

Properties of Sound (remember it's a wave)

We have discovered that sound is a longitudinal wave ie: areas of compression and rarefaction (high pressure and low pressure). Sound needs a medium to travel through.

Audible sound waves – humans can hear. Most can hear 1000 Hz to 5500 Hz
(1 – 5.5 kHz)

Infrasonic waves – below our hearing range < 1000 Hz
Earthquakes are infrasonic. Some animals can hear?

Ultrasonic waves – above our hearing range > 5500 Hz
Medically useful – ultrasound imaging (tissue reflects and absorbs waves and produce an image)

- break up kidney stones so they can 'pass' & avoid surgery

Speed of sound various media

Fastest in solids, then liquids & then gas. (Table 1 p. 395)

Examples _____ (solid) → _____ m/s

Water (liquid) → _____ m/s

Air @ 0° C (gas) → _____ m/s

Speed of sound in air

The warmer the air, the faster the particles are moving and can return to their undisturbed state. Air temperature and speed of sound are related by the following formula:

$$v_{\text{air}} = 331.4 \text{ m/s} + (0.606 \text{ m/s/}^{\circ}\text{C})T$$

where v = velocity (m/s)

T = temperature (°C)

Ambient =
existing

Mach speed

We've all heard of 'mach speed'. Look at formula – Mach # has no units!

Mach 1 = travelling at the speed of sound (at that temperature / pressure)

Mach 2 = travelling at twice the speed of sound

$M = \frac{\text{airspeed of object}}{\text{Local speed of sound}}$	$M = \text{mach \#}$ <p>m/s cancels out – no units</p>
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Sound Intensity

Loudness – describes how humans perceive sound energy.

The greater the amplitude of a wave, the more energy it is transferring.

So...greater amplitude means you hear it louder.

But humans hear mid-range notes better than super high / low.

Sound intensity – You have a small ear drum that vibrates. So we are interested in the amount of energy transferred per unit area.

sound intensity = the amount of sound energy per second (watts) being transferred per metre squared. (W/m^2)

Sound levels – conveniently measured in decibels (dB). It is sound intensity converted to another unit (dB)

Type of sound	Sound intensity (W/m^2)	Sound level (dB)
Threshold of our hearing		
Typical whisper		
Vacuum cleaner		
Motorcycle		
Rock band		
Threshold of pain		
add your favourite		

Loudness & Distance

- farther sound travels, the energy it carries in total stays the same, but spread out over further distance so energy per unit (W/m^2) or decibels decreases. So loud noises safer at a distance.

Sound Safety

Anything louder than 100 dB for more than a few minutes can damage your hearing.

p. 397 # 2, 3, 5 and

Read 'The Sound Barrier' p. 398 – 399 and answer # 1, 2, 3