

ME 104: Homework 6

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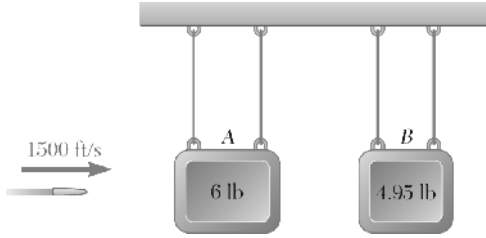
Due Monday, October, 26th

Chapter 14, Solution 1



An airline employee tosses two suitcases, of mass 15 kg and 20 kg, respectively, onto a 25-kg baggage carrier in rapid succession. Knowing that the carrier is initially at rest and that the employee imparts a 3-m/s horizontal velocity to the 15-kg suitcase and a 2-m/s horizontal velocity to the 20-kg suitcase, determine the final velocity of the baggage carrier if the first suitcase tossed onto the carrier is (a) the 15-kg suitcase, (b) the 20-kg suitcase.

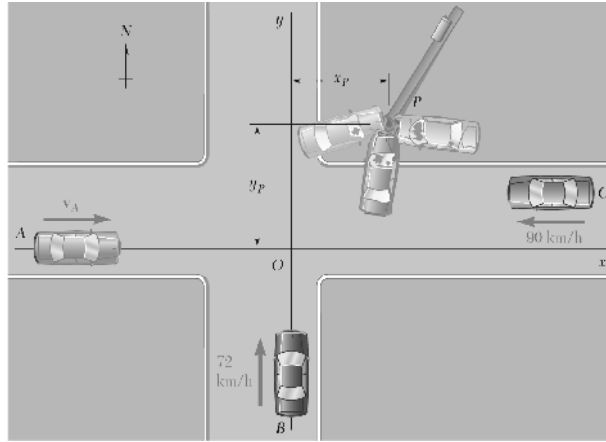
Chapter 14, Problem 5



The diagram shows a horizontal bar at the top with two pairs of strings hanging from it. The left pair of strings is attached to a rectangular block labeled 'A' with '6 lb' written on it. The right pair of strings is attached to a rectangular block labeled 'B' with '4.95 lb' written on it. To the left of block A, a bullet is shown moving horizontally to the right, with an arrow above it labeled '1500 ft/s'.

A bullet is fired with a horizontal velocity of 1500 ft/s through a 6-lb block *A* and becomes embedded in a 4.95-lb block *B*. Knowing that blocks *A* and *B* start moving with velocities of 5 ft/s and 9 ft/s, respectively, determine (a) the weight of the bullet, (b) its velocity as it travels from block *A* to block *B*.

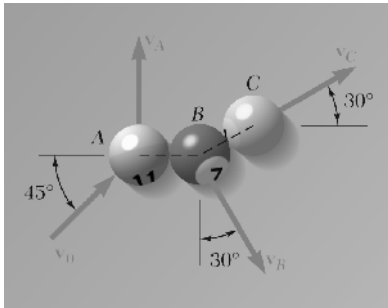
Chapter 14, Problem 19



Car A was traveling east at high speed when it collided at Point O with car B , which was traveling north at 72 km/h . Car C , which was traveling west at 90 km/h , was 10 m east and 3 m north of Point O at the time of the collision. Because the pavement was wet, the driver of car C could not prevent his car from sliding into the other two cars, and the three cars, stuck together, kept sliding until they hit the utility pole P . Knowing that the masses of cars A , B , and C are, respectively, 1500 kg , 1300 kg , and 1200 kg , and neglecting the forces exerted on the cars by the wet pavement, solve the problems indicated.

Knowing that the coordinates of the utility pole are $x_p = 18 \text{ m}$ and $y_p = 13.9 \text{ m}$, determine (a) the time elapsed from the first collision to the stop at P , (b) the speed of car A .

