## AP physics C --- Webreview --- chapter 13 oscillations

**Multiple Choice**
*Identify the choice that best completes the statement or answers the question.*

_____ 1. A large spring requires a force of 150 N to compress it only 0.010 m. What is the spring constant of the spring?
   a. 125 000 N/m
   b. 15 000 N/m
   c. 15 N/m
   d. 1.5 N/m
   e. 1.0 N/m

_____ 2. Tripling the weight suspended vertically from a coil spring will result in a change in the displacement of the spring's lower end by what factor?
   a. 0.33
   b. 1.0
   c. 3.0
   d. 9.0
   e. 12

_____ 3. A tiny spring, with a spring constant of 1.20 N/m, will be stretched to what displacement by a 0.005 0-N force?
   a. 4.2 mm
   b. 6.0 mm
   c. 7.2 mm
   d. 9.4 mm
   e. 11 mm

_____ 4. Suppose there is an object for which $F = +kx$. What will happen if the object is moved away from equilibrium ($x = 0$) and released?
   a. It will return to the equilibrium position.
   b. It will move further away with constant velocity.
   c. It will move further away with constant acceleration.
   d. It will move further away with increasing acceleration.
   e. None of the above.

_____ 5. Which is not an example of approximate simple harmonic motion?
   a. A ball bouncing on the floor.
   b. A child swinging on a swing.
   c. A piano string that has been struck.
   d. A car's radio antenna as it waves back and forth.
   e. Both choices A and D are valid.

_____ 6. A 0.20 kg object, attached to a spring with spring constant $k = 10$ N/m, is moving on a horizontal frictionless surface in simple harmonic motion of amplitude of 0.080 m. What is its speed at the instant when its displacement is 0.040 m? (Hint: Use conservation of energy.)
   a. 9.8 m/s
   b. 4.9 m/s
   c. 49 cm/s
   d. 24.5 cm/s
   e. 53 cm/s

_____ 7. A mass of 0.40 kg, hanging from a spring with a spring constant of 80 N/m, is set into an up-and-down simple harmonic motion. What is the speed of the mass when moving through a point at 0.05 m displacement? The starting displacement of the mass is 0.10 m from its equilibrium position.
   a.   zero
   b.   1.4 m/s
   c.   1.7 m/s
   d.   1.2 m/s
   e.   1.0 m/s

_____ 8. A 0.20-kg mass is oscillating on a spring over a horizontal frictionless surface. When it is at a displacement of 2.6 cm for equilibrium it has a kinetic energy of 1.4 J and a spring potential energy of 2.2 J. What is the maximum speed of the mass during its oscillation?
   a.   3.7 m/s
   b.   4.7 m/s
   c.   6.0 m/s
   d.   6.3 m/s
   e.   7.8 m/s

_____ 9. Suppose a 0.3-kg mass on a spring that has been compressed 0.10 m has elastic potential energy of 1.0 J. How much further must the spring be compressed to triple the elastic potential energy?
   a.   0.30 m
   b.   0.20 m
   c.   0.17 m
   d.   0.07 m
   e.   0.05 m

_____ 10. An ore car of mass 4 000 kg rolls downhill on tracks from a mine. At the end of the tracks, 10.0 m lower in elevation, is a spring with $k = 400\ 000$ N/m. How much is the spring compressed in stopping the ore car? Ignore friction.
   a.   0.14 m
   b.   0.56 m
   c.   1.40 m
   d.   1.96 m
   e.   2.43 m

_____ 11. By what factor must one change the weight suspended vertically from a spring coil in order to triple its period of simple harmonic motion?
   a.   1/9
   b.   0.33
   c.   3.0
   d.   9.0
   e.   12

_____ 12. A mass on a spring vibrates in simple harmonic motion at a frequency of 4.0 Hz and an amplitude of 8.0 cm. If the mass of the object is 0.20 kg, what is the spring constant?
   a.   40 N/m
   b.   87 N/m
   c.   126 N/m
   d.   160 N/m
   e.   190 N/m

_____ 13. For a mass suspended on a spring in the vertical direction, the time for one complete oscillation will depend on:
   a.   the value for $g$ (the acceleration due to gravity).
   b.   the distance the mass was originally pulled down.
   c.   the maximum speed of the oscillating mass.
   d.   the time doesn't depend on any of the above.
   e.   both choices A and C are valid.

