ME230 HW 4

1 Two swimmers A and B, of weight 190 lb and 125 lb, respectively, are at diagonally opposite corners of a floating raft when they realize that the raft has broken away from its anchor. Swimmer A immediately starts walking toward B at a speed of 2 ft/s relative to the raft. Knowing that the raft weighs 300 lb, determine (*a*) the speed of the raft if B does not move, (*b*) the speed with which B must walk toward A if the raft is not to move.

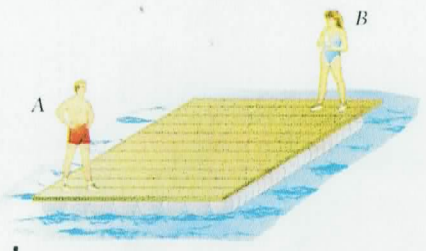


Fig. P1

a) 0.618 ft/sec

b) 3.04 ft/sec

2 The 15-kg suitcase A has been propped up against one end of a 40-kg luggage carrier B and is prevented from sliding down by other luggage. When the luggage is unloaded and the last heavy trunk is removed from the carrier, the suitcase is free to slide down, causing the 40-kg carrier to move to the left with a velocity $\mathbf{v}_B$ of magnitude 0.8 m/s. Neglecting friction, determine (*a*) the velocity $\mathbf{v}_{A/B}$ of the suitcase relative to the carrier as it rolls on the floor of the carrier, (*b*) the velocity of the carrier after the suitcase hits the right side of the carrier without bouncing back, (*c*) the energy lost in the impact of the suitcase on the floor of the carrier.

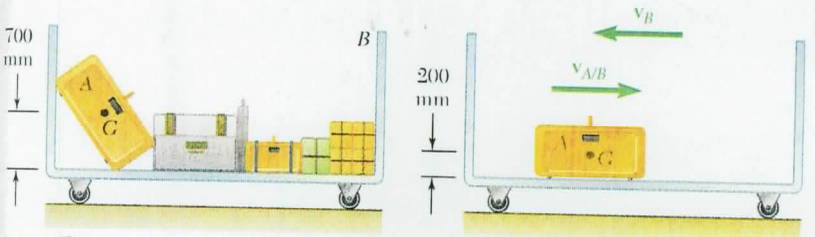


Fig. P2

a) 2.93 m/s

b) 0 m/s

c) 26.7 J

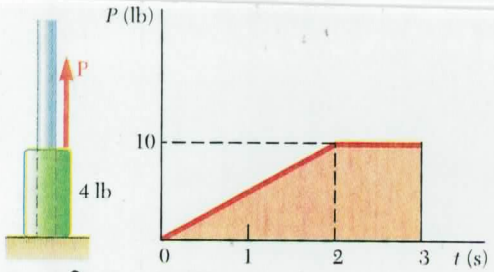


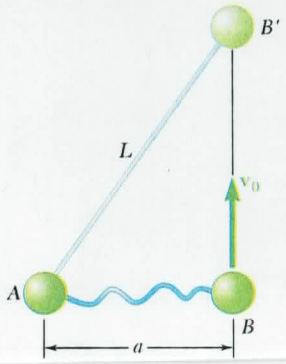
Fig. P3

3 A 4-lb collar which can slide on a frictionless vertical rod is acted upon by a force **P** which varies in magnitude as shown. Knowing that the collar is initially at rest, determine (*a*) the maximum velocity of the collar, (*b*) the time when the velocity is zero.

a) 77.3 ft/s

b) 5.4 s

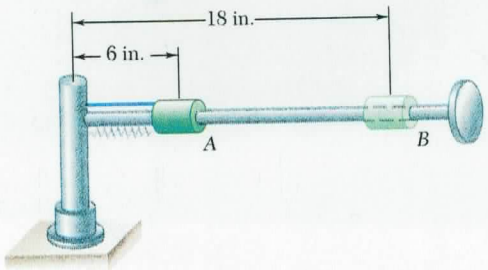
4 Two identical spheres A and B, each of mass m, are attached to an inextensible inelastic cord of length L, and are resting at a distance a from each other on a frictionless horizontal surface. Sphere B is given a velocity $\mathbf{v}_0$ in a direction perpendicular to line AB and moves without friction until it reaches B' when the cord becomes taut. Determine (a) the magnitude of the velocity of each sphere immediately after the cord has become taut, (b) the energy lost as the cord becomes taut.



a) $v_a' = \left(\frac{V_0}{2L}\right)\sqrt{L^2 - a^2}$

$V_b' = \left(\frac{V_0}{2L}\right)\sqrt{L^2 + 3a^2}$

5 A 3-lb collar can slide on a horizontal rod which is free to rotate about a vertical shaft. The collar is initially held at A by a cord attached to the shaft. A spring of constant 2 lb/ft is attached to the collar and to the shaft and is undeformed when the collar is at A. As the rod rotates at the rate $\dot{\theta} =$ 16 rad/s, the cord is cut and the collar moves out along the rod. Neglecting friction and the mass of the rod, determine (a) the radial and transverse components of the acceleration of the collar at A, (b) the acceleration of the collar relative to the rod at A, (c) the transverse component of the velocity of the collar at B.



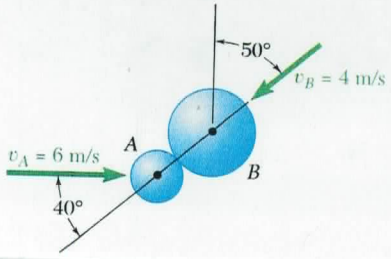
a) $(a_A)_r = 0$

$(a_A)_\theta = 0$

b) 1536 in/s²

c) 32.0 in/s

6 A 600-g ball A is moving with a velocity of magnitude 6 m/s when it is hit as shown by a 1-kg ball B which has a velocity of magnitude 4 m/s. Knowing that the coefficient of restitution is 0.8 and assuming no friction, determine the velocity of each ball after impact.



$V_A = 6.37$ m/s 77.2°

$V_B = 1.80$ m/s 40°

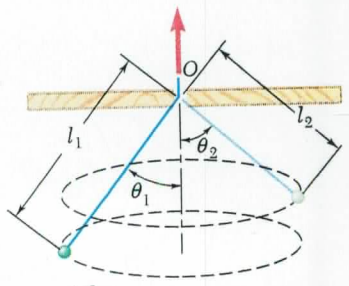


Fig. P7

7 A small ball swings in a horizontal circle at the end of a cord of length l_1, which forms an angle θ_1 with the vertical. The cord is then slowly drawn through the support at O until the length of the free end is l_2. (*a*) Derive a relation among l_1, l_2, θ_1, and θ_2. (*b*) If the ball is set in motion so that initially $l_1 = 0.8$ m and $\theta_1 = 35°$, determine the angle θ_2 when $l_2 = 0.6$ m.

a) $l_1^3 \sin^3\theta_1 \tan\theta_1 = l_2^3 \sin^3\theta_2 \tan\theta_2$

b) $\theta_2 = 43.6°$