Chapter 14, Problem 39

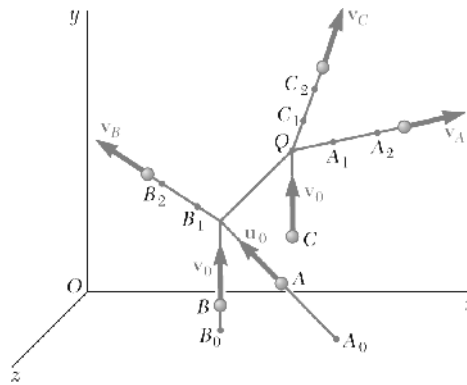


In a game of pool, ball A is moving with a velocity \mathbf{v}_0 of magnitude $v_0 = 15$ ft/s when it strikes balls B and C , which are at rest and aligned as shown. Knowing that after the collision the three balls move in the directions indicated and assuming frictionless surfaces and perfectly elastic impact (i.e., conservation of energy), determine the magnitudes of the velocities \mathbf{v}_A , \mathbf{v}_B , and \mathbf{v}_C .

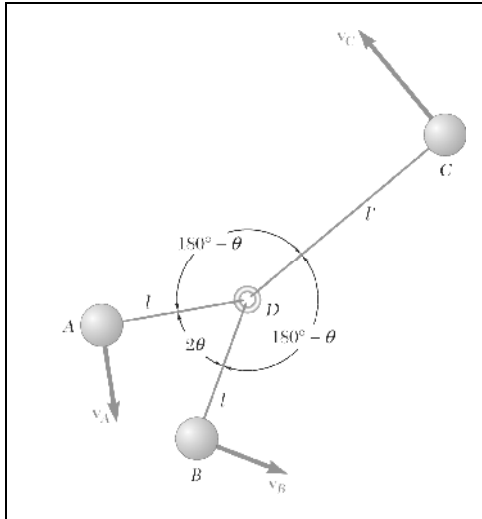
Chapter 14, Problem 46

In the scattering experiment of Problem 14.24, it is known that the alpha particle is projected from $A_0(300, 0, 300)$ and that it collides with the oxygen nucleus C at $Q(240, 200, 100)$, where all coordinates are expressed in millimeters. Determine the coordinates of Point B_0 where the original path of nucleus B intersects the xz plane. (*Hint*: Express that the angular momentum of the three particles about Q is conserved.)

PROBLEM 14.24 In this scattering experiment, an alpha particle A is projected with the velocity $\mathbf{u}_0 = -(600 \text{ m/s})\mathbf{i} + (750 \text{ m/s})\mathbf{j} - (800 \text{ m/s})\mathbf{k}$ into a stream of oxygen nuclei moving with the common velocity $\mathbf{v}_0 = (600 \text{ m/s})\mathbf{j}$. After colliding successively with nuclei B and C , particle A is observed to move along the path defined by the Points $A_1(280, 240, 120)$ and $A_2(360, 320, 160)$, while nuclei B and C are observed to move along paths defined, respectively, by $B_1(147, 220, 130)$, $B_2(114, 290, 120)$, and by $C_1(240, 232, 90)$ and $C_2(240, 280, 75)$. All paths are along straight lines and all coordinates are expressed in millimeters. Knowing that the mass of an oxygen nucleus is four times that of an alpha particle, determine the speed of each of the three particles after the collisions.

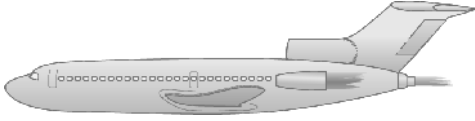


Chapter 14, Problem 49



Three identical spheres A , B , and C , which can slide freely on a frictionless horizontal surface, are connected by means of inextensible, inelastic cords to a small ring D located at the mass center of the three spheres ($l' = 2l \cos \theta$). The spheres are rotating initially about ring D , which is at rest, at speeds proportional to their distances from D . We denote by v_0 the original speed of A and B and assume that $\theta = 30^\circ$. Suddenly, cord CD breaks, causing sphere C to slide away. Considering the motion of spheres A and B and of ring D after the other two cords have again become taut, determine (a) the speed of ring D , (b) the relative speed at which spheres A and B rotate about D , (c) the percent of energy of the original system which is dissipated when cords AD and BD again become taut.

Chapter 14, Problem 75



A jet airliner is cruising at a speed of 600 mi/h with each of its three engines discharging air with a velocity of 2000 ft/s relative to the plane. Determine the speed of the airliner after it has lost the use of (a) one of its engines, (b) two of its engines. Assume that the drag due to air friction is proportional to the square of the speed and that the remaining engines keep operating at the same rate.