Oscillations Problem Set
Read Chapter 15
Due Mon. Jan. 11

Name: _____ Date: _____

1. A particle oscillating in simple harmonic motion is:
   A) never in equilibrium because it is in motion
   B) never in equilibrium because there is a force
   C) in equilibrium at the ends of its path because its velocity is zero there
   D) in equilibrium at the center of its path because the acceleration is zero there
   E) in equilibrium at the ends of its path because the acceleration is zero there

2. An object attached to one end of a spring makes 20 vibrations in 10 seconds. Its angular frequency is:
   A) 0.79 rad/s
   B) 1.57 rad/s
   C) 2.0 rad/s
   D) 6.3 rad/s
   E) 12.6 rad/s

3. A block attached to a spring oscillates in simple harmonic motion along the x axis. The limits of its motion are x = 10 cm and x = 50 cm and it goes from one of these extremes to the other in 0.25 s. Its amplitude and frequency are:
   A) 40 cm, 2 Hz
   B) 20 cm, 4 Hz
   C) 25 cm, 4 Hz
   D) 20 cm, 2 Hz

4. The amplitude and phase constant of an oscillator are determined by:
   A) the frequency
   B) the angular frequency
   C) the initial displacement alone
   D) the initial velocity alone
   E) both the initial displacement and velocity

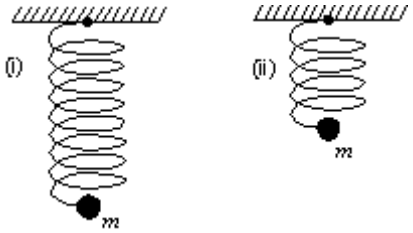
5. The amplitude of any oscillator can be doubled by:
   A) doubling only the initial displacement
   B) doubling only the initial speed
   C) doubling the initial displacement and halving the initial speed
   D) doubling the initial speed and halving the initial displacement
   E) doubling both the initial displacement and the initial speed

6. The acceleration of a body executing simple harmonic motion leads the velocity by what phase?
   A) 0
   B) $\pi/8$ rad
   C) $\pi/4$ rad
   D) $\pi/2$ rad
   E) π rad

7. A particle moves in simple harmonic motion according to $x = 2\cos(50t)$, where x is in meters and t is in seconds. Its maximum velocity in m/s is:
   A) $100 \sin(50t)$
   B) $100 \cos(50t)$
   C) 100
   D) 200
   E) none of these

8. A certain spring elongates 9 mm when it is suspended vertically and a block of mass M is hung on it. The natural frequency of this mass-spring system is:
   A) is 0.088 rad/s
   B) is 33 rad/s
   C) is 200 rad/s
   D) is 1140 rad/s
   E) cannot be computed unless the value of M is given

9. A simple harmonic oscillator consists of a mass m and an ideal spring with spring constant k. The particle oscillates as shown in (i) with period T. If the spring is cut in half and used with the same particle, as shown in (ii), the period will be:



A) $2T$
B) $\sqrt{2}T$
C) $T/\sqrt{2}$
D) T
E) $T/2$

10. Let U be the potential energy (with the zero at zero displacement) and K be the kinetic energy of a simple harmonic oscillator. U_{avg} and K_{avg} are the average values over a cycle. Then:

A) $K_{avg} > U_{avg}$
B) $K_{avg} < U_{avg}$
C) $K_{avg} = U_{avg}$
D) $K = 0$ when $U = 0$
E) $K + U = 0$

11. A particle is in simple harmonic motion along the x axis. The amplitude of the motion is x_m. At one point in its motion its kinetic energy is $K = 5$J and its potential energy (measured with $U = 0$ at $x = 0$) is $U = 3$J. When it is at $x = x_m$, the kinetic and potential energies are:

A) $K = 5$J and $U = 3$J
B) $K = 5$J and $U = -3$J
C) $K = 8$J and $U = 0$
D) $K = 0$ and $U = 8$J
E) $K = 0$ and $U = -8$J

12. A 0.25-kg block oscillates on the end of the spring with a spring constant of 200 N/m. If the oscillation is started by elongating the spring 0.15 m and giving the block a speed of 3.0 m/s, then the maximum speed of the block is:
    A) 0.13 m/s
    B) 0.18 m/s
    C) 3.7 m/s
    D) 5.2 m/s
    E) 13 m/s

13. A 0.25-kg block oscillates on the end of the spring with a spring constant of 200 N/m. If the oscillation is started by elongating the spring 0.15 m and giving the block a speed of 3.0 m/s, then the amplitude of the oscillation is:
    A) 0.13 m
    B) 0.18 m
    C) 3.7 m
    D) 5.2 m
    E) 13 m

14. A block attached to a spring undergoes simple harmonic motion on a horizontal frictionless surface. Its total energy is 50 J. When the displacement is half the amplitude, the kinetic energy is:
    A) zero
    B) 12.5 J
    C) 25 J
    D) 37.5 J
    E) 50 J

15. The amplitude of oscillation of a simple pendulum is increased from 1° to 4°. Its maximum acceleration changes by a factor of:
    A) 1/4
    B) 1/2
    C) 2
    D) 4
    E) 16

16. A simple pendulum consists of a small ball tied to a string and set in oscillation. As the pendulum swings the tension in the string is:
    A) constant
    B) a sinusoidal function of time
    C) the square of a sinusoidal function of time
    D) the reciprocal of a sinusoidal function of time
    E) none of the above

17. Two uniform spheres are pivoted on horizontal axes that are tangent to their surfaces. The one with the longer period of oscillation is the one with:
    A) the larger mass
    B) the smaller mass
    C) the larger rotational inertia
    D) the smaller rotational inertia
    E) the larger radius

18. Five particles undergo damped harmonic motion. Values for the spring constant k, the damping constant b, and the mass m are given below. Which leads to the smallest rate of loss of mechanical energy?
    A) $k = 100\text{N/m}$, $m = 50\text{g}$, $b = 8\text{g/s}$
    B) $k = 150\text{N/m}$, $m = 50\text{g}$, $b = 5\text{g/s}$
    C) $k = 150\text{N/m}$, $m = 10\text{g}$, $b = 8\text{g/s}$
    D) $k = 200\text{N/m}$, $m = 8\text{g}$, $b = 6\text{g/s}$
    E) $k = 100\text{N/m}$, $m = 2\text{g}$, $b = 4\text{g/s}$

19. A sinusoidal force with a given amplitude is applied to an oscillator. To maintain the largest amplitude oscillation the frequency of the applied force should be:
    A) half the natural frequency of the oscillator
    B) the same as the natural frequency of the oscillator
    C) twice the natural frequency of the oscillator
    D) unrelated to the natural frequency of the oscillator
    E) determined from the maximum speed desired

Answer Key - Oscillation Hmwk F12

1. D
2. E
3. D
4. E
5. E
6. D
7. C
8. B
9. C
10. C
11. D
12. D
13. B
14. D
15. D
16. E
17. E
18. B
19. B