Physics II

Chapter 11: Oscillations

Practice Test

Fall 2022

IMPORTANT: Except for multiple-choice questions, you will receive no credit if you show only an answer, even if the answer is correct. Always show in the space on your answer sheet some sketches, words, or equations which clearly justify your answer. Show the equations you use and the values substituted into them whenever equations are necessary. If you go from an equation directly to an answer without showing the values used, you will lose points. Points will also be deducted for missing or erroneous units.

Each individual answer is weighted roughly evenly throughout the exam.

- I will not lie, cheat, or steal in any of my academic endeavors.
- I will forthrightly oppose each and every instance of academic dishonesty.
- I will not request, receive, or give aid in examinations/tests/quizzes.

Name _____

$$F = kx \qquad \omega = \sqrt{\frac{k}{m}} \qquad \omega = \frac{2\pi}{T} \qquad \text{KE} = \frac{1}{2}mv^2$$

$$\sum F = ma \qquad x = A\cos\omega t \qquad T = \frac{1}{f} \qquad \text{SPE} = \frac{1}{2}kx^2$$

1. If the force constant of a spring connected to a mass increases, the period of its oscillations will

   (a) increase.

   (b) decrease.

   (c) remain the same.

2. If the mass of an object connected to a spring increases, the frequency of its oscillations will

   (a) increase.

   (b) decrease.

   (c) remain the same.

3. If the amplitude of the oscillations of an object connected to a spring increases, the frequency of its oscillations will

   (a) increase.

   (b) decrease.

   (c) remain the same.

4. If the amplitude of the oscillations of an object connected to a spring increases, the total energy stored in the simple harmonic oscillator will

   (a) increase.

   (b) decrease.

   (c) remain the same.

5. If the amplitude of small oscillations of a pendulum increases, the period of its oscillations will

   (a) increase.

   (b) decrease.

   (c) remain the same.

6. If the mass of a pendulum bob increases, the frequency of its oscillations will

   (a) increase.

   (b) decrease.

   (c) remain the same.

7. If the length of a pendulum increases, the period of its oscillations will

   (a) increase.

   (b) decrease.

   (c) remain the same.

8. If the angle of oscillation of a pendulum increases from an angle of $5°$ to an angle of nearly $90°$, the period of the pendulum will

   (a) change.

   (b) remain the same.

9. A bob of mass m supported by an elastic string performs simple harmonic oscillations in a vertical plane. The tension in the string

   (1) is independent of m.
   (2) is proportional to the amplitude of the oscillations.
   (3) has its maximum value when the bob is at its lowest point.

   (a) (1), (2) and (3)

   (b) (1) and (2) only

   (c) (2) and (3) only

   (d) (1) only

   (e) (3) only

10. A simple pendulum has a period of 2 s for small amplitude oscillations. The length of the pendulum is most nearly

    (a) $\frac{1}{6}$ m.

    (b) $\frac{1}{4}$ m.

    (c) $\frac{1}{2}$ m.

    (d) 1 m.

    (e) 2 m.

For the next two items

A 2 kg mass connected to a spring oscillates on a horizontal, frictionless surface with simple harmonic motion of amplitude 0.4 m. The spring constant is 50 N/m.

11. The period of this motion is

    (a) 0.04π s

    (b) 0.08π s

    (c) 0.4π s

    (d) 0.8π s

    (e) 1.26π s

12. The maximum velocity occurs where the

    (a) potential energy is a maximum.

    (b) kinetic energy is a minimum.

    (c) displacement from equilibrium is half the amplitude.

    (d) displacement from equilibrium is equal to zero.

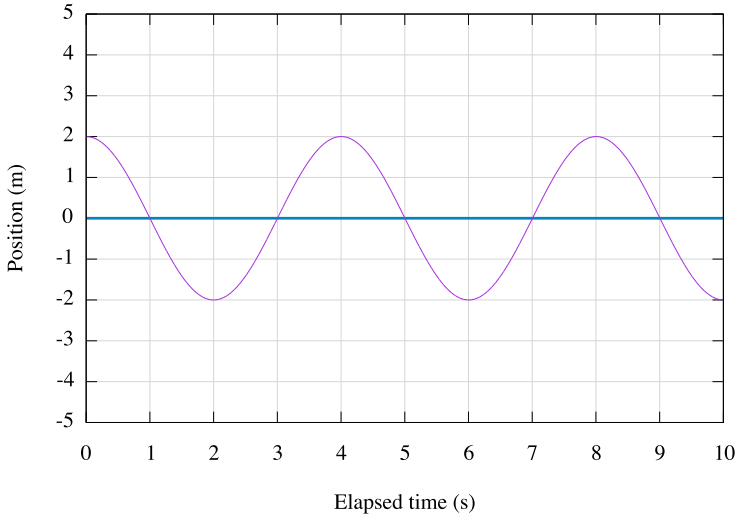
    (e) displacement from equilibrium is equal to zero.

