AP Physics Multiple Choice Practice – Oscillations

1. A mass m, attached to a horizontal massless spring with spring constant k, is set into simple harmonic motion. Its maximum displacement from its equilibrium position is A. What is the mass's speed as it passes through its equilibrium position?

$(A)\ 0 \quad (B)\ A\sqrt{\frac{k}{m}} \quad (C)\ A\sqrt{\frac{m}{k}} \quad (D)\ \frac{1}{A}\sqrt{\frac{k}{m}} \quad (E)\ \frac{1}{A}\sqrt{\frac{m}{k}}$

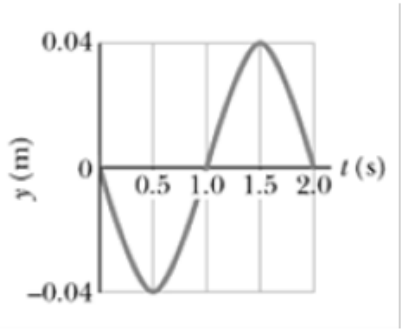
2. The period of a spring-mass system undergoing simple harmonic motion is T. If the amplitude of the spring-mass system's motion is doubled, the period will be:
(A) ¼ T (B) ½ T (C) T (D) 2T (E) 4T

3. A simple pendulum of mass m and length L has a period of oscillation T at angular amplitude $\theta = 5°$ measured from its equilibrium position. If the amplitude is changed to 10° and everything else remains constant, the new period of the pendulum would be approximately.
(A) 2T (B) $(\sqrt{2})$ T (C) T (D) T / $(\sqrt{2})$ (E) T / 2

4. A mass m is attached to a spring with a spring constant k. If the mass is set into simple harmonic motion by a displacement d from its equilibrium position, what would be the speed, v, of the mass when it returns to the equilibrium position?

$(A)\ v = \sqrt{\frac{kd}{m}} \quad (B)\ v^2 = \frac{kd}{m} \quad (C)\ v = \frac{kd}{mg} \quad (D)\ v^2 = \frac{mgd}{k} \quad (E)\ v = d\sqrt{\frac{k}{m}}$

5. A mass on the end of a spring oscillates with the displacement vs. time graph shown. Which of the following statements about its motion is INCORRECT?
(A) The amplitude of the oscillation is 0.08 m.
(B) The frequency of oscillation is 0.5 Hz.
(C) The mass achieves a maximum in speed at 1 sec.
(D) The period of oscillation is 2 sec.
(E) The mass experiences a maximum in the size of the acceleration at t=1.5 sec

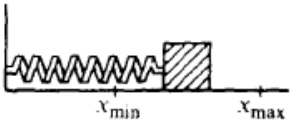


6. What is the period of a simple pendulum if the cord length is 67 cm and the pendulum bob has a mass of 2.4 kg.
(A) 0.259 s (B) 1.63 s (C) 3.86 s (D) 16.3 s (E) 24.3 s

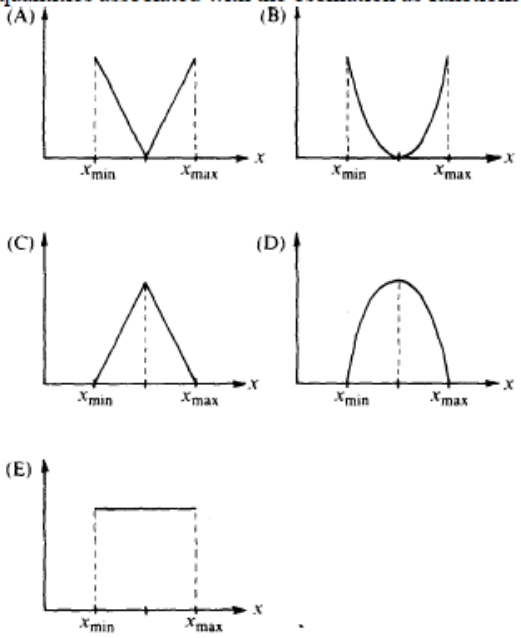
7. If the mass of a simple pendulum is doubled but its length remains constant, its period is multiplied by a factor of
(A) $\frac{1}{2}$ (B) $\frac{1}{\sqrt{2}}$ (C) 1 (D) $\sqrt{2}$ (E) 2

