PS5
SHM Review

Problem #12 pg. 415

1. A block of unknown mass is attached to a spring with a spring constant of 6.50 N/m and undergoes simple harmonic motion with an amplitude of 10.0 cm. When the mass is halfway between its equilibrium position and the end point, its speed is measured to be + 30.0 cm/s. Calculate (a) the mass of the block, (b) the period of the motion, and (c) the maximum acceleration of the block.

Problem #21 pg. 415

2. A 1.50-kg block at rest on a tabletop is attached to a horizontal spring having force constant of 19.6 N/m. The spring is initially unstretched. A constant 20.0-N horizontal force is applied to the object, causing the spring to stretch. (a) Determine the speed of the block after it has moved 0.300 m from equilibrium, assuming that the surface between the block and the tabletop is frictionless. (b) Answer part (a) for a coefficient of kinetic friction of 0.200 between the block and the tabletop.

Problem #49 pg. 417

3. A car with bad shock absorbers bounces up and down with a period of 1.50 s after hitting a bump. The car has a mass of 1500 kg and is supported by four springs of equal force constant k. Determine the value of k.

Problem #53 pg. 418

4. A large block P executes horizontal simple harmonic motion as it slides across a frictionless surface with a frequency of f= 1.50 Hz. Block B rests on it, as shown in Figure P13.53, and the coefficient of static friction between the two is $\mu_s = 0.600$. What maximum amplitude of oscillation can the system have if block B is not to slip?

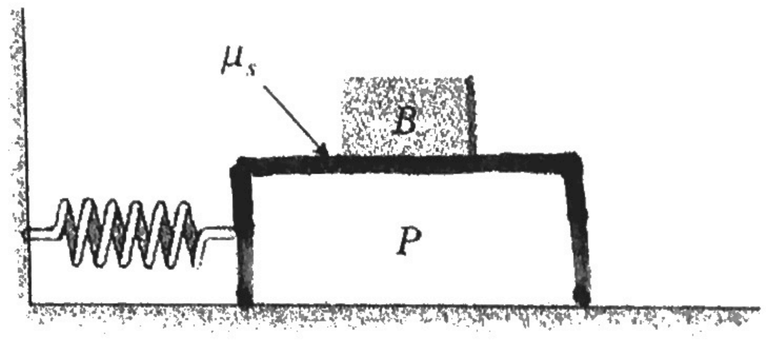


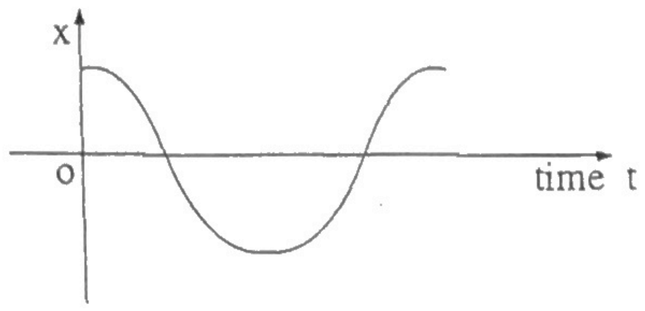
Figure P13.53

Problem #63 pg 419

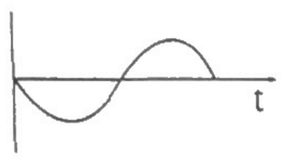
5. A simple pendulum with a length of 2.23 m and a mass of 6.74 kg is given an initial speed of 2.06 m/s at its equilibrium position. Assume that it undergoes simple harmonic motion, and determine its (a) period, (b) total energy, and (c) maximum angular displacement.

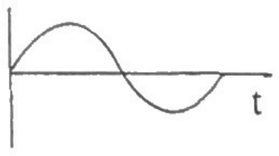
SHM Review Multiple Choice

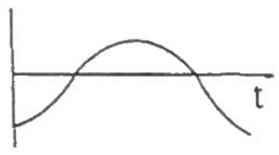
1. A mass m attached to the end of a spring vibrating about its equilibrium position is described by the displacement x *vs* time graph as shown below.



Which of the following graphs represent the velocity *vs* time and the acceleration *vs* time graph?

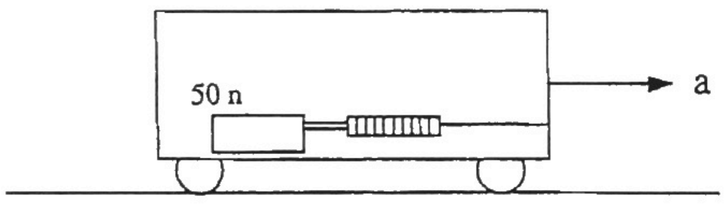
I. 

