Questions and Problems

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

Questions

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 6.1

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 6.2

The two blocks \( m_1 = 16 \text{ kg}, \ m_2 = 88 \text{ kg} \) shown are not attached. The coefficient of 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 6.3
A conical pendulum has a bob (0.040 kg) that moves in a horizontal circle at constant speed. What are (a) the tension in the string and (b) the period of the motion?

Example 6.4
A stuntman drives a car over the top of a hill, the cross section of which can be approximated by a circle. What is the greatest speed at which he can drive without the car leaving the road at the top of the hill?