Problem Set 6 – conservation of mechanical energy

1. A 3-kg projectile has a speed of 12 m/s when the projectile is 10 meters above the ground.

What is the kinetic energy of the object, the gravitational potential energy of the object, and the mechanical energy of the object?

2. A spring has a force constant of 20 N/m. How much elastic potential energy is stored in the spring

if the spring is

(a) neither stretched nor compressed?

(b) stretched by 0.1 meter?

(c) compressed by 10 cm?

3. A roller-coaster car is moving at 10 m/s at point P which is 20 m above the ground.

How high off the ground is the car when its speed is 18 m/s?

4. Another roller-coaster car goes through a vertical loop. The loop has a radius of 4 m. How fast is the car going at the bottom of the loop if its speed is 6.3 m/s at the top of the loop?

5. An object is thrown straight upward at 40 m/s. What is the maximum height of the object?

Do not use the equations of accelerated motion to solve this problem.

pos I

pos II

pos III

1 m

6. I hold a ball horizontally at the end of a 1-m long string (position I).

I release the ball and it swings downward through its lowest

0.5 m

point (position III). Position II is the location at which the ball

has fallen half the vertical distance between positions I & III.

What is the speed of the ball at positions II & III?

A

B

7. Object A is 6 kg and object B is 2 kg.

If the objects start from rest, how far

has object B fallen when object A

reaches a speed of 3 m/s?

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8. A 2000 N/m, horizontal spring is compressed 10 cm and held in place. When released, the spring pushes a 2-kg object across a surface.

(a) What is the size of the force the spring exerts on the object when the spring is released?

(b) What is the speed of the object as it passes through the equilibrium position of the spring?

9. A 5-kg object and a 10-kg object have the same amount of kinetic energy. The 5-kg object has a speed of 20 m/s. What is the speed of the 10-kg object?

10. A 0.4-kg object slides off a table at 1.5 m/s. The object lands on a spring that is 0.8 meters below the table.

The spring compresses 0.05 m due to the object hitting the spring.

(a) What was the speed of the object when it hit the spring?

(b) What is the force constant of the spring in N/m?

ANSWERS

1. KE = 216 J 3. 8.6 m 6. 3.1 m/s at pos II 9. 14 m/s

GPE = 294 J 4.4 m/s at pos III

ME = 510 J 4. 14 m/s 10. (a) 4.23 m/s

7. 1.84 m (b) 3024 N/m 2. (a) zero

(b) 0.1 J 5. 81.6 m 8. (a) 200 N

(c) 0.1 J (b) 3.16 m/s