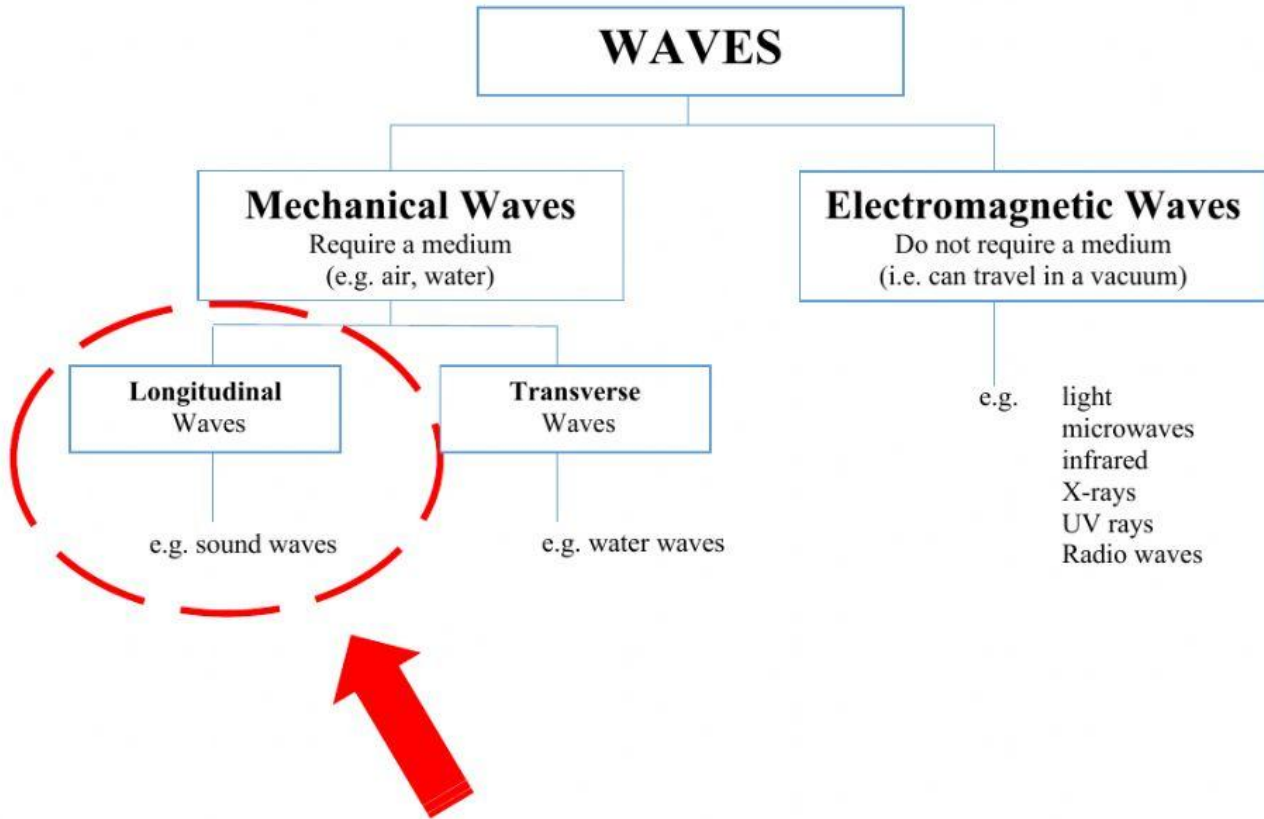
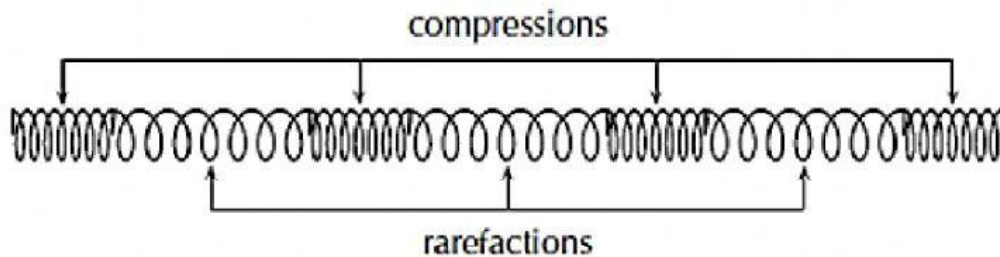


# Longitudinal Waves



- Sound waves travel as longitudinal waves.
- As longitudinal waves are Mechanical Waves, sound waves cannot travel through a vacuum (need a medium to travel through, e.g. air)
- Sound waves can travel through solid, liquid and gas. They travel at  $343 \text{ ms}^{-1}$  in air,  $1\,484 \text{ ms}^{-1}$  in water (4.3x faster than in air), and  $5\,120 \text{ ms}^{-1}$  in solid iron (15x faster than in air!).
- An **echo** is a reflection of sound waves.

