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?

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

3. A simple pendulum of mass m and length L has a period of oscillation T at angular amplitude θ = 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) (√2) T (C) T (D) T / (√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?

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

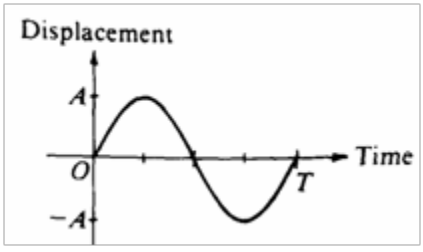
6. What is the period of a simple pendulum if the cord length is 67 cm and the pendulum bob has a mass of 2.4 kg.
(A) 0.259 s (B) 1.63 s (C) 3.86 s (D) 16.3 s (E) 24.3 s

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

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

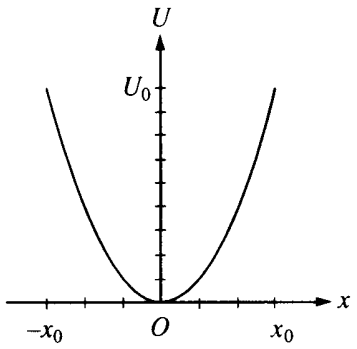


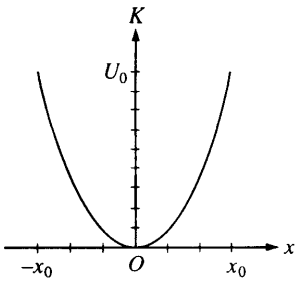
14. When an object oscillating in simple harmonic motion is at its maximum displacement from the equilibrium position. Which of the following is true of the values of its speed and the magnitude of the restoring force?

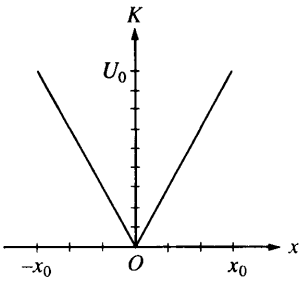
	Speed	Restoring Force
(A)	Zero	Maximum
(B)	Zero	Zero
(C)	½ maximum	½ maximum

(D) Maximum ½ maximum
(E) Maximum Zero

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_0. Which of the following graphs represents the kinetic energy K of the object as a function of displacement x ?



(A)


(B)


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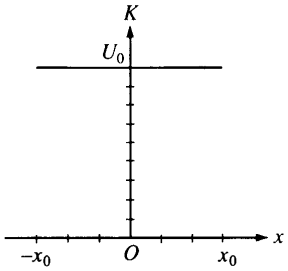

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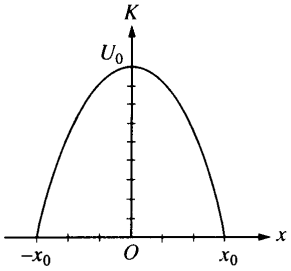
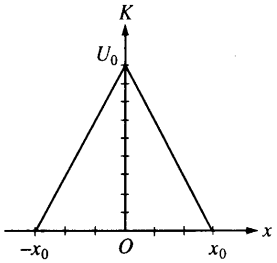
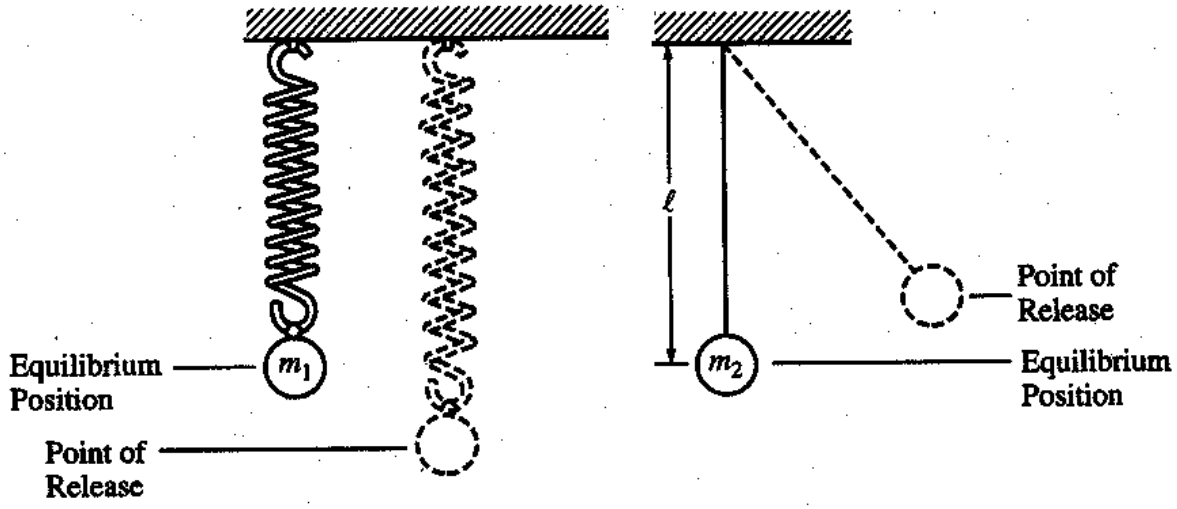


(E)


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.

