404 Problems Set 3: Normal force and Static Kinetic Friction

38. A 35-kg crate rests on a horizontal floor, and a 65-kg person is standing on the crate. Determine the magnitude of the normal force that **(a)** the floor exerts on the crate and **(b)** the crate exerts on the person.

39. ssm A 60.0-kg crate rests on a level floor at a shipping dock. The coefficients of static and kinetic friction are 0.760 and 0.410, respectively. What horizontal pushing force is required to **(a)** just start the crate moving and **(b)** slide the crate across the dock at a constant speed?

40. A rocket blasts off from rest and attains a speed of 45 m/s in 15 s. An astronaut has a mass of 57 kg. What is the astronaut's apparent weight during takeoff?

42. A woman stands on a scale in a moving elevator. Her mass is 60.0 kg, and the combined mass of the elevator and scale is an additional 815 kg. Starting from rest, the elevator accelerates upward. During the acceleration, the hoisting cable applies a force of 9410 N. What does the scale read during the acceleration?

43. A Mercedes-Benz 300SL (m = 1700 kg) is parked on a road that rises 15° above the horizontal. What are the magnitudes of **(a)** the normal force and **(b)** the static frictional force that the ground exerts on the tires?

44. GO Consult Multiple-Concept Example 9 to explore a model for solving this problem. A person pushes on a 57-kg refrigerator with a horizontal force of –267 N; the minus sign indicates that the force points in the $-x$ direction. The coefficient of static friction is 0.65. **(a)** If the refrigerator does not move, what are the magnitude and direction of the static frictional force that the floor exerts on the refrigerator? **(b)** What is the magnitude of the largest pushing force that can be applied to the refrigerator before it just begins to move?

45. ssm A 6.00-kg box is sliding across the horizontal floor of an elevator. The coefficient of kinetic friction between the box and the floor is 0.360. Determine the kinetic frictional force that acts on the box when the elevator is **(a)** stationary, **(b)** accelerating upward with an acceleration whose magnitude is 1.20 m/s^2, and **(c)** accelerating downward with an acceleration whose magnitude is 1.20 m/s^2.

46. GO A cup of coffee is on a table in an airplane flying at a constant altitude and a constant velocity. The coefficient of static friction between the cup and the table is 0.30. Suddenly, the plane accelerates forward, its altitude remaining constant. What is the maximum acceleration that the plane can have without the cup sliding backward on the table?

47. mmh An 81-kg baseball player slides into second base. The coefficient of kinetic friction between the player and the ground is 0.49. **(a)** What is the magnitude of the frictional force? **(b)** If the player comes to rest after 1.6 s, what was his initial velocity?

***48.** Consult Multiple-Concept Example 10 in preparation for this problem. Traveling at a speed of 16.1 m/s, the driver of an automobile suddenly locks the wheels by slamming on the brakes. The coefficient of kinetic friction between the tires and the road is 0.720. What is the speed of the automobile after 1.30 s have elapsed? Ignore the effects of air resistance.

***49. ssm** A person is trying to judge whether a picture (mass = 1.10 kg) is properly positioned by temporarily pressing it against a wall. The pressing force is perpendicular to the wall. The coefficient of static friction between the picture and the wall is 0.660. What is the minimum amount of pressing force that must be used?

***50.** Air rushing over the wings of high-performance race cars generates unwanted horizontal air resistance but also causes a vertical *downforce,* which helps the cars hug the track more securely. The coefficient of static friction between the track and the tires of a 690-kg race car is 0.87. What is the magnitude of the maximum acceleration at which the car can speed up without its tires slipping when a 4060-N downforce and an 1190-N horizontal-air-resistance force act on it?

****51.** While moving in, a new homeowner is pushing a box across the floor at a constant velocity. The coefficient of kinetic friction between the box and the floor is 0.41. The pushing force is directed downward at an angle θ below the horizontal. When θ is greater than a certain value, it is not possible to move the box, no matter how large the pushing force is. Find that value of θ.