AP Physics C
Periodic Motion HO25

1.) A harmonic oscillator is made by using a 0.300 kg block and an ideal spring of unknown force constant. The oscillator is found to have a period of 0.200 s. Find the force constant of the spring. (UP 13-4)

2.) A harmonic oscillator has a mass of 0.200 kg and an ideal spring with force constant 140 N/m. Find

   a.) the angular frequency   b.) the period   (UP 13-5)

3.) An object is vibrating with simple harmonic motion that has an amplitude of 18.0 cm and frequency of 6.00 Hz. Compute the maximum magnitude of the acceleration and the velocity. (UP 13-17)

4.) A harmonic oscillator has angular frequency ω and amplitude A. (UP 13-21)

   a.) What are its position and velocity components when its elastic potential energy is equal to its kinetic energy?

   b.) How often does this occur each cycle?

   c.) What is the time between occurrences?

5.) A block with a mass of 3.00 kg is suspended from an ideal spring having negligible mass and stretches the spring 0.200 m.

   a.) What it the force constant of the spring?

   b.) What is the period of oscillation of the block if it is pulled down and released? (UP 13-25)

6.) Find the length of a simple pendulum that makes 100 complete swings in 55.0 s at a point where $g = 9.80$ m/s^2. (UP 13-33)

7.) On the earth, a certain simple pendulum has a period of 1.60 s. What is its period on the surface of the moon, where $g = 1.62$ m/s^2? (UP 13-35)

8.) You pull a simple pendulum of length 0.55 m to the side through an angle of 7° and release it. How much time does it take the pendulum bob to reach its highest speed? (UP 13-36)

9.) A 0.500 kg object is undergoing simple harmonic motion on the end of a horizontal spring with force constant $k = 400$ N/m. When the object is 0.012 m from its equilibrium position, it is observed to have a speed of 0.300 m/s. (UP 13-19)

   a.) What is the total energy of the object at any point of its motion?

   b.) What is the amplitude of the motion?

   c.) What is the maximum speed attained by the object during motion?

10.) A simple pendulum has a mass of 0.250 kg and a length of 1.00 m. It is displaced through an angle of 15° and then released. (SB 13-29)

    a.)   What is the amplitude of the pendulum's motion?   b.)   What is the maximum speed of the pendulum?

    c.)   What is the maximum angular acceleration?   d.)   What is the maximum restoring force on the pendulum?

11.) A physical pendulum in the form of a planar body moves in simple harmonic motion with a frequency of 0.450 Hz. If the pendulum has a mass of 2.20 kg and the pivot is located 0.350 m from the center of mass, determine the moment of inertia of the pendulum. (SB 13-33)

12.) A uniform thin rod that has a length of 1.0 m and a mass 0.40 kg is used to make a pendulum. The pivot point is located at a distance of 0.20 m from the upper end. Find the period and frequency of oscillation as it swings.

13.) A simple pendulum with a length of 2.23 m and a mass of 6.74 kg is given an initial speed of 2.06 m/s at its equilibrium position. Assume that it undergoes simple harmonic motion and determine its (SB 13-63)

    a.)   period   b.)   total energy   c.)   maximum acceleration   d.)   maximum angular displacement

14.) When a 0.20-kg block is suspended from a vertically hanging spring, it stretches the spring from its original length of 0.050 m to 0.060 m. The same block is attached to the same spring and placed on a horizontal, frictionless surface. The block is then pulled so that the spring stretches to a total length of 0.10 m. The block is released at time $t = 0$ and undergoes simple harmonic motion.

    a.)   What is the frequency of the motion?   b.)   What is the speed of the block each time the spring is 5.0 cm long?

    c.)   What is the maximum acceleration of the block?   d.)   What is the total mechanical energy of the system at any instant?

15.) A vertical spring stretches 0.02 m when a 0.40 kg mass is hung from it. A 0.20 kg mass is attached to the same spring and is held at rest with the spring not stretched. The mass is released it and oscillates with simple harmonic motion.

    a.)   What is the amplitude of this motion?   b.)   What is the maximum velocity of the mass?

16.) The position of a 0.4 kg object is described by the equation $x = (0.4 \text{ m})\cos\left(\frac{\pi}{3}t\right)$, where t is in seconds.

    a.)   What is the maximum speed of the object?   b.)   What is the total energy of the object?

    c.)   What is the period of oscillation?   d.)   What is the object's acceleration at $t = 1.5$ s?

17.) A block of mass $m = 1.5$ kg is attached to the end of a vertical spring of force constant $k = 300$ N/m. After the block comes to rest, it is pulled down a distance of 2.0 cm and released.

    a.)   Write and equation that describes the subsequent motion of the block.

    b.)   What are the minimum and maximum amounts of stretch of the spring during the oscillations of the block?