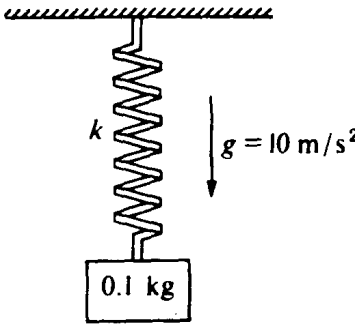
18. If both spheres have the same period of oscillation, which of the following is an expression for the spring constant
(A) $L / m_1 g$
(B) $g / m_2 L$
(C) $m_1 L / g$
(D) $m_2 g / L$
(E) $m_1 g / L$

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

21. A simple pendulum of length *l*, whose bob has mass m, oscillates with a period T. If the bob is replaced by one of mass 4m, the period of oscillation is

(A) $\frac{1}{4}$ T (B) $\frac{1}{2}$ T (C) T (D) 2T (E)4T



Questions 22-23

A 0.l -kilogram block is attached to an initially unstretched spring of force constant k = 40 newtons per meter as shown above. The block is released from rest at time t = 0.

22. What is the amplitude, in meters, of the resulting simple harmonic motion of the block?

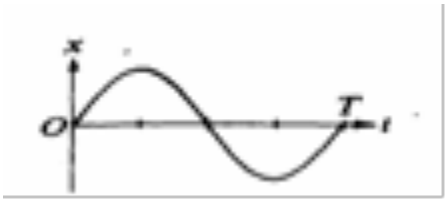
(A) $\frac{1}{40}m$ (B) $\frac{1}{20}m$ (C) $\frac{1}{4}m$ (D) $\frac{1}{2}m$ (E) $1m$

23. What will the resulting period of oscillation be?

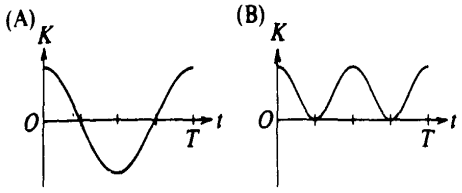
(A) $\frac{\pi}{40}s$ (B) $\frac{\pi}{20}s$ (C) $\frac{\pi}{10}s$ (D) $\frac{\pi}{5}s$ (E) $\frac{\pi}{4}s$

24. A ball is dropped from a height of 10 meters onto a hard surface so that the collision at the surface may be assumed elastic. Under such conditions the motion of the ball is
(A) simple harmonic with a period of about 1.4 s
(B) simple harmonic with a period of about 2.8 s
(C) simple harmonic with an amplitude of 5 m
(D) periodic with a period of about 2.8 s but not simple harmonic
(E) motion with constant momentum

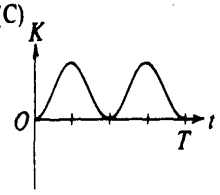
Questions 25-26 refer to the graph below of the displacement x versus time t for a particle in simple harmonic motion.



25. Which of the following graphs shows the kinetic energy K of the particle as a function of time t for one cycle of motion?



(C)



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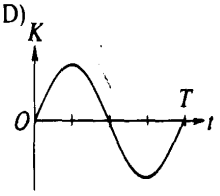
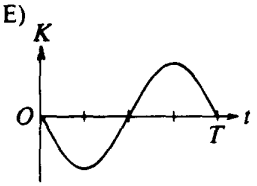
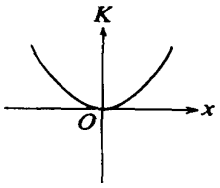


(E)

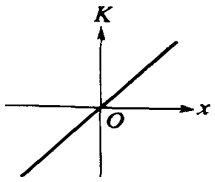


26. Which of the following graphs shows the kinetic energy K of the particle as a function of its displacement x ?

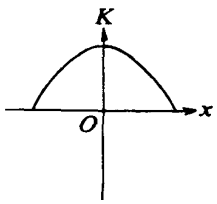
(A)



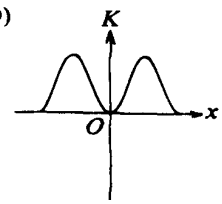
(B)



(C)



(D)



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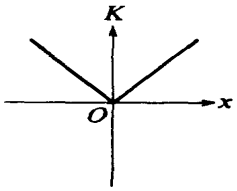
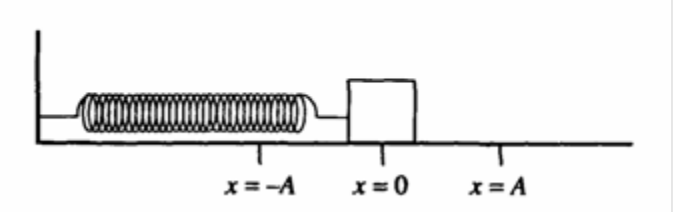


