

Period (s) $T = \frac{1}{f}$ Frequency (Hz)

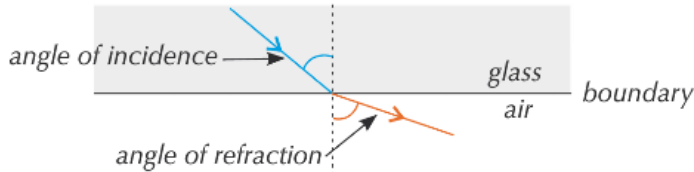
The **wave speed** is the speed at which **energy is being transferred** (or the speed the **wave** is moving at).

The **wave equation** applies to **all waves**:

Wave speed (m/s) $v = f\lambda$ Wavelength (m)
Frequency (Hz)

Waves - Foundation

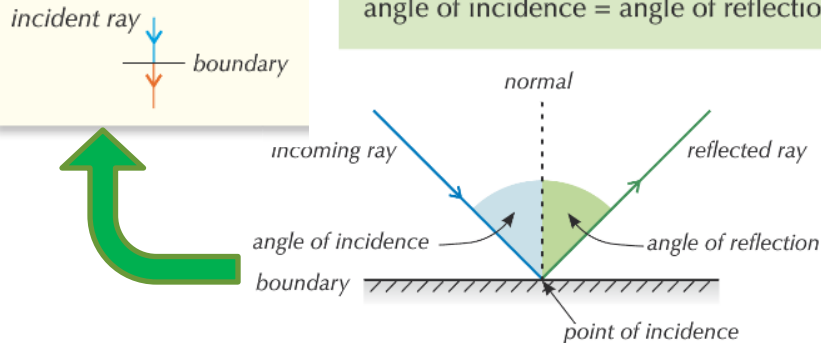
Refraction of Waves



Tip: A ray that hits the boundary at 90° won't change direction.

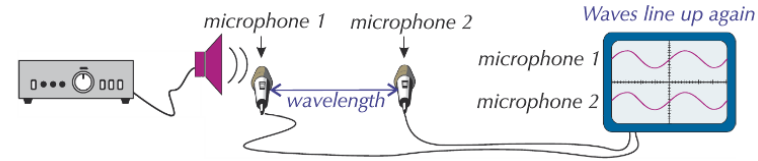
Reflection of Waves

angle of incidence = angle of reflection



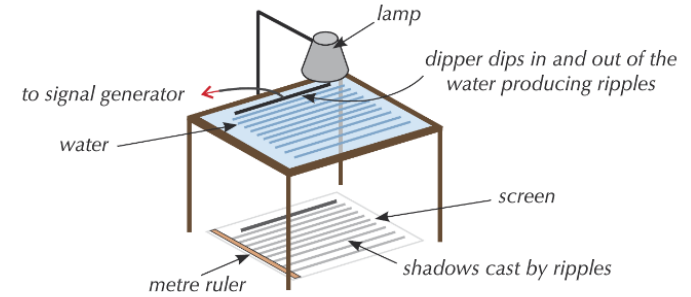
Waves Experiments

Speed of Sound (330 m/s):



You can then use the formula $v = f\lambda$ to find the speed (v) of the sound wave passing through the air — the frequency (f) of the wave will be equal to the frequency set by the signal generator.

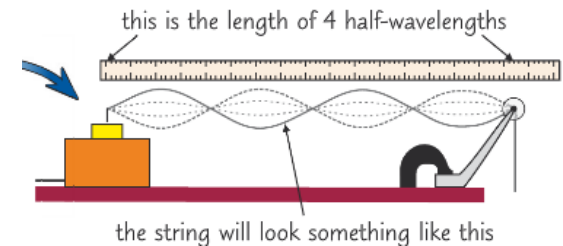
Ripple Tank:



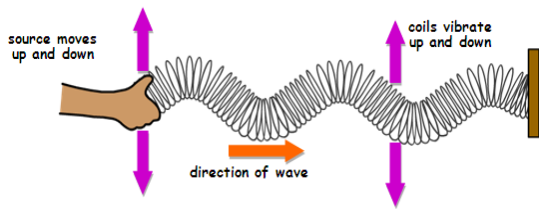
The distance between each shadow line is equal to one wavelength. Measure the **distance** between shadow lines that are 10 wavelengths apart, then **divide** this distance by 10 to find the **average wavelength**.

Use $v = f\lambda$ to calculate the wave **speed** of the waves.

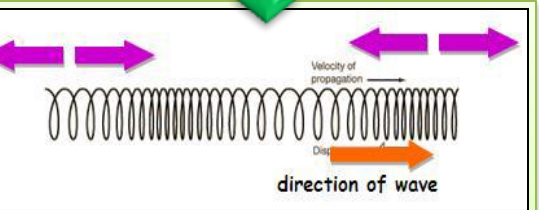
Waves on a String:



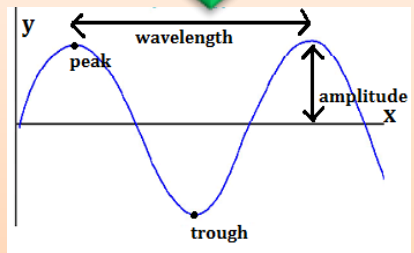
The frequency of the wave is whatever the signal generator is set to. You can then find the speed of the wave using $v = f\lambda$.



