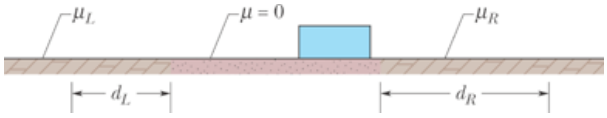
Chapter 9 – Problem Day

21. A 0.30 kg softball has a velocity of 15 m/s at an angle of 35° below the horizontal just before making contact with the bat. What is the magnitude of the change in momentum of the ball while in contact with the bat if the ball leaves with a velocity of (a) 20m/s, vertically downward, and (b) 20 m/s, horizontally back toward the pitcher?

35. A soccer player kicks a soccer ball of mass 0.45 kg that is initially at rest. The player's foot is in contact with the ball for 0.003 s, and the force of the kick is given by $F(t) = \left[\left(6 \times 10^6\right)t - \left(2 \times 10^9\right)t^2\right] N$ for $0 < t < 0.003$ s, where t is in seconds. Find the magnitudes of (a) the impulse on the ball due to the kick, (b) the average force on the ball from the player's foot during the period of contact, (c) the maximum force on the ball from the player's foot during the period of contact, and (d) the ball's velocity immediately after it loses contact with the player's foot.

46. In the figure, a stationary block explodes into two pieces L and R that slide across a frictionless floor and then into regions with friction, where they stop. Piece L, with a mass of 2.0 kg, encounters a coefficient of kinetic friction $\mu_L = 0.40$ and slides to a stop in distance $d_L = 0.15$ m. Piece R encounters a coefficient of kinetic friction $\mu_R = 0.50$ and slides to a stop in distance $d_R = 0.25$ m. What was the mass of the block?

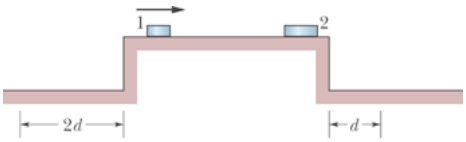


50. A 5.20 g bullet moving at 672 m/s strikes a 700 g wooden block at rest on a frictionless surface. The bullet emerges, traveling in the same direction with its speed reduced to 428 m/s. (a) What is the resulting speed of the block? (b) What is the speed of the bullet–block center of mass?

59. Block 1 (mass 2.0 kg) is moving rightward at 10 m/s and block 2 (mass 5.0 kg) is moving rightward at 3.0 m/s. The surface is frictionless, and a spring with a spring constant of 1120 N/m is fixed to block 2. When the blocks collide, the compression of the spring is maximum at the instant the blocks have the same velocity. Find the maximum compression.

63. A body of mass 2.0 kg makes an elastic collision with another body at rest and continues to move in the original direction but with one-fourth of its original speed. (a) What is the mass of the other body? (b) What is the speed of the two-body center of mass if the initial speed of the 2.0 kg body was 4.0 m/s?

70. In the figure, puck 1 of mass 0.20 kg is sent sliding across a frictionless lab bench, to undergo a one-dimensional elastic collision with stationary puck 2. Puck 2 then slides off the bench and lands a distance d from the base of the bench. Puck 1 rebounds from the collision and slides off the opposite edge of the bench, landing a distance $2d$ from the base of the bench. What is the mass of puck 2? (*Hint:* Be careful with signs.)



72. Two 2.0 kg bodies, A and B, collide. The velocities before the collision are $\vec{v}_A = \left(15\hat{i} + 30\hat{j}\right)$ m/s and $\vec{v}_B = \left(-10\hat{i} + 5\hat{j}\right)$ m/s. After the collision, $\vec{v}_A = \left(-5\hat{i} + 20\hat{j}\right)$ m/s. What are (a) the final velocity of B and (b) the change in the total kinetic energy (including sign)?

Chapter 9 Answers

21a) 5.0 kg•m/s
21b) 10.0 kg•m/s

35a) 9 kg•m/s
35b) 3000 N
35c) 4500 N
35d) 20 m/s

46) 3.39 kg

50a) 1.81 m/s
50b) 4.96 m/s

59) 0.25 m

63a) 1.2 kg
63b) 2.5 m/s

70) 1.0 kg

72a) $v_{B,f} = 10\hat{i} + 15\hat{j}$
72b) -500 J