For the next two items
A 20 g steel ball bearing is pushed back to a maximum compression of 0.10 m against a spring. The spring has a force constant of 50 N/m. The launcher is aimed horizontally.

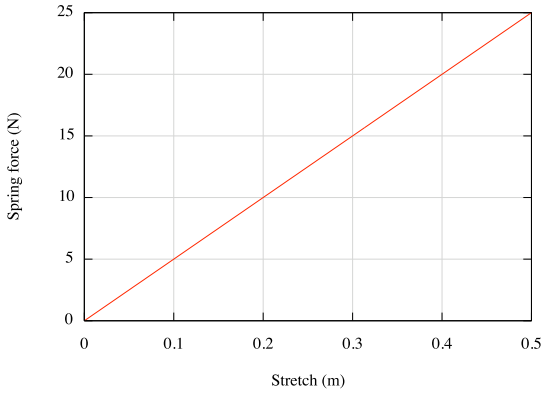
1. How much elastic potential energy is stored in the spring when compressed as described?

   _____

2. Assuming that all the energy stored in the spring is transferred to the ball bearing, how fast will the ball bearing be moving when launched?

   _____

3. A spring exerts a force as it is stretched according to the graph shown.



   (a) What is the value of the force constant (or "spring" constant) for this spring?

   _____

   (b) How much energy does the spring possess if it is stretched 0.15 m?

   _____

4. An elevator in a tall building has a mass of 2000 kg, including its occupants. It rises 100 m at a steady speed from Ground Floor to 9^{th} floor in 20 s. How much power is required to accomplish this?

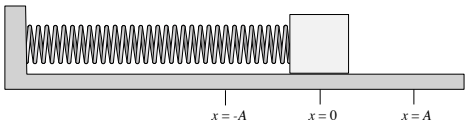
   _____

5. A ball is thrown upward. At a height of 10 meters above the ground the potential energy associated with the ball is 50 joules with reference to ground level defined as zero potential energy. The ball at this position is moving upward with a kinetic energy of 50 Joules. Air friction is negligible. The maximum height above ground reached by the ball is most nearly

   (a) 10 m
   (b) 20 m
   (c) 30 m
   (d) 40 m
   (e) 50 m

6. A weight lifter lifts a mass m at constant speed to a height h in time t. How much work is done by the weight lifter?

   (a) mg
   (b) mh
   (c) mgh
   (d) $mght$
   (e) $\dfrac{mgh}{t}$



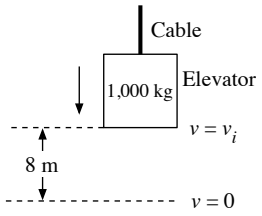
A block on a horizontal frictionless surface is attached to a spring, as shown above. The block oscillates along the x-axis with simple harmonic motion of amplitude A.

7. Which of the following statements about energy is correct?

   (a) The potential energy in the spring is at a minimum at $x = 0$.
   (b) The potential energy in the spring is at a minimum at $x = A$.
   (c) The kinetic energy of the block is at a minimum at $x = 0$.
   (d) The kinetic energy of the block is at a maximum at $x = A$.
   (e) The kinetic energy of the block is always equal to the potential energy in the spring.

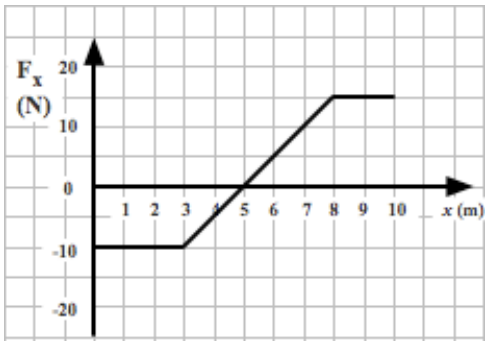
8. A frictionless pendulum of length 3 m swings with an amplitude of 10°. At its maximum displacement the potential energy of the pendulum system is 10 J. What is the kinetic energy of the pendulum when its potential energy is 5 J?