13. When an object oscillating in simple harmonic motion is at its maximum displacement from the equilibrium position, which of the following is true of the values of its speed and the magnitude of the restoring force?

	Speed	**Restoring Force**
(a)	Zero	Maximum
(b)	Zero	Zero
(c)	$\frac{1}{2}$ maximum	$\frac{1}{2}$ maximum
(d)	Maximum	$\frac{1}{2}$ maximum
(e)	Maximum	Zero

14. A 2.00 kg mass hanging from a spring makes 12 full oscillations in 40.0 s. Find the period, frequency, angular frequency of these oscillations. Also find the force constant of this spring.

15. The graph below shows the position of a 0.40 kg mass on a spring as a function of time.



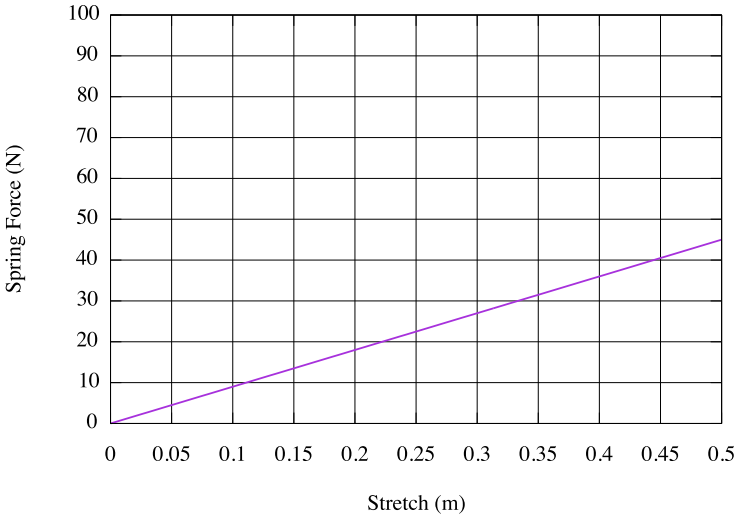
(a) What is the amplitude of its motion?

(b) What is the period of the oscillations?

(c) What is the frequency of the oscillations?

(d) What is the angular frequency of these oscillations?

(e) What is the force constant of the spring?



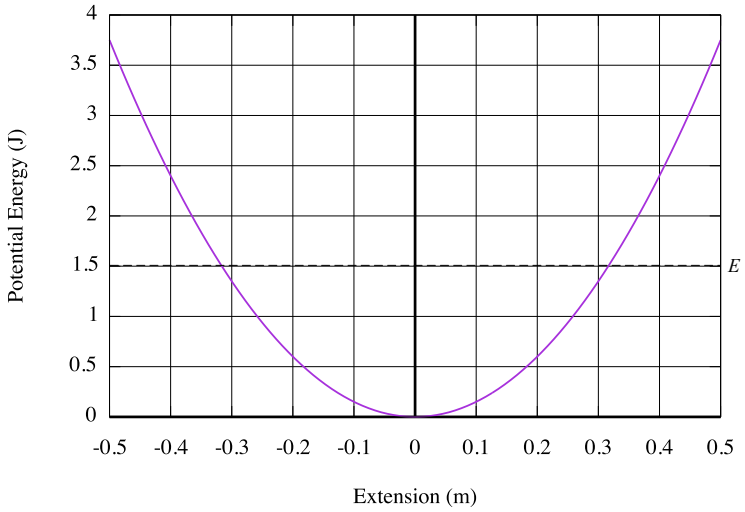
16. A spring stretches as it is subject to a stretching force as shown above.

(a) What is the force constant of this spring?

