KS4: Autumn Term
SCIENCE: Waves

Keyword	Definition
amplitude	The size of vibrations or the maximum distance a particle moves away from its resting position when a wave passes.
frequency	The number of vibrations (or the number of waves) that pass a point per second. (measured in Hz)
hertz (Hz)	The unit for frequency. One hertz (Hz) is one wave per second.
medium	Any substance through which something travels. E.g. air, water, perspex block
period	The time taken for one complete wave to pass a point. It is measured in seconds (s).
seismic waves	Vibrations in the rocks of the Earth caused by earthquakes or explosions. There are transverse (S Waves) and longitudinal seismic waves (P waves).
sound waves	Vibrations in the particles of a solid, liquid or gas, which are detected by our ears and 'heard' as sounds. Sound waves are longitudinal waves.
Transverse wave	A wave where the **vibrations** are at **right angles** to the direction the wave is travelling.
Longitudinal wave	A wave where the **vibrations** are **parallel** to the direction as the wave is travelling.
velocity	The speed of an object in a particular direction. Usually measured in metres per second (m/s).
wave	A way of transferring energy or information. Many waves travel when particles pass on vibrations.
wavelength	The distance between a point on one wave and the same point on the next wave. (measured in metres (m)
interface	The boundary between two materials. e.g. air and glass, air and water
normal	An imaginary line at right angles to a surface where a ray of light hits it.
refraction	The change in direction when waves go from one medium to another. E.g. air to glass

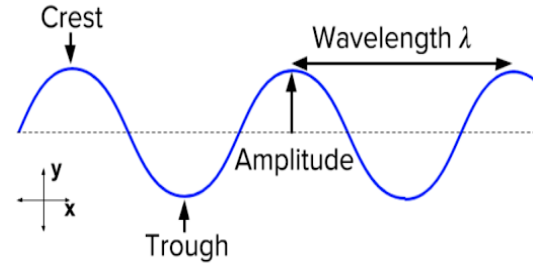
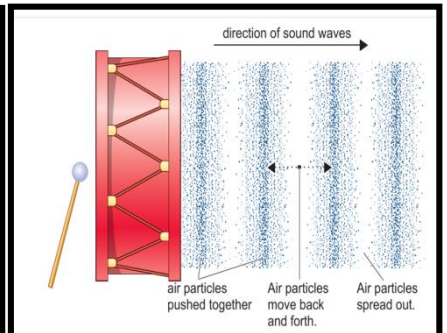


Figure 1: Parts of a transverse wave.



C Sound waves are longitudinal waves. The particles move back and forth in the same direction as the wave is travelling.

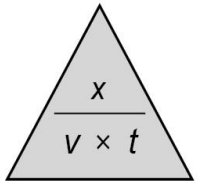
Wave speed equations- to memorise

wave speed = $\frac{\text{distance}}{\text{time}}$

v = wave speed in m/s

x = distance in m

s = time in s

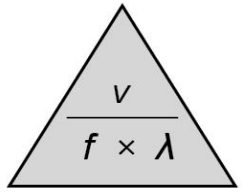


wave speed = frequency × wavelength

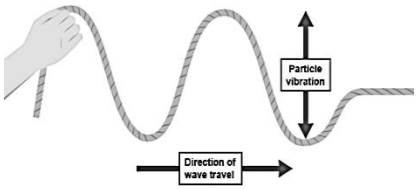
v = wave speed in m/s

f = frequency in Hz

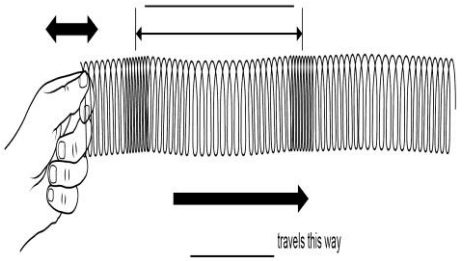
λ = wavelength in m



TRANSVERSE



LONGITUDINAL



Core practical – Investigating waves - Water

Aim	To measure the speed of a water wave using a strobe light using speed= frequency X wavelength equation

