Questions

Chapter 15
Oscillations

15-1 Simple Harmonic Motion
15-2 The Force Law for Simple Harmonic Motion
15-3 Energy in Simple Harmonic Motion
15-4 Angular Simple Harmonic Oscillator
15-5 Pendulums

15-1 Simple Harmonic Motion
F-062

The displacement of a particle oscillating along the x-axis is given as a function of time according to the equation: $x(t) = 0.50 \cos(\pi t + \pi/2)$. The magnitude of the maximum acceleration of the particle is:

A) zero
B) impossible to determine
C) 4.9 m/s^2
D) 9.8 m/s^2
E) 1.8 m/s^2

Answer C

15-1 Simple Harmonic Motion
F-042

A block-spring system has an amplitude of 4.0 cm and a maximum speed of 0.60 m/s. What is the frequency of oscillation?

A) 2.39 Hz
B) 120 Hz
C) 60 Hz
D) 240 Hz
E) 0.50 Hz

Answer A

15-1 Simple Harmonic Motion
F-042

A particle oscillates according to the equation: $x = 0.20 \cos(\pi t)$. What is the period of the motion?

A) 2.0 s
B) 2.0 Hz
C) 0.20 s
D) π s
E) 1.0 s

Answer A

15-2 The Force Law for Simple Harmonic Motion
F-061

A 3 kg block, attached to a spring, executes simple harmonic motion with a displacement given by x = 2 cos (50 t) where x is in meters and t is in seconds. The spring constant of the spring is:

A) 250 N/m
B) 10 N/m
C) 100 N/m
D) 7500 N/m
E) zero

Answer D

15-2 The Force Law for Simple Harmonic Motion
F-061

A weight suspended from an ideal spring oscillates up and down with a period T. If the amplitude of the oscillation is doubled, the period will be:

A) 4 T
B) T / 4
C) 2 T
D) T / 2
E) T

Answer E

15-2 The Force Law for Simple Harmonic Motion
F-042

A simple pendulum of length = L_1 on Earth oscillates with with a period = T. Another pendulum of length = L_2 on the Moon oscillates with a period = 2T. Find the ratio L_1/L_2. (Take g on Moon = (1/6)g on Earth.)

A) 1/2
B) 3/2
C) 1/4
D) 2/3
E) 2

Answer B

15-2 The Force Law for Simple Harmonic Motion
F-041

A 2.0-kg mass connected to a spring of force constant 8.0 N/m is displaced 5.0 cm from its equilibrium position and released. It oscillates on a horizontal, frictionless surface. Find the speed of the mass when it is at 3.0 cm from its equilibrium position.

A) 0.20 m/s
B) 0.04 m/s
C) 0.12 m/s
D) 0.08 m/s
E) 0.32 m/s

Answer D

15-2 The Force Law for Simple Harmonic Motion
F-041

Which of the following equations represent a simple harmonic motion [F is the force and x is a displacement]?

1) $F = -2x$
2) $F = 5x$
3) $F = -10x$
4) $F = 3x^2$
5) $F = -3x^2$

A) 1 & 3
B) 1, 3 & 5
C) 2 & 4
D) 2 only
E) All of them

Answer A

15-3 Energy in Simple Harmonic Motion
F-062

A block of mass 2.0 kg attached to a spring oscillates in simple harmonic motion along the x axis. The limits of its motion are x = −20 cm and x = + 20 cm and it goes from one of these extremes to the other in 0.25 s. The mechanical energy of the block-spring system is:

A) 6.3 J
B) 1.2 J
C) 2.5 J
D) 5.3 J
E) 4.1 J

Answer A

15-3 Energy in Simple Harmonic Motion
F-062

The mechanical energy of a block-spring system executing simple harmonic motion is 8.0 J and the amplitude x_m=12 cm. When K = 6.0 J, the displacement of the block is:

A) x = 4.0 cm
B) x = 6.0 cm
C) x = 12 cm
D) x = −3.0 cm
E) x = 0 cm

Answer B

15-3 Energy in Simple Harmonic Motion
F-061

A block-spring system is oscillating with amplitude x_m. The kinetic energy of the block is equal to the potential energy stored in the spring only when the displacement is:

A) $\pm x_m / \sqrt{2}$
B) zero
C) $\pm x_m / 4$
D) $\pm x_m / 2$
E) $2 x_m$

Answer A

15-3 Energy in Simple Harmonic Motion
F-061

A block attached to a spring undergoes a simple harmonic motion on a horizontal frictionless surface. Its mechanical energy is 40 J. When the displacement is half the amplitude, the kinetic energy is:

A) 15 J
B) zero
C) 30 J
D) 25 J
E) 40 J

Answer C

15-3 Energy in Simple Harmonic Motion
F-041

A block-spring system oscillates with simple harmonic motion according to the equation $x = 0.20 \cos(10\ t + \pi/2)$, where x is in m and t is in s. The mass of the block is 2.0 kg. Find the total energy of the system.

A) 4.0 J
B) 100 J
C) 8.0 J
D) 10 J
E) 15 J

Answer A

15-5 Pendulums
F-062

A physical pendulum consists of a uniform solid disk (radius R = 10.0 cm) supported in a vertical plane by a pivot located at a distance d = 5.0 cm from the center of the disk. The disk is made to oscillate in a simple harmonic motion of period T. Find T.

A) 1.8 s
B) 1.4 s
C) 1.0 s
D) 0.38 s
E) 0.78 s

Answer E

15-5 Pendulums
F-041

A simple pendulum of length 1.55 m has a period (T) on the surface of Earth. What is the length of the pendulum to have the same period (T) on the surface of Moon where g = 1.67 m/s^2?

A) 0.53 m
B) 2.64 m
C) 0.26 m
D) 1.32 m
E) 5.28 m

Answer C