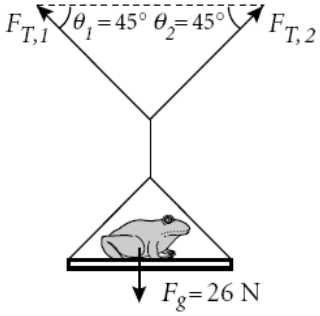
Honors Physics - Chapter 4 Practice Problems

1) About 50 years ago, the San Diego Zoo, in California, had the largest gorilla on Earth: its mass was about 3.10×10^2 kg. Suppose a gorilla with this mass hangs from two vines, each of which makes an angle of 30.0° with the vertical. Draw a free-body diagram showing the various forces, and find the magnitude of the force of tension in each vine. What would happen to the tensions if the upper ends of the vines were farther apart?

2) David Purley, a racing driver, survived deceleration from 173 km/h to 0 km/h over a distance of 0.660 m when his car crashed. Assume that Purley's mass is 70.0 kg. What is the average force acting on him during the crash? Compare this force to Purley's weight. (Hint: Calculate the average acceleration first.)

3) The largest toad ever caught had a mass of 2.65 kg. Suppose a toad with this mass is placed on a metal plate that is attached to two cables, as shown in the figure below. If the plate is pulled upward so that it has a net acceleration of 2.55 m/s^2, what is magnitude of the tension in the cables? (The plate's weight can be disregarded.)



4) A 0.5 mm wire made of carbon and manganese can just barely support the weight of a 70.0 kg person. Suppose this wire is used to lift a 45.0 kg load. What maximum upward acceleration can be achieved without breaking the wire?

5) An average newborn blue whale has a mass of 3.00×10^3 kg. Suppose the whale becomes stranded on the shore and a team of rescuers tries to pull it back to sea. The rescuers attach a cable to the whale and pull it at an angle of 20.0° above the horizontal with a force of 4.00 kN. There is, however, a horizontal force opposing the motion that is 12.0 percent of the whale's weight. Calculate the magnitude of the whale's net acceleration during the rescue pull.

6) The largest squash ever grown had a mass of 409 kg. Suppose you want to push a squash with this mass up a smooth ramp that is 6.00 m long and that makes a 30.0° angle with the horizontal. If you push the squash with a force of 2080 N up the incline, what is

a. the net force exerted on the squash?

b. the net acceleration of the squash?

c. the time required for the squash to reach the top of the ramp?

7) The steepest street in the world is Baldwin Street in Dunedin, New Zealand. It has an inclination angle of 38.0° with respect to the horizontal. Suppose a wooden crate with a mass of 25.0 kg is placed on Baldwin Street. An additional force of 59 N must be applied to the crate perpendicular to the pavement in order to hold the crate in place. If the coefficient of static friction between the crate and the pavement is 0.599, what is the magnitude of the frictional force?

8) The steepest railroad track that allows trains to move using their own locomotion and the friction between their wheels and the track is located in France. The track makes an angle of 5.2° with the horizontal. Suppose the rails become greasy and the train slides down the track even though the wheels are locked and held in place with blocks. If the train slides down the tracks with a constant velocity, what is the coefficient of kinetic friction between the wheels and track?

9) The heaviest train ever pulled by a single engine was over 2 km long. A force of 1.13×10^8 N is needed to overcome static friction in the train's wheels. If the coefficient of static friction is 0.741, what is the train's mass?

10) Suppose a giant hamburger slides down a ramp that has a 45.0° incline. The coefficient of kinetic friction between the hamburger and the ramp is 0.597, so that the net force acting on the hamburger is 6.99×10^3 N. What is the mass of the hamburger? What is the magnitude of the normal force that the ramp exerts on the hamburger?

11) *Cleopatra's Needle*, an obelisk given by the Egyptian government to Great Britain in the nineteenth century, is 20+ m tall and has a mass of 1.89×10^5 kg. Suppose the monument is lowered onto its side and dragged horizontally to a new location. An applied force of 7.6×10^5 N is exerted on the monument, so that its net acceleration is 0.11 m/s^2. What is the magnitude of the frictional force?