(b) How much energy does it take to stretch this spring 45 cm beyond its unstretched length?

17. A 0.150 kg mass is hung on a spring, which then stretches 40 cm. Assuming the spring is Hookean, what is the period of oscillation if the mass is pulled down a little and released?

18. The strength of our Moon's gravitational field is $g = 1.625$ N/kg. You want to set up a "seconds pendulum" on your lunar base. A seconds pendulum takes 1.00 s to swing from one extreme to the other. How long must this pendulum on the Moon be?



19. The graph above plots the potential energy stored in the spring of a simple harmonic oscillator as a function of the extension of the spring. The mass of the object that is hooked to the spring is 2.0 kg. The SHO is given 1.5 J of energy.

    (a) Find the force constant for this spring.

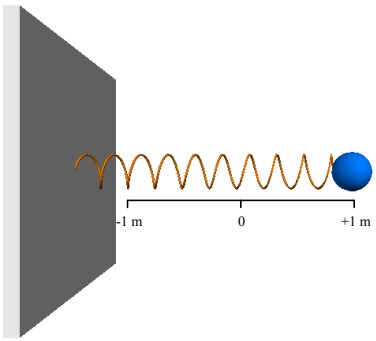
    (b) Find the angular frequency ω for this system.

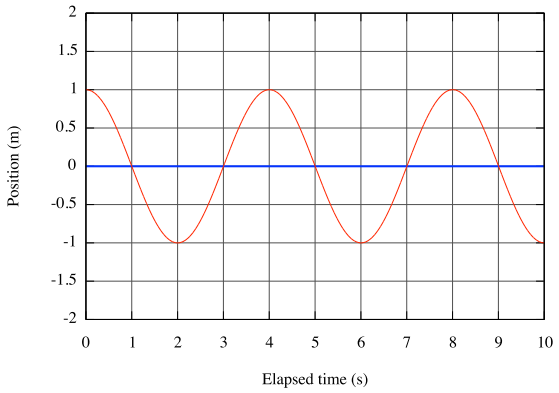
    (c) Find the kinetic energy of the object when it is at position $x = 0.2$ m.

    (d) Find the amplitude of the oscillations.

    (e) Find the period of the oscillations.

20. The graph below shows the position of a horizontal simple harmonic oscillator (aka "SHO") with a mass of 0.50 kg as a function of time. We define "right" to be the positive direction and "left" to be the negative direction. Use the choices that follow to answer each of the questions.





    (a) Does the plot for the position of this oscillator begin when the object is at its equilibrium position, its maximum stretch, or its maximum compression? _____

    (b) At which position is this oscillator moving fastest? _____

    (c) At which positions does this oscillator have zero speed? _____

(d) At which positions does this oscillator experience the biggest force? _____

(e) At which position does this oscillator experience zero net force? _____

(f) At which moments is it at maximum compression? _____

(g) At which moments is this oscillator subject to zero net force? _____

(h) Where is the kinetic energy of the SHO maximum? _____

(i) Where is the kinetic energy of the SHO zero? _____

(j) When is the potential energy in the SHO system maximum? _____

(k) Where is the potential energy in the SHO system minimum? _____

(l) What is the amplitude of these oscillations? _____

(m) What is the period of the motion for this SHO? _____

(n) What is the frequency of the motion for this SHO? _____

(o) What is the angular frequency ω (or 'angular velocity') of this system? _____

(p) What is the force constant of this spring? _____

(q) Write the mathematical expression for $x(t)$, the position of this SHO, as a function of time.

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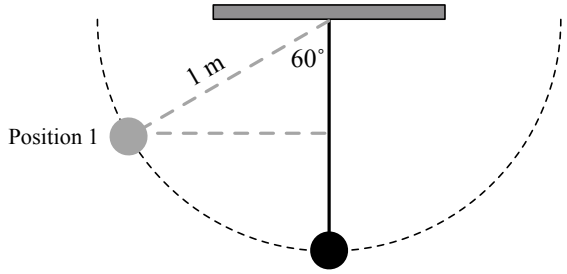
21. A pendulum bob having a mass of 0.050 kg is released from rest at Position 1 as shown below. The length of the pendulum is 1.0 m.



(a) Approximately what will be the period of this pendulum?

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(b) What will be the speed of the bob at the bottom of the swing?

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