Homework Problems

14.6 The magnitude of a force **P** varies as shown. The force **P** is applied to a 100-lb block at the time $t = 0$. It is known that the block is at rest when $t = 0$, and that $\mu_s = 0.4$ and $\mu_k = 0.3$ between the block and the support. Determine (a) the time t_1 at which the block starts to move, (b) the time t_2 at which the block attains its maximum speed, (c) the maximum speed attained by the block, (d) the time t_3 at which the block stops again.

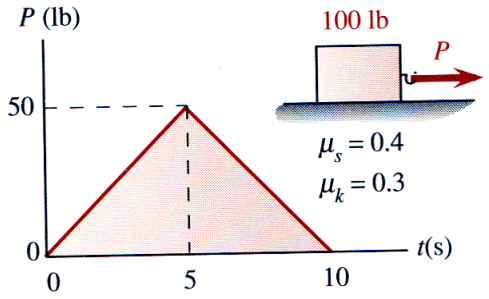

Fig. P14.6

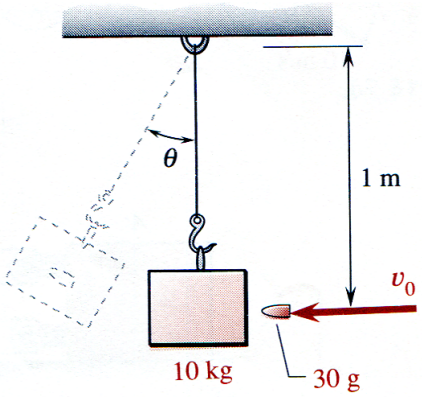

Fig. P14.18*

14.18* A 30-g bullet is fired with a speed v_0 into a 10-kg block which is at rest as shown. If $\theta = 30°$ when the block with the embedded bullet swings to its highest position, determine (a) the speed v_0, (b) the percentage of loss of the kinetic energy during the impact.

14.23 A 1-oz bullet strikes a hard surface with a velocity of 2400 ft/s ∠ 30° and incurs a 6.6-in. scratch on the surface before ricocheting with a velocity of 2000 ft/s ↘ 20° as shown. Assuming an average speed of 2200 ft/s during contact, determine the average impulsive force exerted by the hard surface on the bullet.

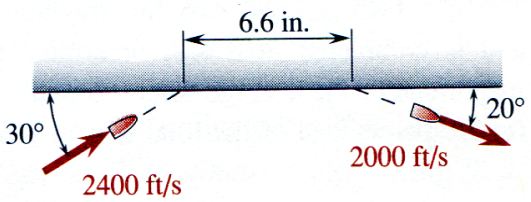

Fig. P14.23

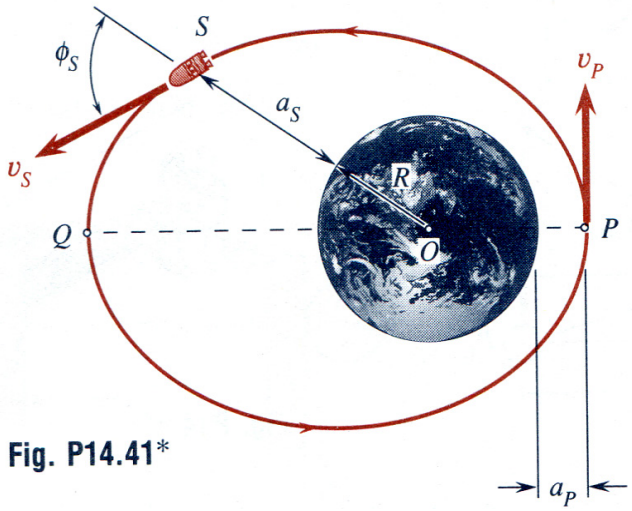

Fig. P14.41*

14.41* A spacecraft describes an elliptic orbit around the earth as shown. In the position S, its velocity $\mathbf{v}_S$ and the vertical make an angle $\phi_S = 70°$, its altitude is $a_S = 5000$ mi, and its speed is $v_S = 3.2$ mi/s. Determine the maximum and the minimum altitudes of its orbit.

14.43 A spacecraft starts its free flight around the earth in the position S at an altitude $a_S = 1500$ mi and with a velocity $\mathbf{v}_S$ of magnitude 4 mi/s as shown. Determine (a) the minimum altitude $a_{\min}$ of its orbit if the angle ϕ_S between $\mathbf{v}_S$ and the vertical is 85°, (b) the range of values of ϕ_S if $a_{\min}$ is to be no less than 300 mi.