II. 

III. 

	Velocity	Acceleration
(A)	I	II
(B)	I	III
(C)	II	III
(D)	II	I
(E)	III	I

2. A 50 newton block is attached to a spring scale which is attached to the front of a cart. The block is on a horizontal frictionless surface. When the cart accelerates the scale reads 16 newtons.



The acceleration of the cart above would be

(A) 13.2 m/s^2
(B) 10 m/s^2
(C) 6.8 m/s^2
(D) 3.2 m/s^2
(E) 0.32 m/s^2

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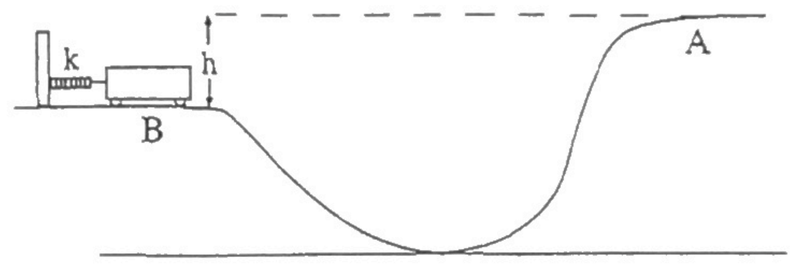
3. The force F = A sinx is applied in the x direction on the box of mass m. A is constant and x is displacement. The work done on the box in moving it from rest to a distance of one wavelength λ would be

(A) λA sinλ
(B) λA cosλ
(C) A sinλ
(D) A cosλ
(E) zero

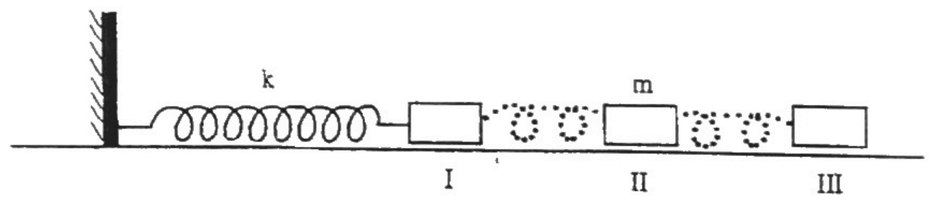
4. The toy car below is released in a horizontal direction from point B by releasing the spring attached to it, which is compressed to a distance of x and has a spring constant k.



Assuming no friction, the speed of a toy car at A, which is at a vertical height h above point B, would be

(A) $\frac{kx^2}{m} - 2gh$
(B) $\frac{kx^2}{m} - \sqrt{2gh}$
(C) $\sqrt{2gh - \frac{kx^2}{m}}$
(D) $\sqrt{\frac{kx^2}{m} - 2gh}$
(E) $\sqrt{\frac{kx}{m} - 2gh}$

5. A mass m attached to a spring vibrates about its equilibrium position as shown below.



The acceleration of the mass is greatest at which positions?

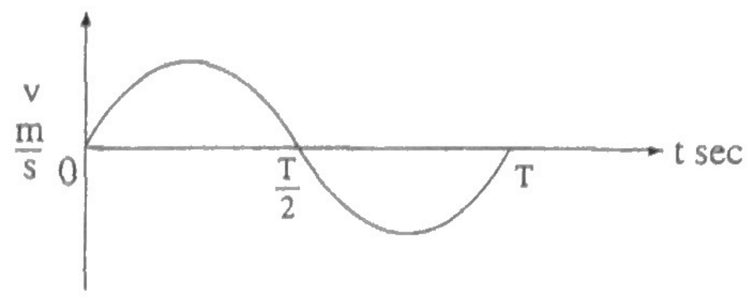
(A) I only
(B) II only
(C) III only
(D) I and III
(E) II and III

6. The frequency of oscillation of a pendulum of length L_0 is f_0 for a small amplitude. If the frequency is doubled, the length of the pendulum would be

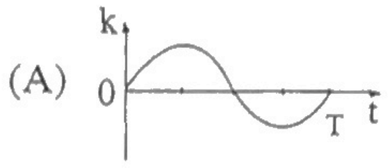
(A) $2L_0$
(B) $\sqrt{2}L_0$
(C) $\frac{L_0}{\sqrt{2}}$
(D) $\frac{L_0}{2}$
(E) $\frac{L_0}{4}$

Questions 7-8

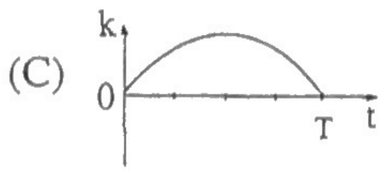
The graph of velocity *vs* time shown below describes the motion of a mass attached to one end of a spring that performs a simple harmonic motion for one cycle of period T.

