Moving through a liquid, an object of mass m experiences a resistive drag force proportional to its velocity, $F_{\text{drag}} = -bv$, where b is a constant. (a) Find an expression for the object's speed as a function of time, when it starts from rest and falls vertically through the liquid. (b) Show that it reaches a terminal velocity mg/b. - 1

note typo in book!

Ex

The potential energy function for the force between two atoms in a diatomic molecule can be expressed as (approximately):

$$U(x) = \frac{a}{x^{12}} - \frac{b}{x^{6}}$$

where x is the distance between atoms and a and b are positive constants.

(a) At what values of x is $U(x) = 0$? When is $U(x)$ a minimum? [Hint: Might be helpful to try part B first!)

(b) Determine the force between atoms. [$F(x)$]

(c) Assume that one of the atoms remains at rest and that the other moves along x. Describe possible motions. [Hint: See hint to part a]

(d) The energy needed to break up the the molecule into separate atoms is called the dissociation energy. What is the dissociation energy of the molecule?

(e) Sketch $U(x)$ and $F(x)$. Provide as much detail as possible.

Ex Two point masses collide elastically. One mass (m_2) was initially at rest. The other mass (m_1) is scattered off at angle θ. What fraction of its initial energy does m_1 have after the collision?

NOTE this problem is closely related to Wolfson ch. 9 #73 as well as Ex. 9.11.

Your alpine rescue team is using a slingshot to send an emergency medical packet to climbers stranded on a ledge, as shown in Fig. 3.26; your job is to calculate the launch speed. What do you report?

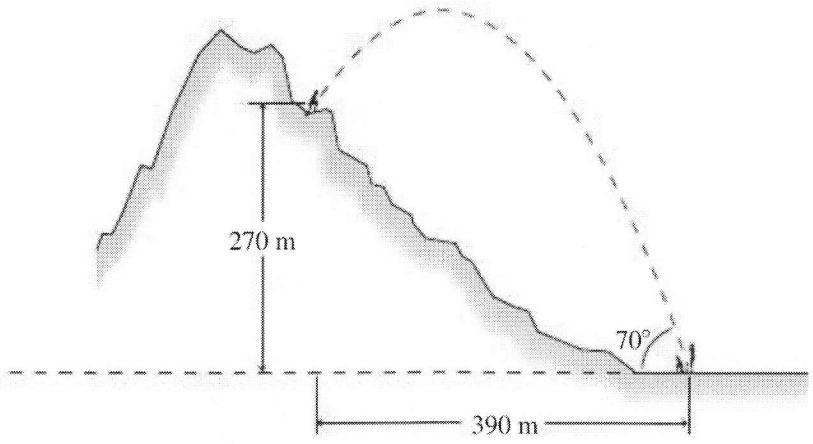
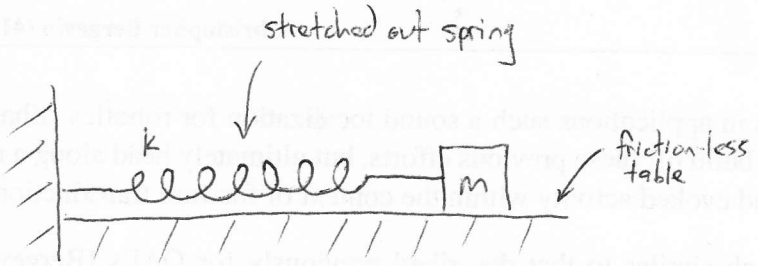


FIGURE 3.26 Problem 76

Ex



Sping is stretched out 3.0 in from equilibrium by a force of 0.75 lb. A mass of 1.5 lb is then attached to the spring and stretched 4.0 in. from equilibrium. When released, the mass undergoes simple harmonic motion.

[a] What is the force const. of the spring?

[b] What is the force exerted by the spring on the mass just before it is released?

[c] What is the period of oscillation after release?

[d] What is the amplitude of oscillation?

[e] What is the maximum speed of the mass?

[f] What is the maximum acceleration of the mass?

[g] Once the block has moved halfway from its initial position to its center of motion, determine the following (at that point): velocity, acceleration, kinetic energy, and potential energy.

[h] Compute the total energy of the oscillating system

[i] What is the displacement of the mass as a function of time?

Ex Determine the volume of a cone of height H and base radius R. Also determine its center of mass, assuming the cone has uniform density δ.

You're a consulting engineer specializing in athletic facilities, and you've been asked to help design the Olympic ski jump pictured in Fig. 3.27. Skiers will leave the jump at 28 m/s and 9.5° below the horizontal, and land 55 m horizontally from the end of the jump. Your job is to specify the slope of the ground so skiers' trajectories make an angle of only 3.0° with the ground on landing, ensuring their safety. What slope do you specify?

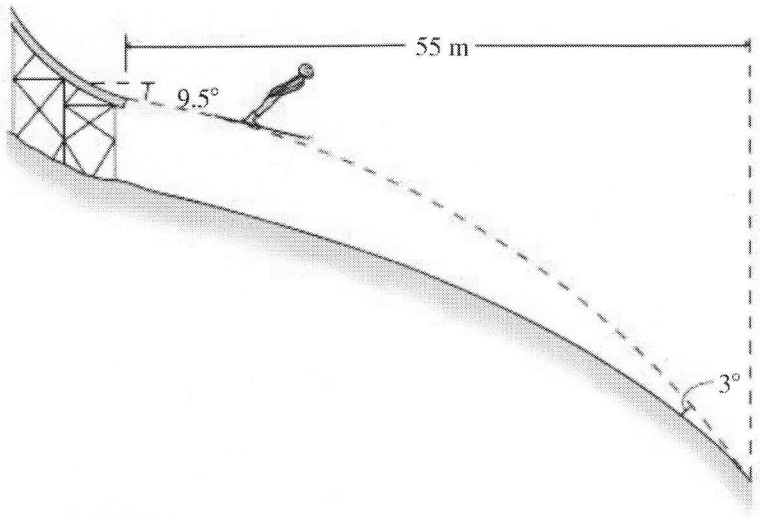


FIGURE 3.27 Problem 82