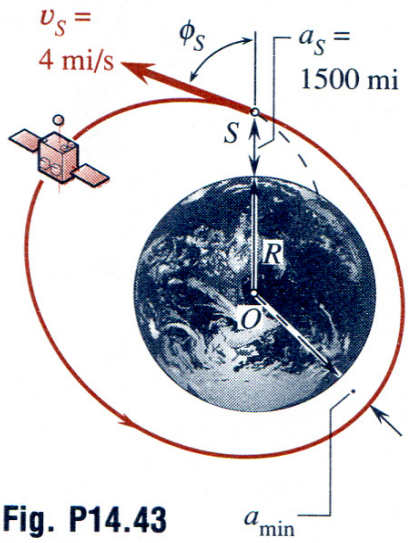

Fig. P14.43

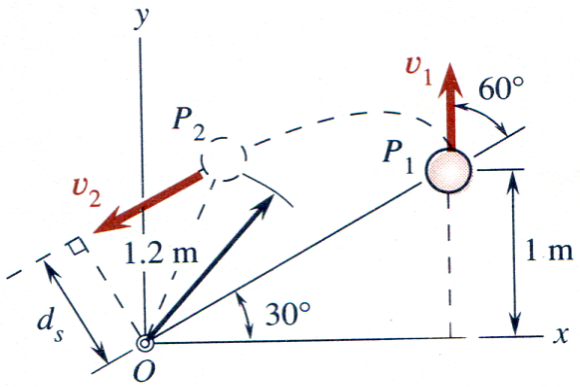

Fig. P14.47

14.47 An elastic cord having a free length $L = 1.2$ m and a modulus $k = 100$ N/m is attached to a fixed point at O and a 0.4-kg disk which is given an initial velocity $\mathbf{v}_1 = 6\mathbf{j}$ m/s at P_1 to move on a horizontal smooth surface in the xy plane as shown. Determine (a) the speed v_2 of the disk when the cord becomes slack at P_2, (b) the shortest distance d_s that the disk will come to O.

14.54* and 14.55 If $e = 0.8$ between the sliders A and B as shown, determine (a) the velocity of each slider after the impact, (b) the percentage of loss in kinetic energy during the impact.

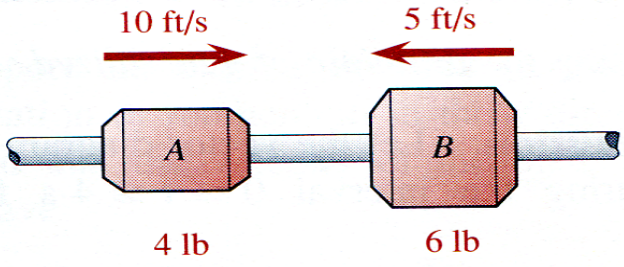

Fig. P14.55

14.59 and 14.60 A sphere is traveling with a velocity $\mathbf{v}_A$ when it strikes a sphere B which is at rest as shown. If $e = 0.65$ between A and B, determine the velocity of each sphere just after the impact.†

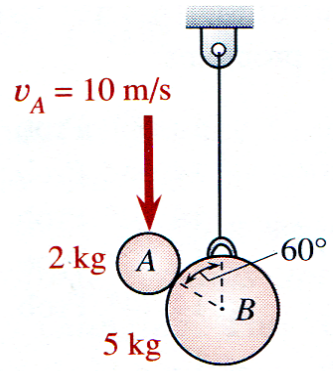

Fig. P14.60

14.66* through 14.75* Using the *principle of generalized virtual work*, solve the following problems:

14.66* Prob. 14.25.
14.67* Prob. 14.26*.
14.68* Prob. 14.27*.
14.69* Prob. 14.28.

14.28 A system of blocks is shown. At the time $t = 0$, the velocity of the block B is 5 ft/s →. If $\mu_k = 0.1$ between the support and the blocks, determine the speed of the block B when $t = 3$ s.

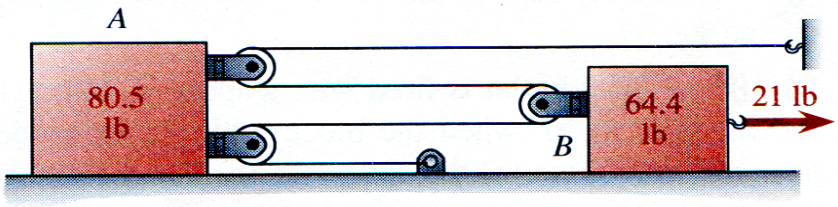

Fig. P14.28