6.7: Exercises

Exercise 6.7.1

a. Draw a free-body diagram for the skydiver in Exercise 5.8.4 of Chapter 5.
b. What is the magnitude of the air drag force on the skydiver, after he reaches terminal speed?

Exercise 6.7.2

A book is sent sliding along a table with an initial velocity of 2 m/s. It slides for 1.5 m before coming to a stop. What is the coefficient of kinetic friction between the book and the table?

Exercise 6.7.3

You are pulling on a block of mass 4 kg that is attached, via a rope of negligible mass, to another block, of mass 6 kg. The coefficient of kinetic friction between the blocks and the surface on which they are sliding is μ_k. You find that when you apply a force of 20 N, the whole thing moves at constant velocity.

a. Draw a free-body diagram for each of the two blocks.
b. What is the coefficient of kinetic friction between the blocks and the surface?
c. What is the tension in the rope?

Exercise 6.7.4

A box of mass 2 kg is sitting on top of a sled of mass 5 kg, which is resting on top of a frictionless surface (ice).

a. What is the normal force exerted by the box on the sled? (And by the sled back on the box.)
b. If you pull on the sled with a force of 35 N, how large does the coefficient of static friction, μ_s, between the box and the sled have to be, in order for the box to move with the sled? Draw free-body diagrams for the box and for the sled under this assumption (that they move together).
c. Suppose that μ_s is less than the value you got in part (b), so the box starts to slide back (relative to the sled). If the coefficient of kinetic friction μ_k between the box and the sled is 0.15, what is the acceleration of the sled, and what is the acceleration of the box, while they are sliding relative to each other (so, before the box falls off, and while you are still pulling with a 35-N force)? Draw again the free-body diagrams appropriate to this situation.

Exercise 6.7.5

You stick two objects together, one with a mass of 10 kg and one with a mass of 5 kg, using a glue that is supposed to be able to provide up to 19 N of force before it fails. Suppose you then pull on the 10 kg block with a force of 30 N.

a. What is the acceleration of the whole system?
b. What is the force exerted on the 5 kg block, and where does it come from? Does the glue hold?
c. Now suppose you pull on the 5 kg block instead with the same force. Does the glue hold this time?

Exercise 6.7.6

Draw a free-body diagram for a 70-kg person standing in an elevator carrying a 15-kg backpack (do not consider the backpack a part of the person!) (a) if the elevator is not moving, and (b) if the elevator is accelerating downwards at 2 m/s^2. In each case, what is the magnitude of the normal force exerted on the person by the floor?