

13.1 OSCILLATIONS AND PERIODIC MOTION

1. While fishing for catfish, a fisherman suddenly notices that the bobber (a floating device) attached to his line is bobbing up and down with a frequency of 2.2 Hz. What is the period of the bobber's motion?
2. If you dribble a basketball with a frequency of 1.77 Hz, how long does it take for you to complete 12 dribbles?
3. You take your pulse and observe 74 heartbeats in a minute. What are the period and frequency of your heartbeat?
4. **(a)** Your heart beats with a frequency of 1.45 Hz. How many beats occur in a minute? **(b)** If the frequency of your heartbeat increases, will the number of beats in a minute increase, decrease, or stay the same? **(c)** How many beats occur in a minute if the frequency increases to 1.55 Hz?
5. You rev your car's engine to 2500 rpm (rev/min). **(a)** What is the period and frequency of the engine? **(b)** If you change the period of the engine to 0.034 s, how many rpms is it doing?

13.2 SIMPLE HARMONIC MOTION

6. The position of a mass oscillating on a spring is given by $x = (3.2 \text{ cm}) \cos [2\pi t / (0.58 \text{ s})]$. **(a)** What is the period of this motion? **(b)** What is the first time the mass is at the position $x = 0$?
7. The position of a mass oscillating on a spring is given by $x = (7.8 \text{ cm}) \cos [2\pi t / (0.68 \text{ s})]$. **(a)** What is the frequency of this motion? **(b)** When is the mass first at the position $x = -7.8 \text{ cm}$?
8. A 0.42-kg mass attached to a spring undergoes simple harmonic motion with a period of 0.75 s. What is the force constant of the spring?
9. When a 0.50-kg mass is attached to a vertical spring, the spring stretches by 15 cm. How much mass must be attached to the spring to result in a 0.75-s period of oscillation?
10. A simple pendulum of length 2.5 m makes 5.0 complete swings in 16 s. What is the acceleration of gravity at the location of the pendulum?
11. **(a)** Find the length of a simple pendulum that has a period of 1.00 s. Assume that the acceleration of gravity is $g = 9.8 \text{ m/s}^2$. If the same pendulum were to be taken to the Moon, where the acceleration of gravity is $g/6$, **(b)** would its period increase, decrease, or stay the same? **(c)** Check your result in part (a) by calculating the period of the pendulum on the Moon.

13.3 WAVES

12. A wave travels along a stretched horizontal rope. The vertical distance from crest to trough for this wave is 11 cm and the horizontal distance from crest to trough is 26 cm. What is **(a)** the wavelength and **(b)** the amplitude of this wave?
13. A surfer floating beyond the breakers notes 14 waves per minute passing her position. If the wavelength of these waves is 34 m, what is their speed?

14. The speed of surface waves in water decreases as the water becomes shallower. Suppose waves travel across the surface of a lake with a speed of 2.0 m/s and a wavelength of 1.5 m. When these waves move into a shallower part of the lake, their speed decreases to 1.6 m/s, though their frequency remains the same. Find the wavelength of the waves in the shallower water.
15. A tsunami traveling across deep water can have a speed of 750 km/h and a wavelength of 310 km. What is the frequency of such a wave?
16. A 4.5-Hz wave with an amplitude of 12 cm and a wavelength of 27 cm travels along a stretched horizontal string. **(a)** How far does a given peak on the wave travel in a time interval of 0.50 s? **(b)** How far does a knot on the string travel in the same time interval? **(c)** How would your answers to parts (a) and (b) change if the amplitude of the wave were halved? Explain.

13.4 SOUND

17. At Zion National Park a loud shout produces an echo 1.85 s later from a colorful sandstone cliff. How far away is the cliff?
18. A sound wave in air has a frequency of 425 Hz. **(a)** What is its wavelength? **(b)** If the frequency of the sound is increased, does its wavelength increase, decrease, or stay the same? Explain. **(c)** Calculate the wavelength for a sound wave with a frequency of 475 Hz.
19. When you drop a rock into a well, you hear the splash 1.5 seconds later. **(a)** How deep is the well? **(b)** If the depth of the well were doubled, would the time required to hear the splash be greater than, less than, or equal to 3.0 seconds? Explain.
20. A person with perfect pitch sits on a bus bench listening to the 450-Hz horn of an approaching car. If the person detects a frequency of 470 Hz, how fast is the car moving?
21. A motorcycle and a police car are moving toward one another. The police car emits sound with a frequency of 512 Hz and has a speed of 27.0 m/s. The motorcycle has a speed of 13.0 m/s. What frequency does the motorcyclist hear?