Name: Key

Notes - 17.1-17.3 Sound

1. A disturbance of matter (such as air) that moves outward from its source is called Sound.

2. Vibrations of an object result in compressions (high pressure regions) and rarefactions (low pressure regions) move out as longitudinal pressure waves.

3. Sound, like all waves, travels at a certain speed and has the properties of frequency and wavelength. The perception of frequency is called pitch.

4. The relationship of the speed of sound, its frequency, and wavelength is the same as for all waves: $v = \lambda f$

5. The speed of sound in a medium is determined by a combination of the medium's rigidity (or compressibility in gases) and its density. The more rigid (or less compressible) the medium, the faster the speed of sound. (This observation is analogous to the fact that the frequency of a simple harmonic motion is directly proportional to the stiffness of the oscillating object.) The greater the density of a medium, the slower the speed of sound. (This observation is analogous to the fact that the frequency of a simple harmonic motion is inversely proportional to the mass of the oscillating object.) The speed of sound in air is low, because air is compressible. Because liquids and solids are relatively rigid and very difficult to compress, the speed of sound in such media is generally greater than in gases.

6. The speed of sound in air is given by:
$$v = 331.3\sqrt{1 + \frac{T}{273.15}}$$ where T [°C]
$$\Rightarrow v = 331.3 + 0.606T$$
1st 2 terms of Taylor's series expansion

7. The sound intensity level β in decibels of a sound having an intensity I in watts per meter squared is defined to be:
$$\beta(dB) = 10\log_{10}\left(\frac{I}{I_0}\right) \text{ where } I_0 = 10^{-12}\frac{W}{m^2}$$

8. Sound Intensity Levels

Table 17.2 Sound Intensity Levels and Intensities

Sound Intensity level β (dB)	Intensity I (W/m^2)	Example/effect
0	1×10^{-12}	Threshold of hearing at 1000 Hz
10	1×10^{-11}	Rustle of leaves
20	1×10^{-10}	Whisper at 1 m distance
30	1×10^{-9}	Quiet home
40	1×10^{-8}	Average home
50	1×10^{-7}	Average office, soft music
60	1×10^{-6}	Normal conversation
70	1×10^{-5}	Noisy office, busy traffic
80	1×10^{-4}	Loud radio, classroom lecture
90	1×10^{-3}	Inside a heavy truck; damage from prolonged exposure[1]
100	1×10^{-2}	Noisy factory, siren at 30 m; damage from 8 h per day exposure
110	1×10^{-1}	Damage from 30 min per day exposure
120	1	Loud rock concert, pneumatic chipper at 2 m; threshold of pain
140	1×10^{2}	Jet airplane at 30 m; severe pain, damage in seconds
160	1×10^{4}	Bursting of eardrums