_____ 14. A mass on a spring vibrates in simple harmonic motion at a frequency of 4.0 Hz and an amplitude of 4.0 cm. If a timer is started when its displacement is a maximum (hence $x = 4$ cm when $t = 0$), what is the acceleration magnitude when $t = 3$ s?
   a.   zero
   b.   8.13 m/s$^2$
   c.   14.3 m/s$^2$
   d.   25.3 m/s$^2$
   e.   32.4 m/s$^2$

_____ 15. A mass on a spring vibrates in simple harmonic motion at a frequency of 4.0 Hz and an amplitude of 8.0 cm. If a timer is started when its displacement is a maximum (hence $x = 8$ cm when $t = 0$), what is the displacement of the mass when $t = 3.7$ s?
   a.   zero
   b.   0.025 m
   c.   0.036 m
   d.   0.080 m
   e.   0.095 m

_____ 16. The motion of a piston in an automobile engine is nearly simple harmonic. If the 1-kg piston travels back and forth over a total distance of 10.0 cm, what is its maximum speed when the engine is running at 3 000 rpm?
   a.   31.4 m/s
   b.   15.7 m/s
   c.   7.85 m/s
   d.   3.93 m/s
   e.   1.66 m/s

_____ 17. The position of a 0.64-kg mass undergoing simple harmonic motion is given by $x = (0.160$ m$)$ cos $(\pi t/16)$. What is its period of oscillation?
   a.   100 s
   b.   32 s
   c.   16 s
   d.   8.0 s
   e.   4.5 s

_____ 18. The position of a 0.64-kg mass undergoing simple harmonic motion is given by $x = (0.160$ m$)$ cos $(\pi t/16)$. What is the maximum net force on the mass as it oscillates?
   a.   3.9 × 10$^{-3}$ N
   b.   9.9 × 10$^{-3}$ N
   c.   1.3 × 10$^{-3}$ N
   d.   5.4 × 10$^{-2}$ N
   e.   6.3 N

19. The position of a 0.64-kg mass undergoing simple harmonic motion is given by $x = (0.160 \text{ m})$ cos $(\pi t/16)$. What is its position at $t = 5.0$ s?
    a. 0.160 m
    b. 0.159 m
    c. 0.113 m
    d. 0.089 m
    e. 0.076 m

20. The kinetic energy of the bob on a simple pendulum swinging in simple harmonic motion has its maximum value when the displacement from equilibrium is at what point in its swing?
    a. zero displacement
    b. 1/4 the amplitude
    c. 1/2 the amplitude
    d. 3/4 the amplitude
    e. equal the amplitude

21. Tripling the mass of the bob on a simple pendulum will cause a change in the frequency of the pendulum swing by what factor?
    a. 0.33
    b. 1.0
    c. 3.0
    d. 9.0
    e. 12

22. A simple pendulum of length 1.00 m has a mass of 100 g attached. It is drawn back 30.0° and then released. What is the maximum speed of the mass?
    a. 1.14 m/s
    b. 3.13 m/s
    c. 2.21 m/s
    d. 1.62 m/s
    e. 2.56 m/s

23. A simple pendulum has a mass of 0.25 kg and a length of 1.0 m. It is displaced through an angle of 30° and then released. After a time, the maximum angle of swing is only 10°. How much energy has been lost to friction?
    a. 0.29 J
    b. 0.65 J
    c. 0.80 J
    d. 1.0 J
    e. 1.2 J

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**Answer Section**

**MULTIPLE CHOICE**

1. B
2. C
3. A
4. D
5. A
6. C
7. D
8. C
9. D
10. C
11. D
12. C
13. D
14. D
15. B
16. B
17. B
18. A
19. D
20. A
21. B
22. D
23. A