

HOMEWORK #4

- *This homework is due by the beginning of class on October 29. It covers material in chapters 13, 14, and 22.*
 - *You will need a calculator and lots of scrap paper.*
 - *Answers are to be recorded on a scantron that you will turn in. You may keep the questions (i.e., these sheets).*
 - *You may (should) use your book. You may even work with other students. However, you should not copy the answers of other students. Since the exams are multiple choice, the homeworks are also exam prep, and so you need to be able to work these problems yourself. If you do not apply yourself to the homework and do your own work, you are not likely to perform well on the exams.*
1. The oxygen molecule (O_2) may be regarded as two masses connected by a spring. In vibrational motion, each oxygen atom alternately approaches, then moves away from the center of mass of the system. If each oxygen atom of mass $m = 2.67 \times 10^{-26}$ kg has a vibrational energy of 1.6×10^{-21} J and the effective spring constant is 50 N/m, then what is the amplitude of oscillation of each oxygen atom?
 - a. 3.2×10^{-11} m
 - b. 1.6×10^{-11} m
 - c. 1.1×10^{-11} m
 - d. 8.0×10^{-12} m
 2. 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
 3. Which one of the following quantities is at a maximum when an object in simple harmonic motion is at its maximum displacement?
 - a. speed
 - b. acceleration
 - c. kinetic energy
 - d. frequency

4. 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 period of oscillation?
- 100 s
 - 32 s
 - 16 s
 - 8.0 s
5. If one could transport a simple pendulum of constant length from the Earth's surface to the Moon's, where the acceleration due to gravity is one-sixth ($1/6$) that on the Earth, by what factor would the pendulum frequency be changed?
- about 6.0
 - about 2.5
 - about 0.41
 - about 0.17
6. 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?
- 0.29 J
 - 0.65 J
 - 0.80 J
 - 1.0 J
7. The superposition principle has to do with which of the following?
- effects of waves at great distances
 - the ability of some waves to move very far
 - how displacements of interacting waves add together
 - relativistic wave behavior
8. Equal wavelength waves of amplitude 0.25 m and 0.15 m interfere with one another. What is the resulting minimum amplitude that can result?
- 0.15 m
 - 0.10 m
 - 0 m
 - 0.40 m
9. The speed of sound at 0°C is 331 m/s. What is the speed of sound at 25°C ? ($0^\circ\text{C} = 273 \text{ K}$)
- 346 m/s
 - 356 m/s
 - 343 m/s
 - 350 m/s

10. What is the intensity of a sound with a measured intensity level of 84 dB? ($I_0 = 10^{-12} \text{ W/m}^2$)
- $8.4 \times 10^{-3} \text{ W/m}^2$
 - $2.5 \times 10^{-4} \text{ W/m}^2$
 - $1.2 \times 10^{-5} \text{ W/m}^2$
 - $7.4 \times 10^{-4} \text{ W/m}^2$
11. If the distance between a point sound source and a dB detector is increased by a factor of 4, what will be the reduction in intensity level?
- 16 dB
 - 12 dB
 - 4 dB
 - 0.5 dB
12. As a train starts from rest and then accelerates down the track, coming toward me faster and faster, the speed of the sound waves coming toward me will be:
- slower than the normal speed of sound in air.
 - equal to the normal speed of sound in air.
 - some constant speed faster than the normal speed of sound in air.
 - faster and faster.
13. While standing at a crosswalk, you hear a frequency of 560 Hz from an approaching police car. After the police car passes, its frequency is 480 Hz. What is the speed of the police car? (speed of sound = 340 m/s)
- 13.1 m/s
 - 17.4 m/s
 - 21.1 m/s
 - 26.2 m/s
14. A standing wave is set up in a 200-cm string fixed at both ends. The string vibrates in 5 distinct segments when driven by a 120-Hz source. What is the wavelength?
- 10 cm
 - 20 cm
 - 40 cm
 - 80 cm
15. What is the lowest frequency that will resonate in an organ pipe 2.00 m in length, closed at one end? The speed of sound in air is 340 m/s.
- 42.5 Hz
 - 85.0 Hz
 - 170 Hz
 - 680 Hz

16. Light from a 560-nm monochromatic source is incident upon the surface of fused quartz ($n = 1.56$) at an angle of 60° . What is the angle of reflection from the surface?
- a. 15°
 - b. 34°
 - c. 60°
 - d. 75°
17. Water has an index of refraction of 1.333. What is the speed of light through it? ($c = 3.00 \times 10^8$ m/s)
- a. 4.00×10^8 m/s
 - b. 2.25×10^8 m/s
 - c. 4.46×10^8 m/s
 - d. 1.46×10^8 m/s
18. A ray of light strikes a thick sheet of glass ($n = 1.5$) at an angle of 25° with the normal. Find the angle of the refracted ray within the glass with respect to the normal.
- a. 56°
 - b. 46°
 - c. 25°
 - d. 16°
19. A fish is 1.2 m beneath the surface of a still pond of water. At what maximum angle can the fish look toward the surface (measured with respect to the normal to the surface) in order to see a fisherman sitting on a distant bank? (for water, $n = 1.333$)
- a. 18.6°
 - b. 37.2°
 - c. 48.6°
 - d. The fish will not see the fisherman at any angle.
20. When white light disperses as it passes through a prism, which of the following colors moves at the lowest speed in the prism?
- a. blue
 - b. green
 - c. yellow
 - d. red
21. A ray of light travels across a liquid-to-glass interface. If the indices of refraction for the liquid and glass are, respectively, 1.75 and 1.52, what is the critical angle at this interface?
- a. 30.0°
 - b. 52.2°
 - c. 60.3°
 - d. Critical angle does not exist.