Chapter 6: Force and Motion II
Questions and Problems

\[ f_{s,\text{max}} = \mu_s N \quad f_k = \mu_k N \quad a = \frac{v^2}{R} \quad F_{\text{net}} = \frac{mv^2}{R} \]

Example 6.1
a. When you tighten a nut on a bolt, how are you increasing the frictional force? How does a lock washer work?
b. When you stand with bare feet on a wet bathtub, the grip feels fairly secure, and yet a catastrophic slip is quite possible. Explain this in terms of the two coefficients of friction.
c. Why does mud fly off a rapidly turning automobile tire?
d. If there is a net force on a particle in uniform circular motion, why does the particle’s speed not change?
e. A coin is put on a phonograph turntable. The motor is started but, before the final speed of rotation is reached, the coin flies off. Explain why.

Example 6.2
A loaded penguin sled weighing 80 N rests on a plane inclined at 20° to the horizontal. Between the sled and the plane, the coefficient of static friction is 0.25, and the coefficient of kinetic friction is 0.15. (a) What is the minimum magnitude of the force \( F \), parallel to the plane that will prevent the sled from slipping down the plane? (b) What is the minimum magnitude \( F \) that will start the sled moving up the plane? (c) What value of \( F \) is required to move the sled up the plane at constant velocity?
Example 6.3
The two blocks (with \( m = 16 \text{ kg} \) and \( M = 88 \text{ kg} \)) shown are not attached. The coefficient of static friction between the blocks is \( \mu_s = 0.38 \), but the surface beneath the larger block is frictionless. What is the minimum magnitude of the horizontal force \( F \) required to keep the smaller block from slipping down the larger block?

Example 6.4
The figure shows a conical pendulum, in which the bob (the small object at the lower end of the cord) moves in a horizontal circle at constant speed. (The cord sweeps out a cone as the bob rotates.) The bob has a mass of 0.040 kg, the string has length \( L = 0.90 \text{ m} \) and negligible mass, and the bob follows a circular path of circumference 0.94 m. What are (a) the tension in the string and (b) the period of the motion?
Example 6.5
A sling-thrower puts a stone (0.250 kg) in the sling's pouch (0.010 kg) and then begins to make the stone and pouch move in a vertical circle of radius 0.650 m. The cord between the pouch and the person's hand has negligible mass and will break when the tension in the cord is 33.0 N or more. Suppose the sling-thrower could gradually increase the speed of the stone. (a) Will the breaking occur at the lowest point of the circle or at the highest point? (b) At what speed of the stone will that breaking occur?

Example 6.5
A stuntman drives a car over the top of a hill, the cross section of which can be approximated by a circle of radius $R = 250$ m. What is the greatest speed at which he can drive without the car leaving the road at the top of the hill?