NAME _____ **PERIOD** ____

UNIT 9 PRACTICE PROBLEMS **PHYSICS 1**

9.1 IMPULSE AND MOMENTUM

1. Your brother's mass is 35.6 kg, and he has a 1.3-kg skateboard. What is the combined momentum of your brother and his skateboard if they are moving at 9.50 m/s?
2. A compact car, with mass 725 kg, is moving at 115 km/h toward the east.
    a. Sketch the moving car and draw an arrow on your sketch showing the momentum vector.
    b. Find the magnitude and direction of its momentum.
    c. A second car, with a mass of 2175 kg, has the same momentum. What is its velocity?
3. Matt strikes a 0.058-kg golf ball with a force of 272 N and gives it a velocity of 62.0 m/s. How long was Matt's club in contact with the ball?
4. A 0.145-kg baseball is pitched at 42 m/s. The batter hits it horizontally to the pitcher at 58 m/s.
    a. Find the change in momentum of the ball.
    b. If the ball and bat are in contact for 4.6104 s, what is the average force during contact?
5. A force of 186 N acts on a 7.3-kg bowling ball for 0.40 s. What is the bowling ball's change in momentum? What is its change in velocity?
6. In a ballistics test at the police department, Officer Rios fires a 6.0-g bullet at 350 m/s into a container that stops it in 1.8 ms. What is the average force that stops the bullet?
7. A car moving at 10.0 m/s crashes into a barrier and stops in 0.050 s. There is a 20.0-kg child in the car. Assume that the child's velocity is changed by the same amount as that of the car, and in the same time period.
    a. What is the impulse needed to stop the child?
    b. What is the average force on the child?
    c. What is the approximate mass of an object whose weight equals the force in part b?
    d. Could you lift such a weight with your arm?
    e. Why is it advisable to use a proper restraining seat rather than hold a child on your lap?
8. A 0.150-kg ball, moving in the positive direction at 12 m/s, is acted on by the impulse shown in the graph in **Figure 9-16**. What is the ball's speed at 4.0 s?

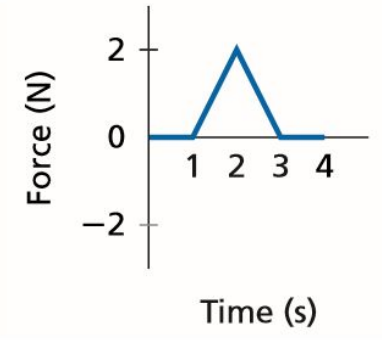

Figure 9-16

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UNIT 9 PRACTICE PROBLEMS PHYSICS 1

9.2 CONSERVATION OF MOMENTUM

9. A 4.00-kg model rocket is launched, expelling 50.0 g of burned fuel from its exhaust at a speed of 625 m/s. What is the velocity of the rocket after the fuel has burned? Hint: Ignore the external forces of gravity and air resistance.
10. Two lab carts are pushed together with a spring mechanism compressed between them. Upon release, the 5.0-kg cart repels one way with a velocity of 0.12 m/s, while the 2.0-kg cart goes in the opposite direction. What is the velocity of the 2.0-kg cart?
11. Carmen and Judi dock a canoe. 80.0-kg Carmen moves forward at 4.0 m/s as she leaves the canoe. At what speed and in what direction do the canoe and Judi move if their combined mass is 115 kg?
12. A 50.0-g projectile is launched with a horizontal velocity of 647 m/s from a 4.65-kg launcher moving in the same direction at 2.00 m/s. What is the launcher's velocity after the launch?

9.3 COLLISIONS

13. Two freight cars, each with a mass of 3.0105 kg, collide and stick together. One was initially moving at 2.2 m/s, and the other was at rest. What is their final speed?
14. A 0.105-kg hockey puck moving at 24 m/s is caught and held by a 75-kg goalie at rest. With what speed does the goalie slide on the ice?
15. A 35.0-g bullet strikes a 5.0-kg stationary piece of lumber and embeds itself in the wood. The piece of lumber and bullet fly off together at 8.6 m/s. What was the original speed of the bullet?
16. A 2575-kg van runs into the back of an 825-kg compact car at rest. They move off together at 8.5 m/s. Assuming that the friction with the road is negligible, calculate the initial speed of the van.
17. A 35.0-g bullet moving at 475 m/s strikes a 2.5-kg bag of flour that is on ice, at rest. The bullet passes through the bag, as shown in **Figure 9-7**, and exits it at 275 m/s. How fast is the bag moving when the bullet exits?

Figure 9-7

18. The bullet in the previous problem strikes a 2.5-kg steel ball that is at rest. The bullet bounces backward after its collision at a speed of 5.0 m/s. How fast is the ball moving when the bullet bounces backward?

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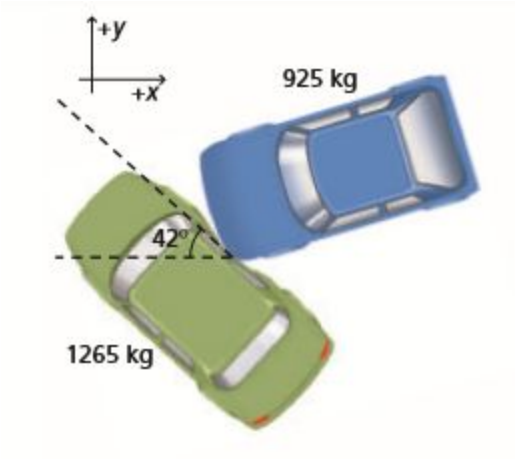
UNIT 9 PRACTICE PROBLEMS **PHYSICS 1**

19. A 0.50-kg ball that is traveling at 6.0 m/s collides head-on with a 1.00-kg ball moving in the opposite direction at a speed of 12.0 m/s. The 0.50-kg ball bounces backward at 14 m/s after the collision. Find the speed of the second ball after the collision.
20. A 0.200-kg plastic ball moves with a velocity of 0.30 m/s. It collides with a second plastic ball of mass 0.100 kg, which is moving along the same line at a speed of 0.10 m/s. After the collision, both balls continue moving in the same, original direction. The speed of the 0.100-kg ball is 0.26 m/s. What is the new velocity of the 0.200-kg ball?
21. Your friend was driving her 1265-kg car north on Oak Street when she was hit by a 925-kg compact car going west on Maple Street. The cars stuck together and slid 23.1 m at 42° north of west. The speed limit on both streets is 22 m/s (50 mph). Assume that momentum was conserved during the collision and that acceleration was constant during the skid. The coefficient of kinetic friction between the tires and the pavement is 0.65.



    a. Your friend claims that she wasn't speeding, but that the driver of other car was. How fast was your friend driving before the crash?
    b. How fast was the other car moving before the crash? Can you support your friend's case in court?

22. A cue ball, with mass 0.16 kg, rolling at 4.0 m/s, hits a stationary eight ball of similar mass. If the cue ball travels 45° above its original path and the eight ball travels 45° below the horizontal, as shown in **Figure 9-20**, what is the velocity of each ball after the collision?