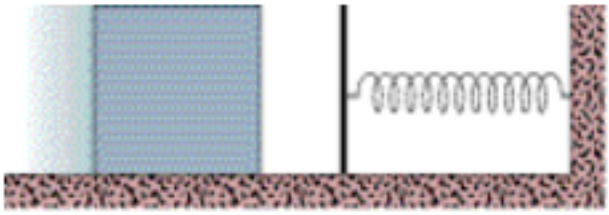
AP Physics C
HW Set 8
Conservation of Energy III

1. **A 54 [kg] skier leaves the end of a ski-jump ramp with a velocity of 25 [m/s] directed 25° above the horizontal. Suppose that as a result of air drag the skier returns to the ground with a speed of 23 [m/s], landing 10 [m] vertically below the end of the ramp. From the launch to the return to the ground, by how much energy does the skier lose due to air resistance?**

2. **During a rockslide, a 550 [kg] rock slides from rest down a hillside that is 500 [m] long and 300 [m] high. The coefficient of kinetic friction between the rock and the hill surface is 0.16 [1].**
   a. **If the gravitational potential energy of the rock is set to zero at the bottom of the hill, what is the value of Ug just before the slide?**
   b. **How much energy is transferred to thermal energy due to friction during the slide?**
   c. **What is the kinetic energy of the rock as it reaches the bottom of the hill?**
   d. **What is its speed then at the bottom of the hill?**

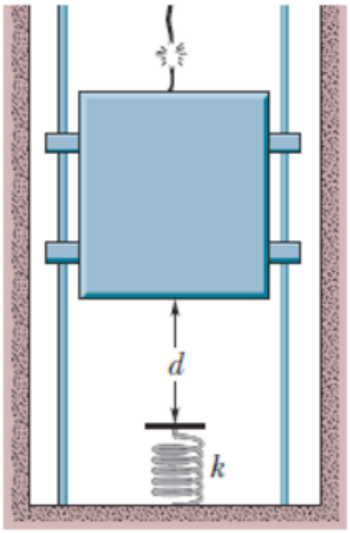
3. **A child whose weight is 261 [N] slides down a 6.4 [m] playground slide that makes an angle of 20° with the horizontal. The coefficient of kinetic friction is 0.10 [1].**
   a. **How much energy is lost to due frictional forces?**
   b. **If she starts at the top with a speed of 5.27 [m/s], what is her speed at the bottom?**

4. **In the figure below, a block of mass m = 1.5 [kg] slides head into a spring of spring constant k = 320 [N/m]. When the block stops, it has compressed the spring by 7.5 [cm]. The coefficient of kinetic friction between the block and floor is 0.15 [1].**



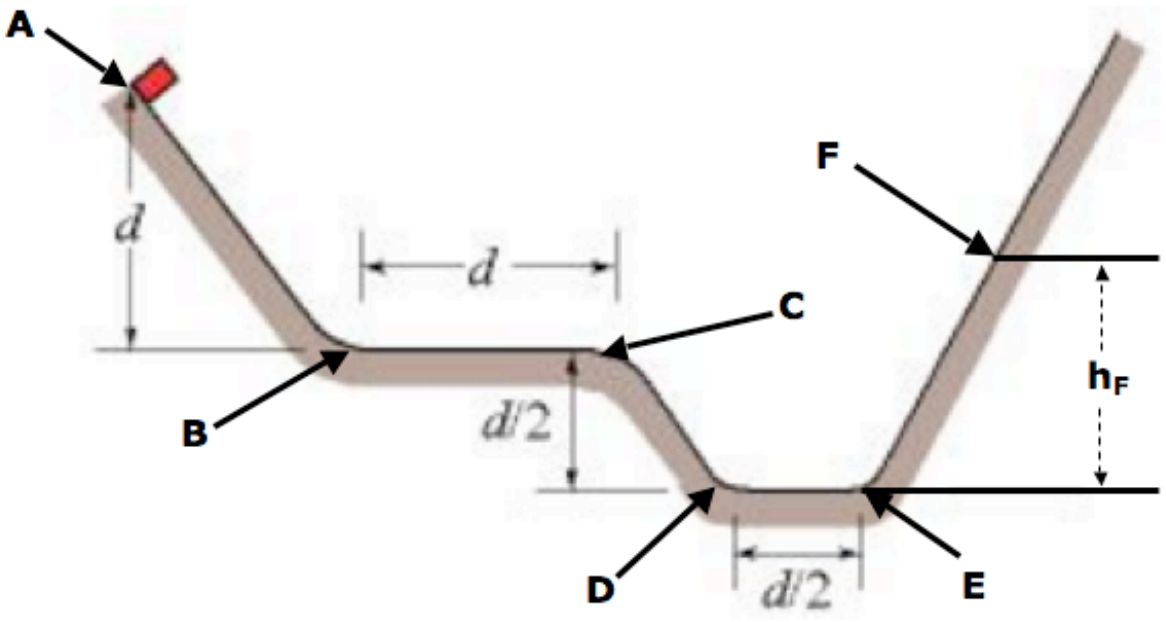
   a. **While the block is in contact with the spring and being brought to rest, how much work is done by the spring force?**
   b. **How much energy is lost due to friction?**
   c. **What is the block's speed just as it reaches the spring?**

5. **The cable of the 2000 [kg] elevator cab shown the figure snaps when the cab is at rest at the first floor, where the cab bottom is a distance d = 4.6 [m] above a spring of spring constant k = 120,000 [N/m]. A safety device clamps the cab against guide rails so that a constant frictional force of 4800 [N] opposes the cab's motion. (Assume that the frictional force on the cab is negligible when the cab is stationary.)**



a. **Find the speed of the cab just before it hits the spring.**
b. **Find the maximum distance x that the spring is compressed (the frictional force still acts during this compression).**
c. **Find the distance that the cab will bounce back up the shaft.**

6. **In the figure below, a block is released from rest at point A at height d = 0.56 [m] and slides down a frictionless ramp and onto a first plateau, which has length d and where the coefficient of kinetic friction is 0.50 [1]. All inclines are frictionless and coefficient of kinetic friction between the block and the both "plateaus" (i.e., B-C and D-E) is 0.5 [1].**



Find the following:

a. **the velocity of the block at point B**
b. **the velocity of the block at point C**
c. **the velocity of the block at point D**
d. **the velocity of the block at point E**
e. **the vertical height, h_F, the block reaches when it comes to rest on the final incline**

HW Set 8 Answers

1. 7880 [J]

2a. 1.62×10^6 [J]
2b. 3.44×10^5 [J]
2c. 1.27×10^6 [J]
2d. 68 [m/s]

3a. 157 [J]
3b. 7.67 [m/s]

4a. -0.9 [J]
4b. 0.165 [J]
4c. 1.19 [J]

5a. 8.25 [m/s]
5b. 1.2 [m]
5c. 3.52 [m]

6a. $v_B = 3.31$ [m/s]
6b. $v_C = 2.34$ [m/s]
6c. $v_D = 3.31$ [m/s]
6d. $v_E = 2.86$ [m/s]
6e. $h_F = 0.417$ [m]