Apparatus
Ripple tank, lamp, ruler, wave dipper, water, white screen, motor, camera, white A3 paper

Method

1. Turn the power supply on so the oscillating paddle moves up and down to produce lots of ripples.
2. Place an A3 white paper underneath the tank
3. Take a photo under the tank
4. Measure the length of 10 waves using the ruler and divide the distance by 10 to give the length of one **wavelength**. Convert wavelength to metres.
5. Find the **frequency** (Hz) of the waves by counting the number of ripples that pass a point in 10 seconds and dividing by 10.
6. Calculate the wave speed (m/s)= frequency x wavelength

Aim	To measure the speed of a water wave using a strobe light. using speed= distance/time equation

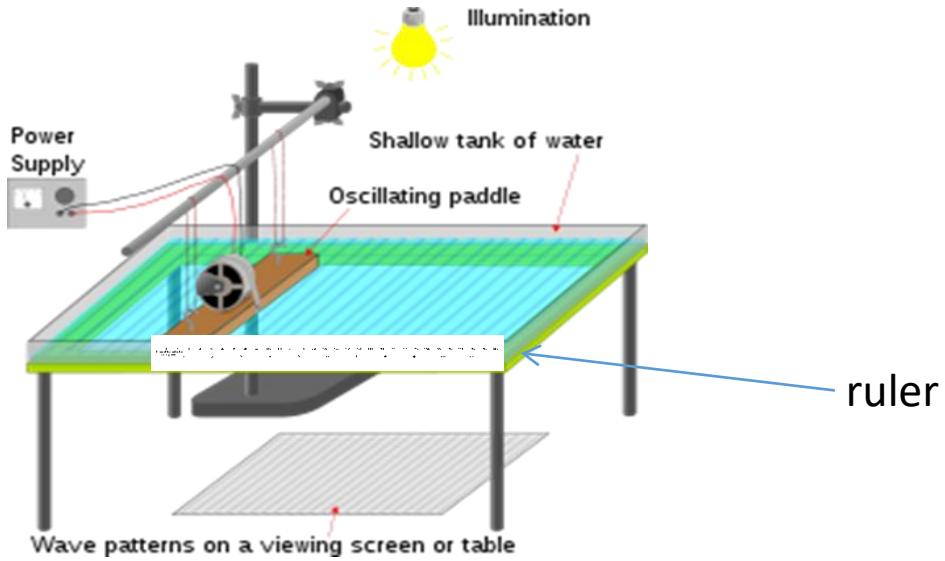
Method:

1. Turn the power supply on so the oscillating paddle moves up and down to produce lots of ripples.

2. Time how long a wave takes to pass two points on the ripple tank e.g. 30cm (0.3 m).

3. Calculate the Wave speed (m/s) = distance / time

BBC bitesize investigating waves video
https://www.bbc.co.uk/bitesize/guides/zs86v9q/video



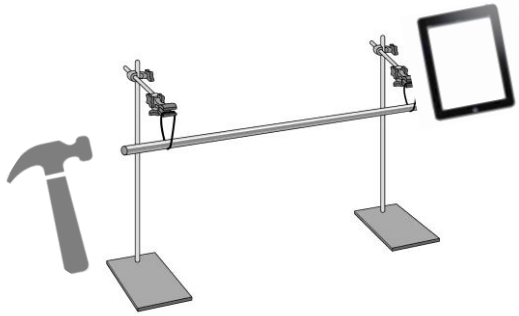
Core practical – investigating waves in a solid

Aim	To measure the speed of a sound wave using a hammer, tablet and metal bar

Apparatus
Metal rod, 2 rubber bands, 2 clamp stands and clamps, hammer, ipad or phone with frequency app

1. Suspend a metal rod horizontally using 2 clamp stands and 2 rubber bands, as shown in the diagram.
2. Hit a suspended metal bar with a hammer and measure the frequency using an app.
3. Measure the metal bar – The wavelength will be twice the length of the rod.
4. Wave speed= frequency X wavelength

Measure wave speed in a solid



Practise Questions

1.Describe how you can measure walking speed using a tape measure and a stopwatch. (hint: bullet point the steps)
Challenge: Explain why these instruments are not suitable for measuring the speed of sound in a solid.

