

WAVES AND SOUND WORKSHEET

1. The Sears Building in Chicago sways back and forth with a frequency of about 0.1 Hz. What is its period of vibration?
2. An ocean wave has a length of 10 m. A wave passes a fixed location every 2 seconds. What is the speed of the wave?
3. Water waves in a shallow dish are 6 cm long. At one point, the water oscillates up and down at a rate of 4.8 oscillations per second. What is the speed of the water waves? What is the period of the water waves?
4. Water waves in a lake travel at 4.5 m in 1.8 seconds. The period of oscillation is 1.2 seconds. What is the speed of the water waves? What is their frequency?
5. A group of swimmers is resting in the sun on an off-shore raft. They estimate that 3 m separates a trough and an adjacent crest of surface waves on the lake. They count 14 crests that pass by the raft in 20 seconds. How fast are the waves moving?
6. AM radio signals are broadcast at frequencies between 550 kHz and 1600 kHz and travel at 3×10^8 m/s. What is the range of wavelengths for these signals?
7. A sonar signal of frequency 1×10^6 Hz has a wavelength of 1.55 mm in water. What is the speed of the signal in water? What is the period in water? What is the period in air?
8. A sound wave of wavelength 0.7 m and velocity 330 m/s is produced for 0.5 seconds. What is the frequency of the wave? How many complete waves are emitted in this time interval?
9. The speed of sound in water is 1498 m/s. A sonar signal is sent from a ship at a point just below the water surface and 1.8 seconds later that reflected signal is detected. How deep is the ocean beneath the ship?

If a temperature is not given in the problem, assume that it is occurring at room temperature.

10. The frequency of a certain sound is 440 Hz. What is the wavelength of this sound when the temperature of air is a) 20 degrees Celsius b) 30 degrees Celsius
11. An observer hears thunder 3 seconds after seeing the flash of lightning. If the air temperature is 20 degrees Celsius, how far from the observer did the lightning strike?
12. An observer sees the flash of a skyrocket explode and hears the sound of the explosion a half a second later. If the explosion occurred 175 m from the observer, what is the air temperature?
13. Andrew hears the sound of the firing of a distant cannon 6 seconds after seeing the flash. How far is Andrew from the cannon?
14. A rifle is fired in a valley with parallel vertical walls. The echo from one wall is heard 2 seconds after the rifle was fired. The echo from the other wall is heard 2 seconds after the first echo. How wide is the valley?
15. If Karen claps her hands and hears the echo from a distant wall 0.2 seconds later, how far away is the wall?
16. If Karen shouts across a canyon and hears an echo 4 seconds later, how wide is the canyon?
17. A field judge fires a starter pistol and hears the echo from the bleacher wall .75 s later. If the air temperature is 15 degrees Celsius, how far from the wall is the judge?
18. A ship lies between a horn buoy and a cliff. An observer on the ship hears the horn 2 s after it is blown, and the echo from the cliff 8 s after the horn is blown. If the air temperature is 8 degrees Celsius, find a) the distance between the ship and the buoy b) the distance between the ship and the cliff.
19. A bullet having a velocity of 680 m/s hits a target 510 m away. If the speed of sound is 340 m/s, how soon after the bullet hits the target does sound of the shot reach the target?
20. A miner drops a stone into a mine shaft 122.5 m deep. If the temperature is 20 degrees Celsius, how soon after he drops the stone does he hear the sound?

21. A tuning fork resonates with an open tube 25 cm long and 2 cm in diameter when the temperature is 20 degrees Celsius. What is the speed of sound? What is the length of the vibrating air column? What is the fundamental wavelength? What is the fundamental frequency?
22. An organ pipe open at both ends is 1.23 m long and 10 cm in diameter. What is its fundamental frequency when the air temperature is 15 degrees Celsius?
23. A tuning fork, frequency 384 Hz, produces first resonance in a closed tube 20 cm long and 4 cm in diameter. What is the speed of sound for this resonance?
24. An organ pipe closed at one end is 0.76 m long and has a diameter of 5 cm. The air temperature is 12 degrees Celsius. Determine its fundamental frequency.
25. An organ pipe closed at one end is 0.76 m long and has a diameter of 5 cm. The air temperature is 12 degrees Celsius. Determine the frequency for second resonance.

26. Car A is moving at 20 m/s and Car B is moving at 30 m/s, each sounding a horn with a frequency of 300 Hz on a day when the speed of sound is 330 m/s. They are approaching each other on adjacent lanes of a road. What is the apparent frequency of car A's horn to an observer in car B? What is the apparent frequency of car B's horn to an observer in car A? What is the apparent frequency of **each** car's horn to a stationary observer on the side of the road?
27. The cars in the previous problem pass each other and move apart as they continue to sound their horns. What is the apparent frequency of car A's horn to an observer in car B? What is the apparent frequency of each of the Car's horns to a stationary observer standing at the point where the two cars passed each other?
28. A source of sound and an observer are moving directly toward each other. The source has a frequency of 500 Hz and a speed of 30 m/s. The speed of the observer is 20 m/s. What is the apparent frequency of the sound to the observer if the speed of sound in air is 330 m/s?
29. If the source and the observer reverse directions in the previous problem but not speeds what would be the frequency heard by the observer?
30. On a sunny 30° Celsius day, a train is blowing its whistle which has a frequency of 500 Hz as it passes through the station at a constant speed of 30 m/s. To a person standing on the platform, what frequency do they hear as the train approaches the station? What frequency do they hear as the train leaves the station?

1. 10 sec	2. 5 m/s	3. 0.29 m/s, 0.21 sec	4. 2.5 m/s 0.83 Hz	5. 4.2 m/s
6. 187.5 – 545 m	7. 1550 m/s, 1E-6 sec 1E-6 sec	8. 471 Hz 235 waves	9. 1348.2 m	10. 0.779 m 0.793 m
11. 1029 m	12. 31.66°C	13. 2058 m	14. 1029 m	15. 34.3 m
16. 686 m	17. 127.5 m	18. 671.6 m 1007.4 m	19. 0.75 sec	20. 5.36 sec
21. 343 m/s 0.258 m 0.516 m 665 Hz	22. 133.9 Hz	23. 331.8 m/s	24. 108 Hz	25. 325 Hz
26. 348.4 Hz 350 Hz 330 Hz 319.4 Hz	27. 257 Hz 275 Hz 282.9 Hz	28. 583 Hz	29. 431 Hz	30. 547 Hz 460 Hz

