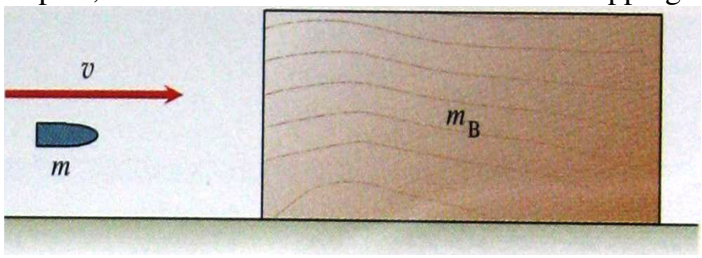
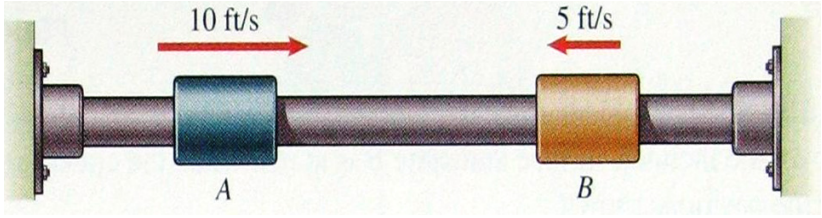
EGBE261: Biomechanics 2
Homework from Chapter 5: Momentum Methods

5.45 .An 80-lb boy sitting in a stationary 20-lb wagon wants to simulate rocket propulsion by throwing bricks out of the wagon. Neglect horizontal forces on the wagon's wheels. If he has three bricks weighing 10 lb each and throws them with a horizontal velocity of 10 ft/s relative to the wagon, determine the velocity he attains a) if he throws the bricks one at a time; b) if he throws them all at once.
Answers: a) 2.74 ft/s, b) 3 ft/s

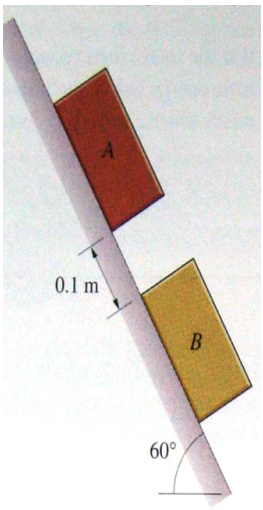
5.52. A bullet (mass m) hits a stationary block of wood (mass m_B) and becomes embedded in it. The coefficient of kinetic friction between the block and the floor is μk. As a result of the impact, the block slides a distance D before stopping. What was the velocity v of the bullet?



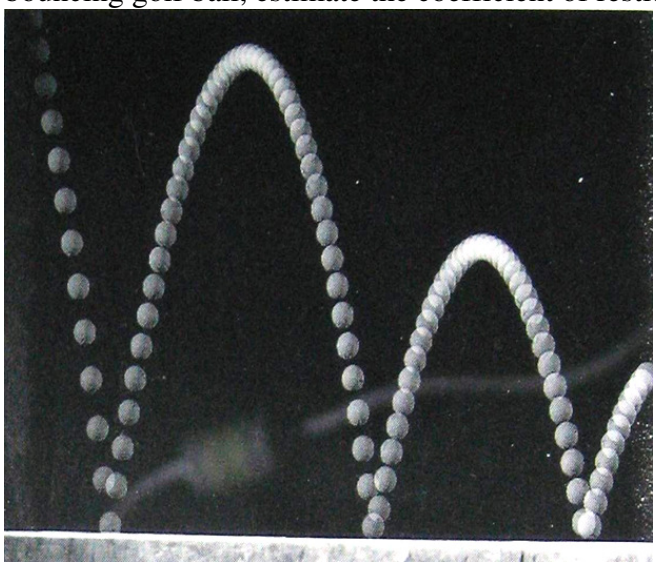
5.60. The 20-lb weight A and 30-lb weight B slide on the smooth horizontal bar. Determine their velocities after they collide if the coefficient of restitution is e=0.8.



