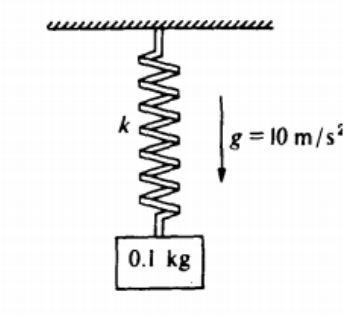
SIMPLE HARMONIC MOTION MULTIPLE CHOICE PRACTICE

1984

3. 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

18. 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 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.



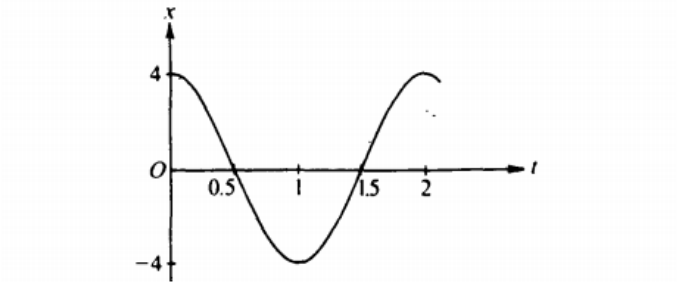
Questions 23-24
A 0. l -kilogram block is attached to an initially unstretched spring of force constant k = 40 newtons per meter as shown above. The block is released from rest at time t = 0.

23. What is the amplitude 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) $1m$

24. At what time after release will the block first return to its initial position?

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

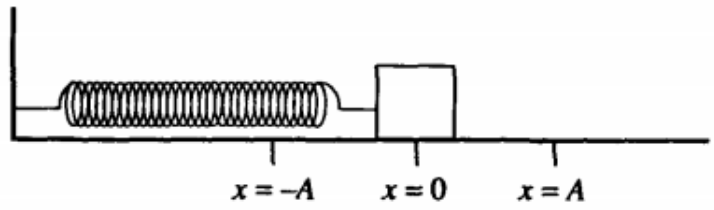


25. A particle moves in simple harmonic motion represented by the graph above. Which of the following represents the velocity of the particle as a function of time?

(A) v(t) = 4 cos πt (B) v(t)= πCosπt
(C) v(t) = $-\pi^2\cos\pi t$ (D) v(t) =-4 sinπt (E) v(t) = - 4πsinπt

1993

Questions 7-8



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.

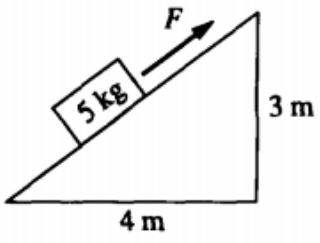
7. Which of the following statements about the block is correct?
   (A) At x = 0, its velocity is zero. (B) At x = 0, its acceleration is at a maximum.
   (C) At x = A, its displacement is at a maximum. (D) At x = A, its velocity is at a maximum.
   (E) At x = A, its acceleration is zero.

8. 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.

23. The force constant of each spring is most nearly
   (A) 40 N/m (B) 48 N/m (C) 60 N/m (D) 80 N/m (E) 96 N/m

24. When the block is set into oscillation with amplitude A, it passes through its equilibrium point with a speed v. In which of the following cases will the block, when oscillating with amplitude A, also have speed v when it passes through its equilibrium point?
   I. The block is hung from only one of the two springs.
   II. The block is hung from the same two springs, but the springs are connected in series rather than in parallel.
   III. A 0.5 kilogram mass is attached to the block.
   (A) None (B) III only (C) I and II only (D) II and III only (E) I, II, and III

33. A simple pendulum consists of a 1.0-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



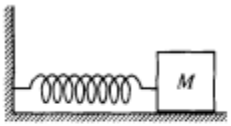
   (E) amplitude of the motion were increased

1998

9. The equation of motion of a simple harmonic oscillator is $d^2x/dt^2 = -9x$, where x is displacement and t is time. The period of oscillation is
(A) 6π (B) $9/2\pi$ (C) $3/2\pi$ (D) $2\pi/3$ (E) $2\pi/9$

18. 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

29. A particle moves in the xy-plane with coordinates given by
$x = A\cos\omega t$ and $y = A\sin\omega t$,
where A = 1.5 meters and $\omega = 2.0$ radians per second. What is the magnitude of the particle's acceleration?
(A) Zero (B) 1.3 m/s^2 (C) 3.0 m/s^2 (D) 4.5 m/s^2 (E) 6.0 m/s^2



35. 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) $\frac{Mv_m^2}{2A^2}$

2004

18. 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

19. Which of the following equations could represent the angle θ that the pendulum makes with the vertical as a function of time t ?
(A) $\theta = \theta_{max} \sin \frac{\pi}{2} t$
(B) $\theta = \theta_{max} \sin \pi t$
(C) $\theta = \theta_{max} \sin 2\pi t$
(D) $\theta = \theta_{max} \sin 4\pi t$
(E) $\theta = \theta_{max} \sin 8\pi t$

29. 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 $\frac{1}{9}$ and radius $\frac{1}{2}$ that of Earth, is most nearly
(A) $\frac{1}{3}T$
(B) $\frac{2}{3}T$
(C) T
(D) $\frac{3}{2}T$
(E) $3T$

31. 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

2009

Questions 9-10

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.

9. 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

10. The maximum velocity occurs where the

   (A) potential energy is a maximum
   (B) kinetic energy is a minimum
   (C) displacement from equilibrium is equal to the amplitude of 0.4 meter
   (D) displacement from equilibrium is half the amplitude
   (E) displacement from equilibrium is equal to zero