   (a) 3.3 J
   (b) 5 J
   (c) 6.7 J
   (d) 10 J
   (e) 15 J



9. A descending elevator of mass 1,000 kg is uniformly decelerated to rest over a distance of 8 m by a cable in which the tension is 11,000 N. The speed v_i of the elevator at the beginning of the 8 m descent is most nearly

   (a) 4 m/s
   (b) 10 m/s
   (c) 13 m/s
   (d) 16 m/s
   (e) 21 m/s



For the next two items:

The graph shows the force applied to a 2 kg body free to move along a straight line on a frictionless surface. The body is initially at $x = 0$ and moving to the right with a speed of 10 m/s. The force exerted on the body acts along the same straight line.

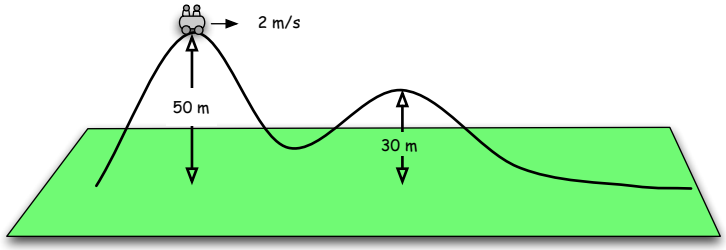
10. After the body has moved a distance of 3 meters its kinetic energy is

    (a) 10 J.
    (b) 20 J.
    (c) 30 J.
    (d) 70 J.
    (e) 29.4 J.

11. After the body has moved a distance of 10 meters its kinetic energy is

    (a) 112.5 J.
    (b) 192.5 J.
    (c) 12.5 J.
    (d) 15 J.
    (e) 100 J.

12. A roller coaster car has a mass of 1000 kg including its two passengers. This carefully designed roller coaster has negligible friction; wheels, bearings, and tracks have been carefully designed to make this so. When the coaster car is at the top of the first hill, which has a height of 50 m above ground, the car has a speed of 2 m/s.



    (a) What is the amount of kinetic energy possessed by the coaster car at the top of the first hill?

(b) What is the amount of gravitational energy in this system when the coaster car is at the top of the first hill? Define the ground to be at $y = 0$.

_____

(c) What is the total mechanical energy in this system when the coaster car is at the top of the first hill?

_____

(d) What is the amount of gravitational energy in this system when the coaster car is at the top of the second hill?

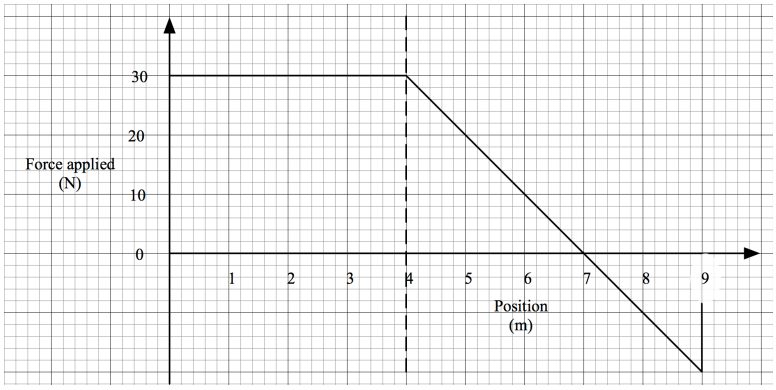
_____

(e) What is the amount of kinetic energy that the coaster car will have at the top of the second hill?

_____

(f) What is the speed of the coaster car at the top of the second hill?

_____



13. A hockey goal at rest is then pushed on ice by a referee with a force that varies with position as shown above.

(a) Find the amount of work done by the referee in displacing the goal the first 4 m.

(b) Find the speed of the goal when it is at position x = 7 m.

(c) Find the final speed of the object when at position x = 9 m.