8. Which of the following is true for a system consisting of a mass oscillating on the end of an ideal spring?
(A) The kinetic and potential energies are equal to each other at all times.
(B) The kinetic and potential energies are both constant.
(C) The maximum potential energy is achieved when the mass passes through its equilibrium position.
(D) The maximum kinetic energy and maximum potential energy are equal, but occur at different times.
(E) The maximum kinetic energy occurs at maximum displacement of the mass from its equilibrium position

9. The length of a simple pendulum with a period on Earth of one second is most nearly
(A) 0.12 m (B) 0.25 m (C) 0.50 m (D) 1.0 m (E) 10.0 m



Questions 10-11: A block oscillates without friction on the end of a spring as shown above. The minimum and maximum lengths of the spring as it oscillates are, respectively, x_{min} and x_{max}. The graphs below can represent quantities associated with the oscillation as functions of the length x of the spring.



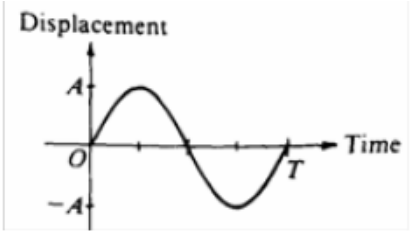
10. Which graph can represent the total mechanical energy of the block-spring system as a function of x ?
(A) A (B) B (C) C (D) D (E) E

11. Which graph can represent the kinetic energy of the block as a function of x ?
(A) A (B) B (C) C (D) D (E) E

12. An object swings on the end of a cord as a simple pendulum with period T. Another object oscillates up and down on the end of a vertical spring also with period T. If the masses of both objects are doubled, what are the new values for the Periods?

	Pendulum	Mass on Spring
(A)	$T/\sqrt{2}$	$T\sqrt{2}$
(B)	T	$T\sqrt{2}$
(C)	T	T
(D)	$T\sqrt{2}$	T
(E)	$T\sqrt{2}$	$T/\sqrt{2}$

13. An object is attached to a spring and oscillates with amplitude A and period T, as represented on the graph. The nature of the velocity v and acceleration a of the object at time T/4 is best represented by which of the following?

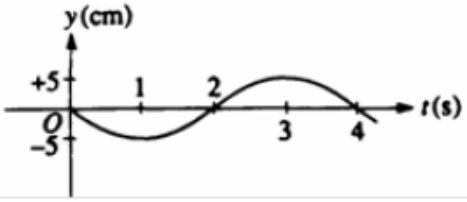


(A) $v > 0, a > 0$ (B) $v > 0, a < 0$ (C) $v > 0, a = 0$
(D) $v = 0, a < 0$ (E) $v = 0, a = 0$

14. 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?

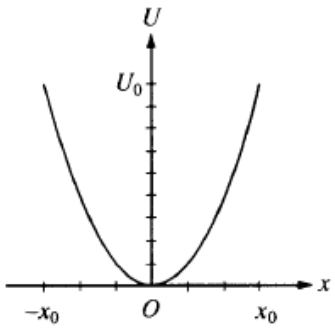
Speed	Restoring Force
(A) Zero	Maximum
(B) Zero	Zero
(C) ½ maximum	½ maximum
(D) Maximum	½ maximum
(E) Maximum	Zero

15. A particle oscillates up and down in simple harmonic motion. Its height y as a function of time t is shown in the diagram. At what time t does the particle achieve its maximum positive acceleration?

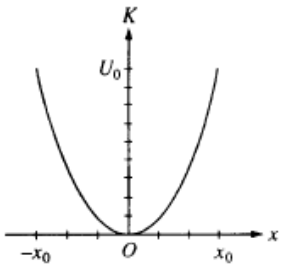


(A) 1 s (B) 2 s (C) 3 s (D) 4 s
(E) None of the above, because the acceleration is constant

16. The graph shown represents the potential energy U as a function of displacement x for an object on the end of a spring oscillating in simple harmonic motion with amplitude x_o. Which of the following graphs represents the kinetic energy K of the object as a function of displacement x ?



