Moderate

1. (HRK Chapter 13) A projectile whose mass is 9.4 kg is fired vertically upward. On its upward flight, 68 kJ of mechanical energy is dissipated because of air drag. How much higher would it have gone if the air drag had been made negligible (for example, by streamlining the projectile)?

   Solution: 740 m

2. (HRK Chapter 13) When a space shuttle (mass 79,000 kg) returns to Earth from orbit, it enters the atmosphere at an altitude of 100 miles and a speed of 18,000 mi/h, which is gradually reduced to a touchdown speed of 190 knots (220 mi/h). What is its total energy (a) at atmospheric entry and (b) at touchdown? (c) What happens to the "missing" energy?

   Solution: (a) 2.56 x 10^{12} J (b) 3.82 x 10^{8} J (c) The missing energy is dissipated as heat, light, and sound due to atmospheric drag

3. (HRK Chapter 11) A 0.20-kg puck slides across a frictionless floor with a speed of 10 m/s. The puck strikes a soft wall and stops.
   (A) The magnitude of the impulse on the puck is
   (a) 0 kg · m/s
   (b) 1 kg · m/s
   (c) 2 kg · m/s
   (d) 4 kg · m/s
   (B) The net work done on the puck is
   (a) -20 J
   (b) -10 J
   (c) 0 J
   (d) 20 J

   Solution: (A) c (B) b

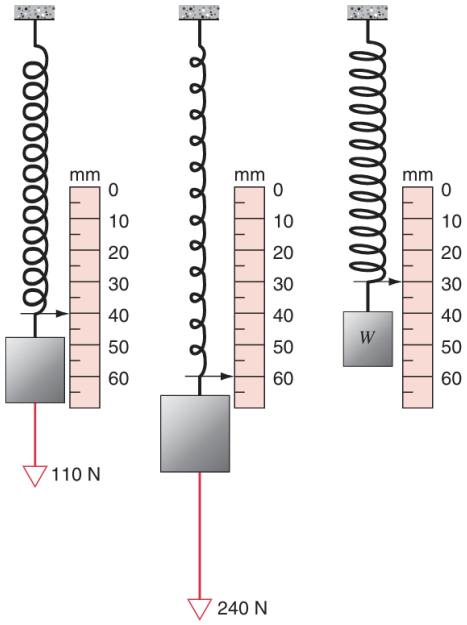
4. (HRK Chapter 11) A ball rolls off the edge of a horizontal tabletop, 4.23 ft high. It strikes the floor at a point 5.11 ft horizontally away from the edge of the table.
   (a) For how long was the ball in the air?
   (b) What was its speed at the instant it left the table?

Use g = 32 ft/s^2.

Solution: (a) 0.514 s (b) 9.94 ft/s

Hard

5. (HRK Chapter 11) The figure below shows a spring with a pointer attached,hanging next to a scale graduated in millimeters. Three different weights are hung from the spring, in turn,as shown. (a) If all weight is removed from the spring,which mark on the scale will the pointer indicate? (b) Find the weight W.

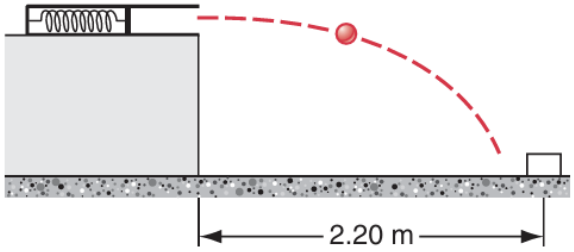


Solution: (a) 23 mm. (b) 45 N.

6. (HRK Chapter 12) A 2.14-kg block is dropped from a height of 43.6 cm onto a spring of force constant k = 18.6 N/cm. Find the maximum distance the spring will be compressed.

Solution: 11.1 cm

7. (HRK Chapter 12) Two children are playing a game in which they try to hit a small box on the floor with a marble fired from a spring-loaded gun that is mounted on a table. The target box is 2.20 m horizontally from the edge of the table; see the figure below. Bobby compresses the spring 1.10 cm, but the marble falls 27.0 cm short. How far should Rhoda compress the spring to score a hit?.



Solution: 1.25 cm

8. A stone of weight w is thrown vertically upward into the air with an initial speed v_0. Suppose that the air drag force f dissipates an amount f_y of mechanical energy as the stone travels a distance y.
   (a) Show that the maximum height reached by the stone is

$$h = \frac{v_0^2}{2g(1 + \frac{f}{w})}$$

   (b) Show that the speed of the stone upon impact with the ground is

$$v = v_0(\frac{w - f}{w + f})^{1/2}$$