Week 3. Problems for class:

**10.** T A 40.0-kg child swings in a swing supported by two chains, each 3.00 m long. The tension in each chain at the lowest point is 350 N. Find (a) the child's speed at the lowest point and (b) the force exerted by the seat on the child at the lowest point. (Ignore the mass of the seat.)

**22.** S Assume the resistive force acting on a speed skater is proportional to the square of the skater's speed $v$ and is given by $f = -kmv^2$, where $k$ is a constant and $m$ is the skater's mass. The skater crosses the finish line of a straight-line race with speed $v_i$ and then slows down by coasting on his skates. Show that the skater's speed at any time $t$ after crossing the finish line is $v(t) = v_i/(1 + ktv_i)$.

**49.** Because of the Earth's rotation, a plumb bob does not hang exactly along a line directed to the center of the Earth. How much does the plumb bob deviate from a radial line at 35.0° north latitude? Assume the Earth is spherical.

**15.** S A small particle of mass $m$ is pulled to the top of a frictionless half-cylinder (of radius $R$) by a light cord that passes over the top of the cylinder as illustrated in Figure P7.15. (a) Assuming the particle moves at a constant speed, show that $F = mg\cos\theta$. *Note:* If the particle moves at constant speed, the component of its acceleration tangent to the cylinder must be zero at all times. (b) By directly integrating $W = \int \vec{\mathbf{F}} \cdot d\vec{\mathbf{r}}$, find the work done in moving the particle at constant speed from the bottom to the top of the half-cylinder.

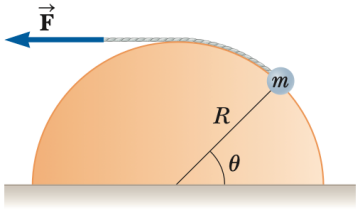


**Figure P7.15**

**28.** **Review.** A 7.80-g bullet moving at 575 m/s strikes the hand of a superhero, causing the hand to move 5.50 cm in the direction of the bullet's velocity before stopping. (a) Use work and energy considerations to find the average force that stops the bullet. (b) Assuming the force is constant, determine how much time elapses between the moment the bullet strikes the hand and the moment it stops moving.

**38.** For the potential energy curve shown in Figure P7.38, (a) determine whether the force $F_x$ is positive, negative, or zero at the five points indicated. (b) Indicate points of stable, unstable, and neutral equilibrium. (c) Sketch the curve for $F_x$ versus $x$ from $x = 0$ to $x = 9.5$ m.

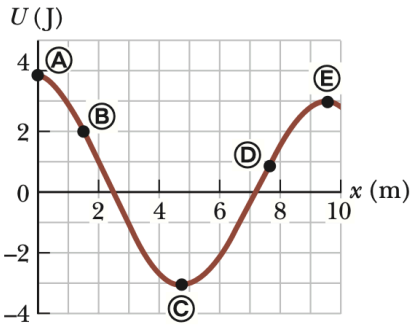


**Figure P7.38**

Problem Statement: Accelerating Frame of Reference

Revisit Problem 53 from Week 2, this time analyzing it within an accelerating frame of reference. Assume that the applied force F is nonzero (i.e. F>0).

Determine the magnitude of F required to ensure that the smaller blocks remain stationary relative to the larger block M.

**47.** An inclined plane of angle $\theta = 20.0°$ has a spring of force constant $k = 500$ N/m fastened securely at the bottom so that the spring is parallel to the surface as shown in Figure P7.47. A block of mass $m = 2.50$ kg is placed on the plane at a distance $d = 0.300$ m from the spring. From this position, the block is projected downward toward the spring with speed $v = 0.750$ m/s. By what distance is the spring compressed when the block momentarily comes to rest?

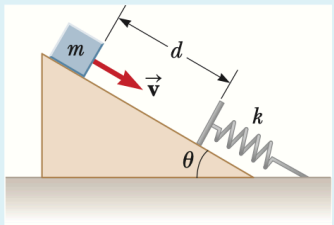


**Figure P7.47**
Problems 47 and 48.

---

Problems for practice at home:

**36.** S A truck is moving with constant acceleration $a$ up a hill that makes an angle $\phi$ with the horizontal as in Figure P6.36. A small sphere of mass $m$ is suspended from the ceiling of the truck by a light cord. If the pendulum makes a constant angle $\theta$ with the perpendicular to the ceiling, what is $a$?

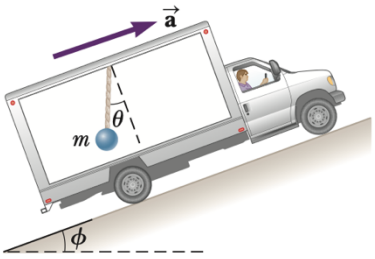


**Figure P6.36**

[g(cosϕ tanθ – sinϕ)]

**46.** Q|C (a) Take $U = 5$ for a system with a particle at position $x = 0$ and calculate the potential energy of the system as a function of the particle position $x$. The force on the particle is given by $(8e^{-2x})\,\hat{\mathbf{i}}$. (b) Explain whether the force is conservative or nonconservative and how you can tell.

[(a) $1+4e^{-2x}$]