Physics 17 Practice Problems F

1. An object at an altitude of 20.0 m is rising straight upward at 14 m/s. What will be the object's speed (in m/s) when its altitude is 12 m?

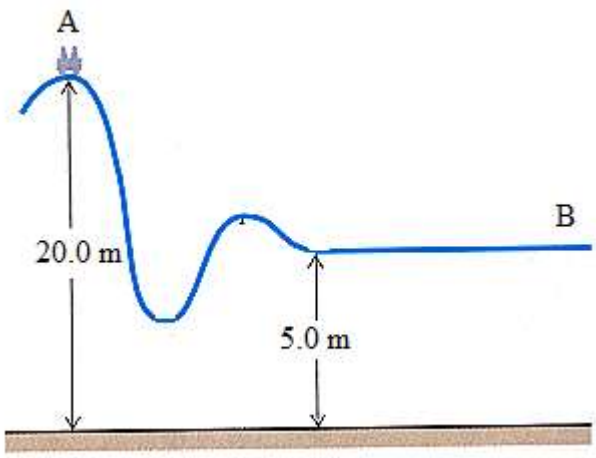
2. A 5-kg object is dropped from the top of a 90-meter cliff. What will be its kinetic energy when it strikes the ground?

3. An object's initial total energy is 20,000 J. Later, its total energy is only 14,000 J. What non-conservative work was done on the object?

4. The potential energy of an object at some moment is 1200 J, while its kinetic energy is 2300 J. Later, the object's kinetic energy is 900 J. Assume no non-conservative forces are acting. What is its potential energy?

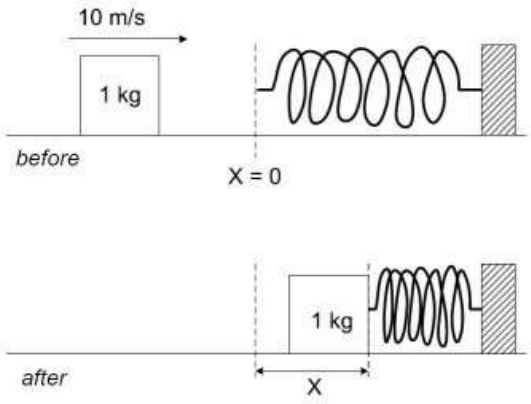
5. A 10-kg object has a total energy of 3000 J. What is its potential energy when its speed is 20 m/s?

6. The cart at the top of the tallest hill at A has a mass of 60 kg and is moving at 9.0 m/s. The cart arrives at B with a speed of 12 m/s. What non-conservative work was done on the cart in traveling from A to B?



7. A falling object's kinetic energy increases from 200 J to 700 J as it travels a certain distance downward. What was the change in the object's potential energy?

8. In the figure below, the 1-kg object sliding across a frictionless tabletop at a speed of 10 m/s is brought to rest by a spring whose spring constant is 500 N/m. By about how much was the spring compressed?



9. An object is oscillating on a horizontal frictionless surface at the end of a spring. The total energy of the spring-mass system is 200 J.

(a) What is the object's maximum kinetic energy?
(b) Maximum potential energy?

Assume the mass of the object is 4 kg and the spring constant is 1000 N/m:

(e) Maximum speed of the object?
(f) Maximum compression of the spring (in centimeters)?

Solutions

1. $E = E_o$

$\frac{1}{2} mv^2 + mgh = \frac{1}{2} mv_o^2 + mgh_o.$

$v = 18.78$ m/s

2. $K_o = \frac{1}{2} (5)(0)^2$

$= 0$

$U_o = 5(9.8)90$

$= 4410$ J

$U = 5(9.8)(0)$

$= 0$

$K + U = K_o + U_o$

$K + 0 = 0 + 4410$

$K = 4410$ J

3. $E = E_o + W_{NC}$

$14{,}000 = 20{,}000 + W_{NC}$

$W_{NC} = -6000$ J

4. $E_o = 1200 + 2300$

$= 3500$ J

$K = 900$ J

$K + U = E_o$

$900 + U = 3500$

$U = 2600$ J

5. $K + U = E$

$\frac{1}{2} (10)20^2 + U = 3000$

$2000 + U = 3000$

$U = 1000$ J

6.

Let the reference level be at Point B.

$h_o = 20 - 5$

$= 15$ m.

$h_o = 0$

$v_o = 9.0$ m/s

$v = 12.0$ m/s

$W_{NC} = E - E_o$

$= [\frac{1}{2} (60)12^2 + 60(98)(0)] - [\frac{1}{2} (60)9.0^2 + 60(9.8)(15)]$

$= -6930$ J

7. By however much one of the energies changes, the other one changes in the opposite way. In this way, the sum of the two kinds of energy is always the same.

The kinetic energy *increased* by 500 J, so the gravitational potential energy *decreased* by 500 J.

8. The elevation of the object never changes, so the gravitational potential energy on the "E" side of the equation below is the same as the potential energy on the "E_o" side of the equation, so we just omit those energies, since they cancel out, anyway.

$$E = E_o$$

$$\tfrac{1}{2}(1.0)(0)^2 + \tfrac{1}{2}(500)x^2 = \tfrac{1}{2}(1.0)10^2 + \tfrac{1}{2}(500)(0)^2$$

$$x = 0.45 \text{ m}$$

9.

(a) $K + U = 200$ J

$K = 200 - U$

K is max when U = 0

$K = 200 - 0$

$= 200$ J

(b) $K + U = 200$ J

$U = 200 - K$

U is max when K = 0

$U = 200 - 0$

$= 200$ J

(c) $\tfrac{1}{2}(4)v^2 = 200$ J

$v = 10$ m/s

(d) $\tfrac{1}{2}(1000)x^2 = 200$ J

$x = 0.63$ m

$= 63$ cm