A **longitudinal wave** is a wave in which the particles of the medium vibrate **parallel** to the direction of motion of the wave.



A **compression** is a region of high pressure in a longitudinal wave.  
(i.e. where the particles are closest together)

A **rarefaction** is a region of low pressure in a longitudinal wave.  
(i.e. where the particles are furthest apart)

**Wavelength** is the distance between two successive points in phase.

Symbol:  $\lambda$       Unit: meter (m)

**Frequency** is the number of compressions (or rarefactions) that pass a given point per second.

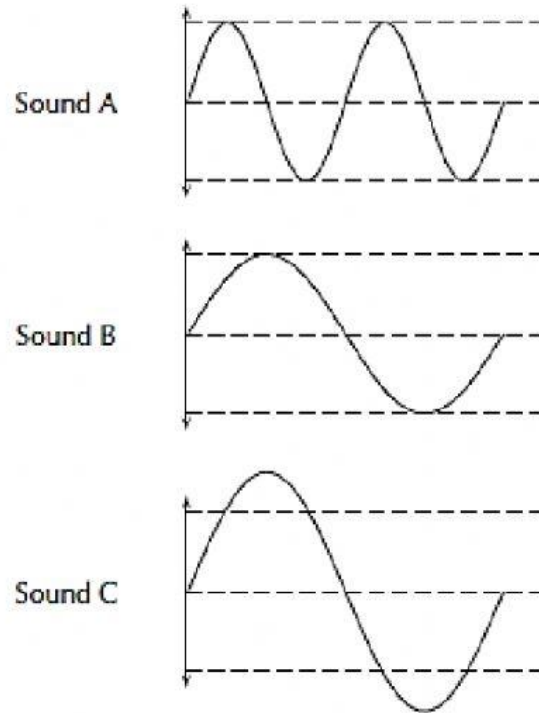
Symbol:  $f$       Unit: hertz (Hz)

**Amplitude** is the maximum displacement of a particle from its equilibrium position.

Symbol:  $A$       Unit: meter (m)

The amplitude of a sound wave determines how **loud** the sound is.

The frequency of a sound wave determines the **pitch** of a sound (high or low).



Determine:

- 1) Which sound wave is the loudest
- 2) Which sound wave has the highest pitch
- 3) Which waves have the same pitch
- 4) Which waves have same volume

Write only A, B or C as your answer, or use the format "A and B" or "A and B and C" for (3) and (4)

### Ultrasound

Ultrasound is sound with a frequency that is higher than 20 kHz. Some animals, such as dogs, dolphins, and bats, have an upper limit that is greater than that of the human ear and can hear ultrasound.

Ultrasound image of a unborn baby

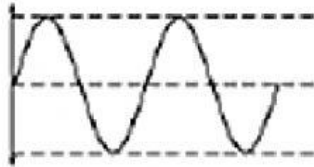


The most common use of ultrasound is to create images, and has industrial and medical applications. The use of ultrasound to create images is based on the reflection and transmission of a wave at a boundary (when the wave goes from one substance to another). When an ultrasound wave travels inside an object that is made up of different materials such as the human body, each time it encounters a boundary, e.g. between bone and muscle, or muscle and fat, part of the wave is reflected and part of it is transmitted. The reflected rays are detected and used to construct an image of the object.

Ultrasound in medicine can visualise muscle and soft tissue, making them useful for scanning the organs, and is commonly used during pregnancy. Ultrasound is a safe, non-invasive method of looking inside the human body.

### Question 1

Study the following diagram representing a musical note.



Redraw the diagram for a note

1. with a higher pitch
2. that is louder
3. that is softer

Complete  
this question  
in the back of  
your Physics  
book.

### Question 2

The amplitude and frequency of a sound wave are both increased. How are the loudness and pitch of the sound affected?

	Loudness	Pitch
A	increased	raised
B	increased	unchanged
C	increased	lowered
D	decreased	raised
E	decreased	lowered

Choose ONE answer, from A to E:



### Question 3

Select a word from Column B that best fits the description in Column A:

Column A	Column B
1. waves in the air caused by vibrations	A. longitudinal waves
2. waves that move in one direction, but medium moves in another	B. frequency
3. waves and medium that move in the same direction	C. period
4. the distance between consecutive points of a wave which are in phase	D. amplitude
5. how often a single wavelength goes by	E. sound waves
6. half the difference between high points and low points of waves	F. standing waves
7. the distance a wave covers per time interval	G. transverse waves
8. the time taken for one wavelength to pass a point	H. wavelength
	I. music
	J. sounds
	K. wave speed

Write ONLY the letter (e.g. A) of your answer next to each description