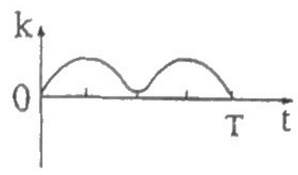


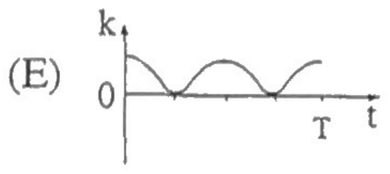
7. Which of the following graphs best represents the kinetic energy k of the mass as a function of time t?

(A) 

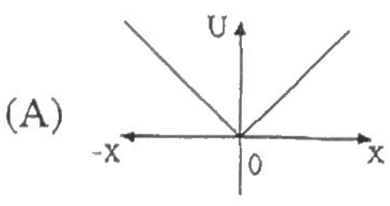
(B) 

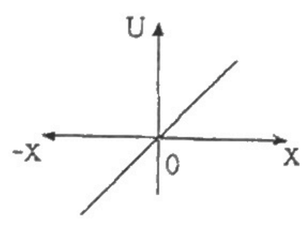
(C) 

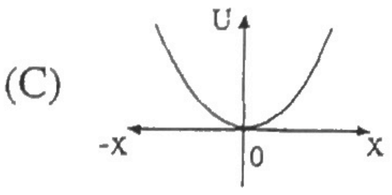
(D) 

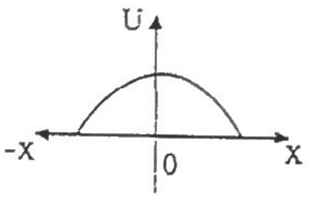
(E) 

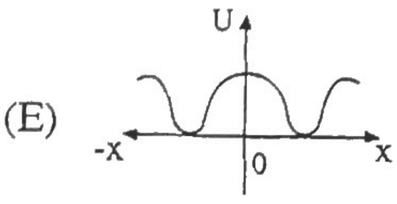
8. Which of the following graphs best represents the elastic potential energy U of a spring as a function of its displacement x from equilibrium position for only half the cycle?

(A) 

(B) 

(C) 

(D) 

(E) 

Questions 9-10

The position of a 0.4 kg mass in an oscillating mass-spring system is given by $x = 0.8\sin(9.5t)$.

9. The frequency of the oscillating mass is

(A) 12 Hz
(B) 9.5 Hz
(C) 7.5 Hz
(D) 1.5 Hz
(E) 0.8 Hz

10. The maximum kinetic energy of the oscillating mass would be

(A) 1.2 J
(B) 2.4 J
(C) 3.1 J
(D) 11.6 J
(E) 23.1 J

Questions 11-13

The displacement as a function of time t, $x = 0.5\sin(14\pi t)$ is the solution of the differential equation $d^2x/dt^2 = -\omega^2 x$ describing the simple harmonic motion of a particle of mass m = 0.1 kg, with x in meters.

11. The frequency of oscillations of the particle in Hertz is

(A) 132
(B) 44
(C) 15
(D) 7
(E) 3

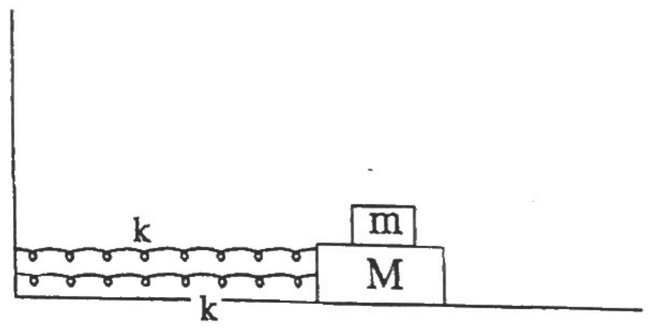
12. The maximum kinetic energy, in Joules, of the oscillating particle is very nearly equal to

(A) 0
(B) 10
(C) 18
(D) 24
(E) 44

13. The magnitude of the maximum acceleration of the particle in meters per second squared is

(A) 22
(B) 44
(C) 176
(D) 966
(E) 1933

14. The mass M with a small mass m on the top of it oscillates on a frictionless horizontal table as shown below. The spring constant is k.



The minimum coefficient of friction between the two masses so that the system can vibrate with amplitude A without the small mass being thrown off would be

(A) $\dfrac{kA}{(m+M)g}$

(B) $\dfrac{2kA}{mg}$

(C) $\dfrac{2kA}{(m+M)g}$

(D) $\sqrt{\dfrac{2kA}{(m+M)g}}$

(E) $\dfrac{2k}{(m+M)g}$