

Speed of Sound – Problems

Name: _____ Date: _____

$$v = f\lambda \quad v_s = 332 + 0.6T \quad T = \frac{1}{f} \quad f = \frac{1}{T} \quad Mach\# = \frac{v_0}{v_s} \quad c = 3 \times 10^8 \text{ m/s}$$

Show all of your work in your solutions.

- Calculate the speed of sound in air for the following temperatures:
 - 0°C
 - 25°C
 - 15°C
- What is the speed of a plane flying at Mach (convert answers to km/h)
 - 2.1 at 35°C.
 - 2.1 at -10°C
 - 0.5 at 20°C
- Calculate the Mach number for a plane flying at:
 - 1300 km/h at 25°C
 - 400 m/s at 3°C
- The lapse rate of the atmosphere is approximately -10°C per km of altitude. Lapse rate is the decrease in temperature with height above the surface of the ground. A fighter jet plane is flying overhead at an altitude of 15 km at Mach 2.5. Calculate the speed of the plane in km/h if the ground temperature is 23°C.
- Calculate the wavelength in the following substances if the frequency is 1000s^{-1} and the speed of sound in the medium is given:
 - Helium (1230 m/s)
 - Hydrogen (1267 m/s)
 - Steel (5130 m/s)
 - Glass (4700 m/s)
- Calculate the wavelength of the sound produced by a bat if the frequency of the sound is 90 KHz on a night when the air temperature is 22°C.
- If it takes 0.8 s for your voice to be heard at a distance of 272 m, calculate the temperature of the air.

8. The air temperature is 20°C . You are swimming underwater when you hear a boat crash. The sound underwater took 0.5 seconds to reach you from the crash site. If the speed of sound in water is 1450 m/s, calculate how long after the crash your friend standing on the dock beside you hears the crash?
9. On a hot summer night (32°C), you are listening to a rock group in a stadium. You are 150 m away from the speakers. Your friend is sitting in an air-conditioned house across the country, listening to the same concert over the internet. If the radio signal travels 30,000 km up to the satellite and then is retransmitted another 30,000 km to your friends computer, which person hears the concert first? (radio waves are light and travel at the speed of light).