27. A mass m is attached to a vertical spring stretching it distance d. Then, the mass is set oscillating on a spring with an amplitude of A, the period of oscillation is proportional to

(A) $\sqrt{\frac{d}{g}}$ (B) $\sqrt{\frac{g}{d}}$ (C) $\sqrt{\frac{d}{mg}}$ (D) $\sqrt{\frac{m^2 g}{d}}$ (E) $\sqrt{\frac{m}{g}}$

28. Two objects of equal mass hang from independent springs of unequal spring constant and oscillate up and down. The spring of greater spring constant must have the

(A) smaller amplitude of oscillation
(B) larger amplitude of oscillation
(C) shorter period of oscillation
(D) longer period of oscillation
(E) lower frequency of oscillation



Questions 29-30. A block on a horizontal frictionless plane is attached to a spring, as shown above. The block oscillates along the x-axis with simple harmonic motion of amplitude A.

29. Which of the following statements about the block is correct?

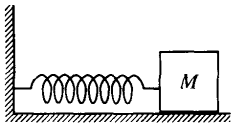
(A) At x = 0, its velocity is zero.
(B) At x = 0, its acceleration is at a maximum.
(C) At x = A, its displacement is at a maximum.
(D) At x = A, its velocity is at a maximum.
(E) At x = A, its acceleration is zero.

30. Which of the following statements about energy is correct?
(A) The potential energy of the spring is at a minimum at x = 0.
(B) The potential energy of the spring is at a minimum at x = A.
(C) The kinetic energy of the block is at a minimum at x =0.
(D) The kinetic energy of the block is at a maximum at x = A.
(E) The kinetic energy of the block is always equal to the potential energy of the spring.

31. A simple pendulum consists of a l.0-kilogram brass bob on a string about 1.0 meter long. It has a period of 2.0 seconds. The pendulum would have a period of 1.0 second if the
(A) string were replaced by one about 0.25 meter long
(B) string were replaced by one about 2.0 meters long
(C) bob were replaced by a 0.25-kg brass sphere
(D) bob were replaced by a 4.0-kg brass sphere
(E) amplitude of the motion were increased

32. A pendulum with a period of 1 s on Earth, where the acceleration due to gravity is g, is taken to another planet, where its period is 2 s. The acceleration due to gravity on the other planet is most nearly
(A) g/4 (B) g/2 (C) g (D) 2g (E) 4g

33. A frictionless pendulum of length 3 m swings with an amplitude of 10°. At its maximum displacement, the potential energy of the pendulum is 10 J. What is the kinetic energy of the pendulum when its potential energy is 5 J ?
(A) 3.3 J (B) 5 J (C) 6.7 J (D) 10 J (E) 15 J



34. An ideal massless spring is fixed to the wall at one end, as shown above. A block of mass M attached to the other end of the spring oscillates with amplitude A on a frictionless, horizontal surface. The maximum speed of the block is v_m. The force constant of the spring is
(A) $\frac{Mg}{A}$ (B) $\frac{Mgv_m}{2A}$ (C) $\frac{Mv_m^2}{2A}$ (D) $\frac{Mv_m^2}{A^2}$ (E) $\frac{Mv_m^2}{2A^2}$

35. A simple pendulum has a period of 2 s for small amplitude oscillations. The length of the pendulum is most nearly
(A) 1/6 m (B) 1/4 m (C) 1/2 m (D) 1 m (E) 2 m

36. A mass M suspended by a spring with force constant k has a period T when set into oscillation on Earth. Its period on Mars, whose mass is about 1/9 and radius 1/2 that of Earth, is most nearly
(A) T/3 (B) 2T/3 (C) T (D) 3T/2 (E) 3T

37. A mass M suspended on a string of length L has a period T when set into oscillation on Earth. Its period on Mars, whose mass is about 1/9 and radius 1/2 that of Earth, is most nearly
(A) T/3 (B) 2T/3 (C) T (D) 3T/2 (E) 3T

38. A 1.0 kg mass is attached to the end of a vertical ideal spring with a force constant of 400 N/m. The mass is set in simple harmonic motion with an amplitude of 10 cm. The speed of the 1.0 kg mass at the equilibrium position is
(A) 2 m/s (B) 4 m/s (C) 20 m/s (D) 40 m/s (E) 200 m/s

39. An object of mass m hanging from a spring of spring constant k oscillates with a certain frequency. What is the length of a simple pendulum that has the same frequency of oscillation?
(A) mk / g (B) mg / k (C) kg / m (D) k / mg (E) g / mk