) is exerted on the ball by the catcher?

G:

U: S:

E: S:

ANSWERS: 1. 130 kg m/s S 2. 23 m/s W 3. 140 kg m/s SW 5. 130 N to the left

6. A 0.62 kg kickball approaches a player at 3.8 m/s north. The player kicks the ball, causing it to move at 12 m/s in the opposite direction. What impulse was delivered to the kickball by the player?

7. A 0.073 kg hockey puck is moving at 2.7 m/s to the right when a 0.94 N net force in the direction of its motion acts on the puck over a time of 0.85 s. What is the velocity of the puck at the end of this interval?

G:

U: S:

E: S:

8. A 9150 kg bus is initially traveling at 18.8 m/s west. If a braking force of 2.00×10^4 N is applied to the bus, how long would it take to come to a complete stop?

G:

U: S:

E: S:

9. A 910 kg speedboat traveling north is slowed down uniformly from an initial velocity of 24 m/s by a 2800 N braking force. What is the boat's velocity after 2.25 s?

G:

U: S:

E: S:

10. An object of weight F_w moving with initial velocity v_i to the right is acted upon by a net force F (to the right) over a time interval Δt. In terms of F_w, g, v_i, F, and Δt, find the final velocity v_f of the object.

ANSWERS: 6. 9.8 kg m/s S 7. 14 m/s right 8. 8.60 s 9. 17 m/s north

Set 3: Conservation of Momentum

11. A 47.8 kg child jumps onto a 2.91 kg snowboard at rest. If the velocity of the child is 2.22 m/s west as he jumps, what is the final velocity of the child and the snowboard?

12. A 75.5 kg astronaut is on a spacewalk when the tether line to the spacecraft breaks. The astronaut throws a spare 12.0 kg oxygen tank in a direction away from the craft with a speed of 6.60 m/s. Assuming that the astronaut and shuttle are initially from rest, find the astronaut's final speed with respect to the shuttle after the tank is thrown.

13. A child on a 1.7 kg scooter at rest throws a 6.8 kg medicine ball. The ball is given a speed of 2.4 m/s and the child and scooter move in the opposite direction at 0.62 m/s. Find the child's mass.

14. A shopper tosses a 22.7 kg bag of cat litter into a grocery cart of mass 14.3 kg. If the bag hits the cart with a horizontal speed of 2.15 m/s, what is the final speed of the cart and bag?

15. A hospital worker throws an 18.6 kg bag of laundry onto a stationary 8.7 kg cart. The cart and bag begin moving at 2.3 m/s to the right. Find the velocity of the laundry bag before the collision.

16. A 54.4 kg student runs and jumps with a horizontal speed of 1.75 m/s onto a stationary skateboard. The student and skateboard move down the sidewalk at 1.65 m/s. Find the mass of the skateboard.

ANSWERS:

11. 2.09 m/s W
12. 1.05 m/s
13. 25 kg
14. 1.32 m/s
15. 3.4 m/s to the right
16. 3.3 kg

Set 4: Kinetic Energy in Collisions

17. A 0.320 kg arrow going 16.8 m/s west strikes and becomes embedded in a 6.50 kg target. With what velocity does the combined mass recoil?

18. With reference to Q17, what is the decrease in kinetic energy during the collision?

19. A student kicks a 0.43 kg soccer ball at 6.2 m/s south into a 0.87 kg steel bucket lying on its side. The bucket travels with the ball after the collision. What is the final velocity of the combined mass?

20. With reference to Q19, what is the decrease in kinetic energy during the collision?

21. Bumper Car A (87.1 kg) moves at 5.20 m/s left before colliding elastically with Car B (68.8 kg), which was initially moving 3.80 m/s right. After the collision, Car B moves to the left at 6.26 m/s. Find the velocity of Car A after the collision.

22. Verify your answer to Q21 by calculating the total kinetic energy before and after the collision.

ANSWERS:

17. 0.788 m/s W
18. 43.0 J
19. 2.1 m/s S
20. 5.4 J
21. 2.75 m/s to the right

Set 5: Review Problems

23. Find the linear momentum of a 19.0 g rifle bullet moving 375 m/s to the right.

24. A punter accelerates a 0.53 kg football from rest to 8.4 m/s in 0.23 s. What constant force does the punter exert on the ball over this time?

25. A 14.5 kg ice skater moving to the right at 1.84 m/s throws a 0.166 kg snowball to the right with a velocity of 18.0 m/s. What is the velocity of the skater just after throwing the snowball?

26. A 37.6 kg pitching machine fires a 185 g baseball at a horizontal speed of 38 m/s. What is the recoil speed of the machine?

27. A 5.90 kg wagon is coasting along a level sidewalk at 3.16 m/s when a 3.45 kg cat drops from a tree vertically downward onto the wagon. What is the new speed of the combined mass?

28. A mass m_1 moves to the right with a speed v_{1i}. m_1 overtakes and collides with a slower-moving mass m_2 that is moving to the right with speed v_{2i}. The two masses couple together after the collision. In terms of m_1, v_{1i}, m_2, and v_{2i}, find the final velocity v_f of the combined mass.

ANSWERS:

23. 7.12 kg m/s to the right
24. 19 N
25. 1.65 m/s to the right
26. 0.19 m/s
27. 1.99 m/s

29. A 3.00×10^4 kg train car going 3.30 m/s collides and couples with two train cars already joined together, each with the same mass as the single car and initially moving in the same direction at 1.35 m/s. What is the speed of the three joined cars after the collision?

30. With reference to Q29, what is the decrease in kinetic energy during the collision?

31. A 46.8 kg bumper car moving 5.46 m/s right overtakes and collides elastically with a 57.3 kg car, also moving right. After the collision, the 46.8 kg car slows to 1.67 m/s right, while the 57.3 kg car is found to be moving 5.11 m/s right. Find the velocity of the 57.3 kg car before the collision.

32. Verify your answer to Q31 by calculating the total kinetic energy before and after the collision.

33. A mass m_1 moves to the right with a speed v_{1i} and collides with mass m_2 that is moving with speed v_{2i} to the left. After the collision, m_1 recoils to the left with speed v_{1f}. In terms of m_1, v_{1i}, m_2, v_{2i}, and v_{1f}, find the final velocity v_{2f} of m_2.

34. A 1430 kg car going 10.5 m/s at 34.6^o N of E undergoes a perfectly inelastic collision with a 1690 kg car going 19.8 m/s at 22.3^o E of S. Find the velocity of the coupled mass immediately after the collision.

ANSWERS: 29. 2.00 m/s 30. 3.80×10^4 J 31. 2.01 m/s to the right 34. 10.8 m/s @ 41.8^o S of E