5.64. The kinetic coefficients of friction between the 5-kg crates A and B and the inclined surface are 0.1 and 0.4 respectively. The coefficient of restitution between the crates is e=0.8. If the crates are released from rest in the positions shown, what are the magnitudes of their velocities immediately after they collide?

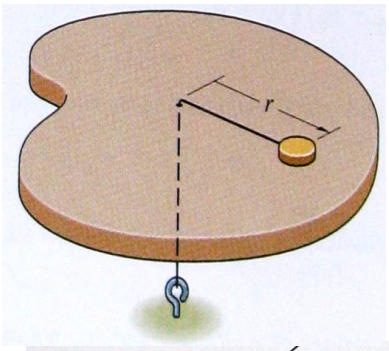


5.70. By making measurements directly from the photograph of the bouncing golf ball, estimate the coefficient of restitution.

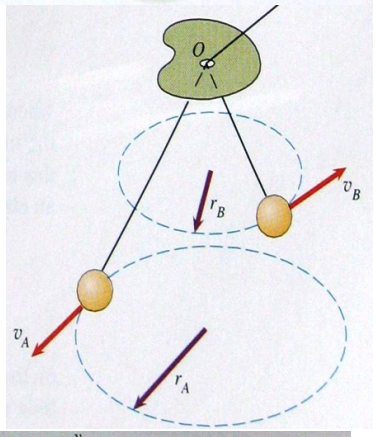


5.74. A bioengineer studying helmet design strikes a 2.4 kg helmet containing a 2-kg simulated human head against a rigid surface at 6 m/s. The head, being suspended within the helmet, is not immediately affected by the impact of the helmet with the surface and continues to move to the right at 6 m/s, so it then undergoes an impact with the helmet. If the coefficient of restitution of the helmet's impact with the surface is 0.8 and the coefficient of restitution of the following impact of the head and helmet is 0.2, what are the velocities of the helmet and head after their initial interaction?

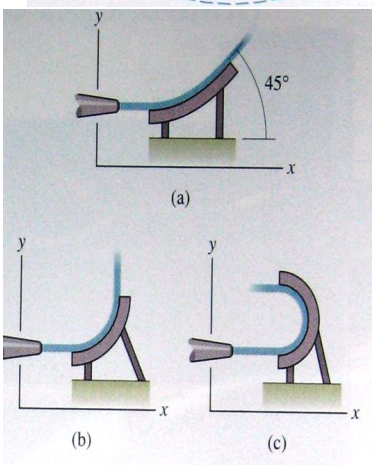
5.92. A 2-kg disk slides on a smooth horizontal table and is connected to an elastic cord whose tension is T = 6r N, where r is the radial position of the disk in meters. If the disk is at r = 1m and is given an initial velocity of 4 m/s in the transverse direction, determine the maximum value of r reached by the disk.



5.98. A ball suspended from a string that goes through a hole in the ceiling at O moves with velocity v_A in the horizontal circular path of radius r_A. The string is then drawn through the hole until the ball moves with velocity v_B in the horizontal circular path of radius r_B. Use the principle of angular impulse and momentum to show that $r_A v_A = r_B v_B$.
Strategy: let e be a unit vector that is perpendicular to the ceiling. You can show that $\hat{e}\cdot(\underline{r}\times\underline{F})=0$, so that $\hat{e}\cdot\underline{H}$ is conserved.



5.104. A nozzle ejects a stream of water horizontally at 40 m/s with a mass flow rate of 30 kg/s, and the stream is deflected in the horizontal plane by a plate. Determine the force exerted on the plate by the stream in cases a), b), and c).



5.114. Suppose that you grasp the end of a chain that weighs 3 lb/ft and lift it straight up off the floor at a constant speed of 2 ft/s.
a) Determine the upward force F you must exert as a function of the height s.
b) How much work do you do in lifting the top of the chain to s = 4 ft?