## UNIT # 4 REVIEW – WAVES

### Key Terms

sound

infrasonic

ultrasonic

pitch

sound intensity

decibel

echo

sonar

beats

beat frequency

Doppler Effect

Mach number

supersonic speed

sound barrier

sonic boom

fundamental frequency

overtones

harmonics

closed air column

open air column

resonance

damping

compression

rarefaction

crest

trough

transverse wave

longitudinal wave

amplitude

### Questions

1. Draw a transverse wave showing 2 cycles. The wavelength should be 4 cm, and the amplitude should be 1.0 cm. Label 2 points that are in phase with each other as well as the rest axis.
2. Calculate the speed of a sound if its frequency and wavelengths are
   1. 384 Hz and 90.0 cm
   2. 256 Hz and 1.32 m
   3. 1.50 kHz and 23.3 cm
3. Find the wavelength that corresponds to each of the following frequencies. (Assume that the speed of sound is 342 m/s)
   1. 20 Hz
   2. 2.0 x 104 Hz
4. What is the speed of sound in air if the temperature is
   1. 15˚C
   2. –40.0˚C
5. Thunder is heard 3.0 s after the lightning that caused it is seen. If the air temperature is 14˚C, how far away is the lightning?
6. Find the period of a sound wave with a wavelength of 0.86 m, if the temperature is 20˚C.
7. A man sets his watch at noon by the sound of a factory whistle 4.8 km away. If the temperature is 20.0˚C, how many seconds slow will his watch be?
8. A marching drummer strikes the drum every 1.0 s. At what distance from the drummer will a listener hear the drum at the instant the drumstick is farthest from the drum? The air temperature is 20.0˚C.
9. Orca whales make sounds so loud that hydrophones can pick them up from a great distance in seawater. Assume that an orca traveling at 55 km/h is approaching an observer using a hydrophone. How long after the sound is heard will the whale take to reach the observer from the initial distance of 8.0 km? The speed of sound in salt water is 1470 m/s.
10. The oboe sounds the note A (440 Hz) when the orchestra tunes up before a performance. How many vibrations does the oboe make before sound reaches a person seated in the audience 45 m away? Assume that the temperature in the concert hall is 20.0˚C.
11. A ship sends a sound signal simultaneously through the air and through the salt water to another ship 1.0 km away. Using 336 m/s as the speed of sound in air and 1450 m/s as the speed of sound in salt water, calculate the time interval between the arrivals of the two sounds at the second ship.
12. A 21-gun salute is about to be given by a Navy ship anchored 3.0 km from a person who is swimming near the shore. The swimmer sees a puff of smoke from the gun, quickly pops her head under water, and listens. In 2.0 s she hears the sound of the gun; she then lifts her head above water. In another 8.6 s, she hears the sound from the same shot coming through the air. Find the speed of sound in air and water.
13. An armed forces ship patrolling the ocean receives its own sound signals back by underwater reflection 4.5 s after emitting them. How far away is the reflecting surface in metres?
14. Two sources with frequencies of 300 Hz and 306 Hz are sounded together. How many beats are heard in 4.0 s?
15. Two tuning forks are sounded together, producing three beats per second. If the first fork has a frequency of 300 Hz, what are the possible frequencies of the other fork?
16. At a certain altitude the speed of sound is 1066 km/h. Jet A is traveling at Mach 1.2 and jet B is traveling Mach 2.0. What is the velocity of each jet in metres per second?
17. Estimate how long it would take the space shuttle Enterprise, traveling at Mach 25, where the speed of sound is 296 m/s, to travel once around the Earth. Assume that the Earth’s radius is 6.4 x 103 km.
18. An oncoming ambulance is moving at 100 km/h with siren blaring at a steady 850 Hz approaching a person standing on a sidewalk. If the speed of sound is 340 m/s, what frequency will she hear as the ambulance approaches and as the ambulance moves away from her?
19. If the frequency of a guitar string is 400 Hz, what is the frequency of the second overtone?
20. A closed air column is 60.0 cm long. If the speed of sound is 344 m/s, calculate the frequency of a tuning fork that will cause resonance at
    1. the first resonant length
    2. the second resonant length
    3. the third resonant length
21. The first resonant length of an open air column in resonance with a 512 Hz fork is 33.0 cm. What is the speed of sound?
22. You are constructing a wooden resonance box open at both ends on which you want to mount a 320 Hz tuning fork. What is the minimum length of the box? Assume that the air temperature is 20.0 ˚C.
23. Singers are reputed to be able to shatter delicate wine glasses by singing high, loud notes. Explain.