(A)



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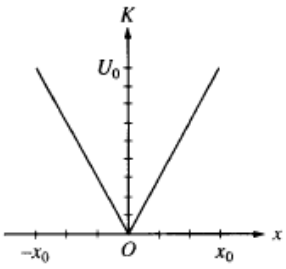

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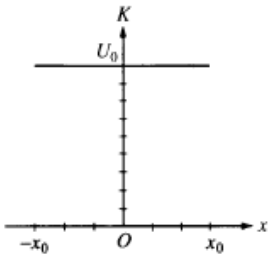

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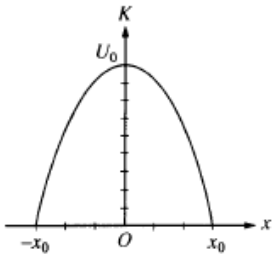
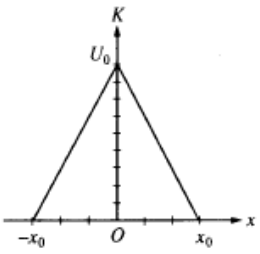
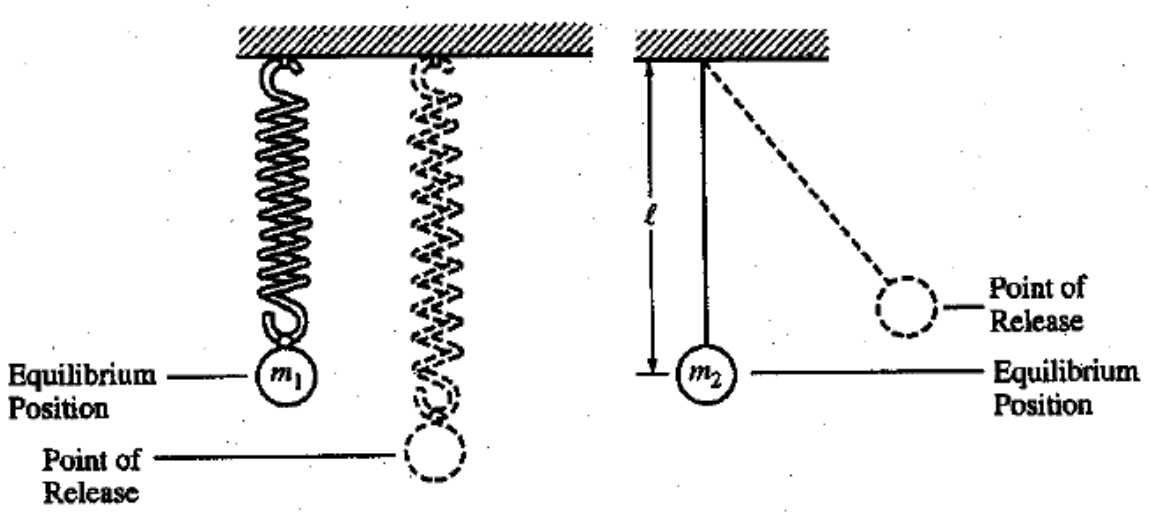


(E)



Questions 17-18



A sphere of mass m_1, which is attached to a spring, is displaced downward from its equilibrium position as shown above left and released from rest. A sphere of mass m_2, which is suspended from a string of length L, is displaced to the right as shown above right and released from rest so that it swings as a simple pendulum with small amplitude. Assume that both spheres undergo simple harmonic motion

17. Which of the following is true for both spheres?
(A) The maximum kinetic energy is attained as the sphere passes through its equilibrium position
(B) The maximum kinetic energy is attained as the sphere reaches its point of release.
(C) The minimum gravitational potential energy is attained as the sphere passes through its equilibrium position.
(D) The maximum gravitational potential energy is attained when the sphere reaches its point of release.
(E) The maximum total energy is attained only as the sphere passes through its equilibrium position.

18. If both spheres have the same period of oscillation, which of the following is an expression for the spring constant
(A) $L / m_1 g$
(B) $g / m_2 L$
(C) $m_1 L / g$
(D) $m_2 g / L$
(E) $m_1 g / L$

19. A block attached to the lower end of a vertical spring oscillates up and down. If the spring obeys Hooke's law, the period of oscillation depends on which of the following?
I. Mass of the block
II. Amplitude of the oscillation
III. Force constant of the spring
(A) I only
(B) II only
(C) III only
(D) I and II
(E) I and III

20. A simple pendulum and a mass hanging on a spring both have a period of 1 s when set into small oscillatory motion on Earth. They are taken to Planet X, which has the same diameter as Earth but twice the mass. Which of the following statements is true about the periods of the two objects on Planet X compared to their periods on Earth?
(A) Both are shorter.
(B) Both are the same.
(C) Both are longer.
(D) The period of the mass on the spring is shorter; that of the pendulum is the same.
(E) The period of the pendulum is shorter; that of the mass on the spring is the same