of 5.0 m/s and 4.0 m/s respectively. The carts stick together after colliding head-on. Find the final speed.

29. A 1.20 kg skateboard is coasting along the pavement at a speed of 5.00 m/s when a 0.800 kg cat drops from a tree vertically downward onto the skateboard. What is the speed of the skateboard-cat combination?

For problems 30–31, see Sample Problem F.

30. A railroad car with a mass of 2.00×10^4 kg moving at 3.00 m/s collides and joins with two railroad cars already joined together, each with the same mass as the single car and initially moving in the same direction at 1.20 m/s.

- **a.** What is the speed of the three joined cars after the collision?
- **b.** What is the decrease in kinetic energy during the collision?

31. An 88 kg fullback moving east with a speed of 5.0 m/s is tackled by a 97 kg opponent running west at 3.0 m/s, and the collision is perfectly inelastic. Calculate the following:

- **a.** the velocity of the players just after the tackle
- **b.** the decrease in kinetic energy during the collision

For problems 32–34, see Sample Problem G.

32. A 5.0 g coin sliding to the right at 25.0 cm/s makes an elastic head-on collision with a 15.0 g coin that is initially at rest. After the collision, the 5.0 g coin moves to the left at 12.5 cm/s.

- **a.** Find the final velocity of the other coin.
- **b.** Find the amount of kinetic energy transferred to the 15.0 g coin.

33. A billiard ball traveling at 4.0 m/s has an elastic head-on collision with a billiard ball of equal mass that is initially at rest. The first ball is at rest after the collision. What is the speed of the second ball after the collision?

34. A 25.0 g marble sliding to the right at 20.0 cm/s overtakes and collides elastically with a 10.0 g marble moving in the same direction at 15.0 cm/s. After the collision, the 10.0 g marble moves to the right at 22.1 cm/s. Find the velocity of the 25.0 g marble after the collision.

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35. If a 0.147 kg baseball has a momentum of $\mathbf{p}$ = 6.17 kg•m/s as it is thrown from home to second base, what is its velocity?

36. A moving object has a kinetic energy of 150 J and a momentum with a magnitude of 30.0 kg•m/s. Determine the mass and speed of the object.

37. A 0.10 kg ball of dough is thrown straight up into the air with an initial speed of 15 m/s.

- **a.** Find the momentum of the ball of dough at its maximum height.
- **b.** Find the momentum of the ball of dough halfway to its maximum height on the way up.

38. A 3.00 kg mud ball has a perfectly inelastic collision with a second mud ball that is initially at rest. The composite system moves with a speed equal to one-third the original speed of the 3.00 kg mud ball. What is the mass of the second mud ball?

39. A 5.5 g dart is fired into a block of wood with a mass of 22.6 g. The wood block is initially at rest on a 1.5 m tall post. After the collision, the wood block and dart land 2.5 m from the base of the post. Find the initial speed of the dart.

40. A 730 N student stands in the middle of a frozen pond having a radius of 5.0 m. He is unable to get to the other side because of a lack of friction between his shoes and the ice. To overcome this difficulty, he throws his 2.6 kg physics textbook horizontally toward the north shore at a speed of 5.0 m/s. How long does it take him to reach the south shore?

41. A 0.025 kg golf ball moving at 18.0 m/s crashes through the window of a house in 5.0×10^{-4} s. After the crash, the ball continues in the same direction with a speed of 10.0 m/s. Assuming the force exerted on the ball by the window was constant, what was the magnitude of this force?

42. A 1550 kg car moving south at 10.0 m/s collides with a 2550 kg car moving north. The cars stick together and move as a unit after the collision at a velocity of 5.22 m/s to the north. Find the velocity of the 2550 kg car before the collision.

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23. 0.037 m/s to the south

24. Because the initial velocities of the truck and the car are the same and the final velocity is the same, the change in *KE* depends only on the mass. The truck has a greater mass, so the change in its *KE* is greater.

25. by calculating the kinetic energy before and after the collision; If *KE* is conserved, the collision is elastic. If the collision is not elastic, look at the final velocities to determine if it is perfectly inelastic.

26. no; Total kinetic energy is conserved but kinetic energy can be transferred from one object to the other.

27. Both cannot be at rest after the collision because the total initial momentum was greater than zero; The object initially in motion can be at rest if its momentum is entirely transferred to the other object.

28. 1 m/s

29. 3.00 m/s

30. **a.** 1.80 m/s
b. 2.16×10^4 J

31. **a.** 0.81 m/s to the east
b. 1.4×10^3 J

32. **a.** 12 cm/s to the right
b. 1.1×10^{-4} J

33. 4.0 m/s

34. 17.2 cm/s to the right

35. 42.0 m/s toward second base

36. 3.0 kg; 1.0×10^1 m/s

37. **a.** 0.0 kg•m/s
b. 1.1 kg•m/s upward

38. 6.00 kg

39. 23 m/s

40. 29 s

41. 4.0×10^2 N

42. 14.5 m/s to the north