Core practical – Investigating refraction

Aim	To investigate how light is affected when it travels from air into glass, or from glass into air.

Apparatus
A4 paper, ray box with single slit, power supply, rectangular glass block,(perspex block) , pencil, ruler, protractor

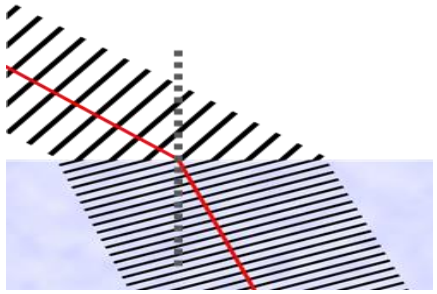
Safety: Ray boxes get hot. Handle with care.

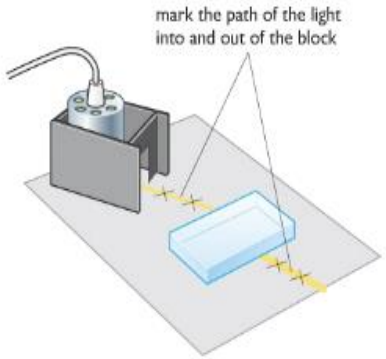
Method

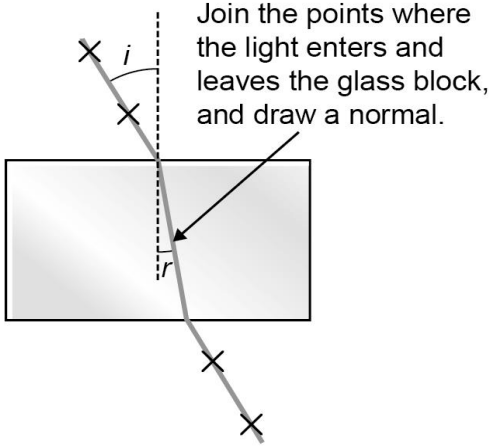
1. Place a Perspex block on the back of an A4 white paper.
2. Shine a beam of light using a ray box at the perspex block along the dotted lines indicated.
3. Use a pencil to mark the path of the rays leaving the block and then join the marks using a ruler.
4. Measure the angle between each of the grey dotted lines and normal line. This is the angle of incidence (i).
5. Measure the angle between the normal line and the drawn lines in the block. These are the angles of refraction (r).

Useful websites:
Schoology: Science
https://www.bbc.co.uk/bitesize/topics/zt4gfcw
ttps://members.gcsepod.com/shared/podcasts/title/11120

Refraction: The change in direction when waves go from one medium to another.







Refraction Key terms

Refraction	The change in direction when waves go from one medium to another.
Interface	The boundary between two materials. e.g. air and glass, air and water
Normal	An imaginary line at right angles to a surface (interface) where a ray of light hits it.
Travelling from air to glass or water	Light waves bends ***towards*** the normal when they travel from less dense media to more dense media.
Travelling from glass or air to water	Light bends ***away*** from the normal when the waves travel from more dense media to less dense media.
Explaining refraction	Light waves slow down as they go from air to water. The 'bottom' of the wave hits the water and slows down first, causing refraction.

Practise questions:

1. What is the name of a line drawn at 90° to the surface of a material?
2. Which term is used to refer to an incoming ray?
3. DO light waves bend towards or awat from the normal when they travel from less dense media to more dense media?
4. Write the two wave speed equations include units.
5. What is the speed of sound in air? *Remember your units*