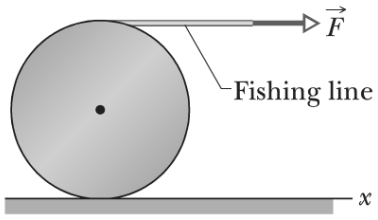
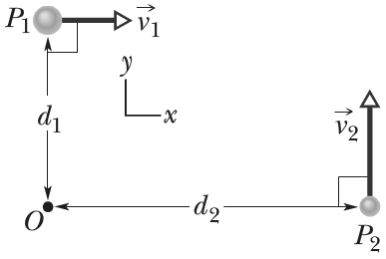
- For material covering Ch. 11 (skipping Sects. 11-3 & 11-9) and Ch. 12 (Sects. 12-1 & 12-2 only)
- Due Friday, Nov. 7 at 5 pm

1. A hollow sphere of radius 0.230 m, with rotational inertia I = 0.0948 kg·m^2 about a line through its center of mass, rolls without slipping up a surface inclined at 14.3° to the horizontal. At a certain initial position, the sphere's total kinetic energy is 17.0 J. **(a)** How much of this initial kinetic energy is rotational? **(b)** What is the speed of the center of mass of the sphere at the initial position? When the sphere has moved 0.500 m up the incline from its initial position, what are **(c)** its total kinetic energy and **(d)** the speed of its center of mass? [Answer: **(a)** 6.80 J; **(b)** 2.75 m/s; **(c)** 13.7 J; **(d)** 2.47 m/s].

2. A constant horizontal force $\vec{F}$ of magnitude 21.8 N is applied to a uniform solid cylinder by fishing line wrapped around the cylinder. The mass of the cylinder is 27.3 kg, its radius is 0.439 m, and the cylinder rolls smoothly on the horizontal surface. **(a)** What is the magnitude of the acceleration of the center of mass of the cylinder? **(b)** What is the magnitude of the angular acceleration of the cylinder about the center of mass? **(c)** What is the magnitude and direction of the frictional force acting on the cylinder? [Answer: **(a)** 1.06 m/s^2; **(b)** 2.42 rad/s^2; **(c)** -7.27 N (to the left)].

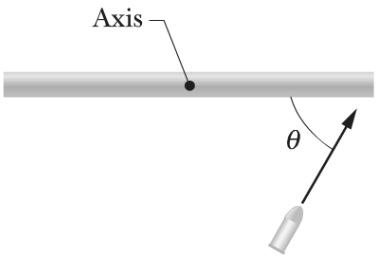


3. Two particles move in an xy plane. Particle P_1 has mass 5.74 kg and speed v_1 = 7.03 m/s, and it is at distance d_1 = 6.22 m from point O. Particle P_2 has mass 4.78 kg and speed v_2 = 5.45 m/s, and it is at distance d_2 = 7.26 m from point O. What is the magnitude of the net angular momentum of the two particles about O? [Answer: 61.9 kg·m^2/s].



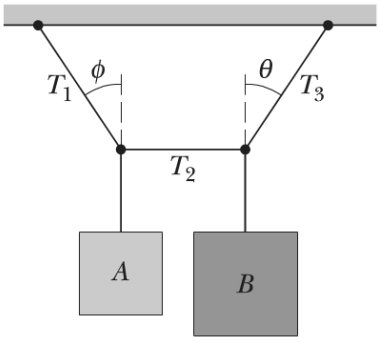
4. A cockroach of mass m lies on the rim of a uniform disk of mass 4m that can rotate freely about its center like a merry-go-round. Initially the cockroach and disk rotate together with an angular velocity of ω_0. Then the cockroach walks halfway to the center of the disk. **(a)** What then is the angular velocity of the cockroach-disk system? **(b)** What is the ratio K/K_0 of the new kinetic energy of the system to its initial kinetic energy? State your answer in terms of the given variables. [Answer: **(a)** $4/3\omega_0$; **(b)** 4/3].

5. A uniform thin rod of length 0.87 m and mass 4.9 kg can rotate in a horizontal plane about a vertical axis through its center. The rod is at rest when a 4.8 g bullet traveling in the rotation plane is fired into one end of the rod. As viewed from above, the bullet's path makes angle θ = 60° with the rod. If the bullet lodges in the rod and the angular velocity of the rod is 8.00 rad/s immediately after the collision, what is the bullet's speed just before impact? [Answer: 1.37 km/s].

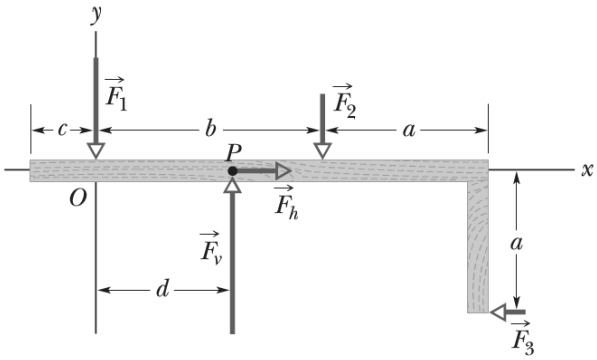


6. An archer's bow is drawn at its midpoint until the tension in the string is 1.16 times the force exerted by the archer. What is the angle between the two halves of the string? [Answer: 129°].

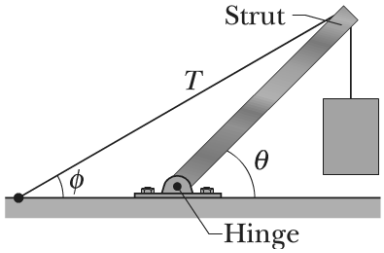
7. The system below is in equilibrium, with the string in the center exactly horizontal. Block A weighs 36.0 N, block B weighs 56.0 N, and angle φ is 31.0°. Find **(a)** tension T_1, **(b)** tension T_2, **(c)** tension T_3, and **(d)** angle θ. [Answer: **(a)** 42.0 N; **(b)** 21.6 N; **(c)** 60.0 N; **(d)** 21.1°].



8. Forces $\vec{F}_1$, $\vec{F}_2$, and $\vec{F}_3$ act on the structure shown below (overhead view). We wish to put the structure in equilibrium by applying a fourth force, at a point such as P. The fourth force has vector components $\vec{F}_h$ and $\vec{F}_v$. We are given that a = 1.21 m, b = 3.77 m, c = 0.748 m, F_1 = 47.6 N, F_2 = 19.3 N, and F_3 = 3.29 N. Find **(a)** magnitude of F_h, **(b)** magnitude of F_v, and **(c)** d. [Answer: **(a)** 3.29 N; **(b)** 66.9 N; **(c)** 1.15 m].



9. The system below is in equilibrium. A concrete block of mass 308 kg hangs from the end of the uniform strut of mass 49.6 kg. For angles φ = 26.9° and θ = 58.0°, find **(a)** the tension T in the cable and the **(b)** horizontal and **(c)** vertical components of the force on the strut from the hinge. [Answer: **(a)** 3.35 kN; **(b)** 2.98 kN; **(c)** 5.02 kN].



10. What magnitude of force $\vec{F}$ applied horizontally at the axle of the wheel is necessary to raise the wheel over an obstacle of height h = 0.205 m? The wheel's radius is r = 0.601 m and its mass is m = 0.882 kg. [Answer: 9.87 N].