Transverse Waves
 Transverse waves move up and down whilst the energy moves forward.



Longitudinal Waves
 Longitudinal waves move forwards and backwards whilst the energy moves forward.



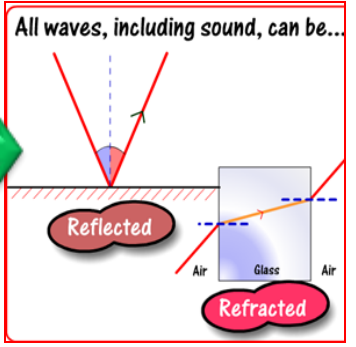
- A **peak** is the tip of the wave, a **trough** is the bottom of a wave.
- **Wavelength** is the length of one full wave – so from one peak to the next for example.
- **Amplitude** is the height of the wave from the middle line. The greater the amplitude, the greater the energy of the wave.

Visible light
 Optical fibres carry information e.g. internet. Other uses: photography, photocopying.

Infrared-IR
 All objects emit IR. The hotter the object the more IR it emits. Uses: heaters, IR scanners, IR cameras, remote controls, optical fibres and communications.

X-Rays and Gamma Rays
 X rays are used in hospital to see broken bones. **Gamma rays** are used to **sterilise** equipment.
 Both types of wave **damage living cells** as they pass through. Large doses can **kill** cells. Smaller doses can cause **cancer**.

Microwaves
 Used in communication: can pass through atmosphere for satellite communications in space. Used in cooking e.g. microwave ovens which heat water molecules.

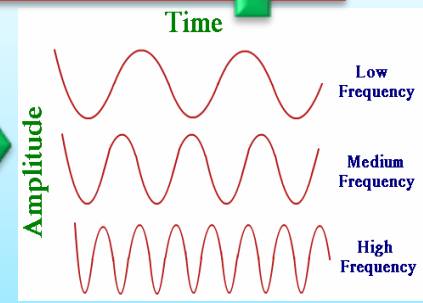
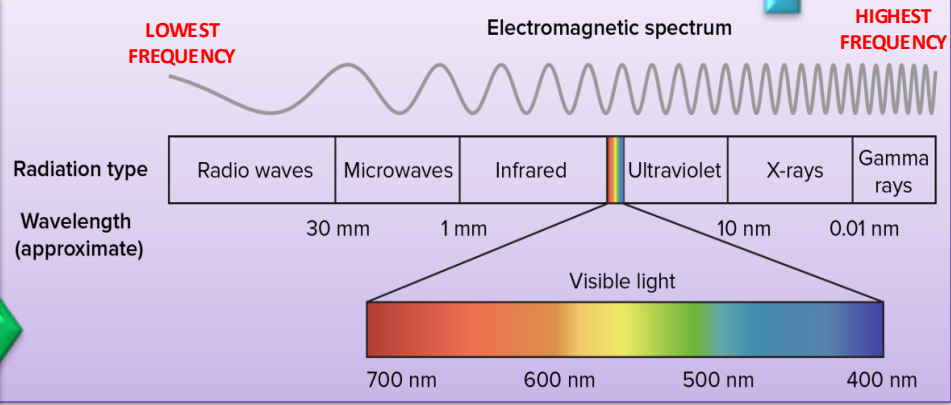


Radio waves

- 1 Have the longest wavelengths.
- 2 Used in communications.
- 3 Carry radio, TV, mobile phone signals.
- 4 Highest frequency radio waves- have a shorter range.

The Electromagnetic ('EM') Spectrum
LEARN IT IN ORDER!

1. Radio waves
2. Microwaves
3. Infrared waves
4. Visible light
5. Ultraviolet
6. X-rays
7. Gamma rays



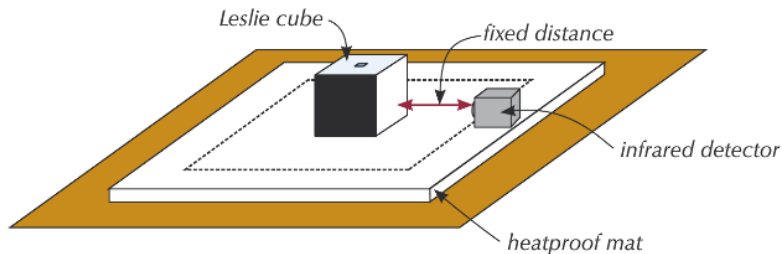
Frequency
 The frequency of a wave is how many waves that pass a point per second. The closer together the waves, the higher the frequency. Frequency is measured in **Hertz (Hz)**.

$speed = frequency (Hz) \times wavelength ('λ' - in metres)$

Investigating Infrared Radiation

Place an empty Leslie cube on a heatproof mat and fill it with boiling water from a kettle. Wait a while for the cube to warm up, then hold a thermometer against each of the four vertical faces of the cube. You should find that all four faces are the same temperature.

Next hold an infrared detector a set distance (e.g. 10 cm) away from one of the cube's vertical faces, and record the amount of IR radiation it detects. Repeat this measurement for each of the cube's vertical faces. Make sure you position the detector at the same distance from the cube each time.



You should find that you detect **more infrared radiation** from the **black** surface than the **white** one, and more from the **matt** surfaces than the **shiny** ones.

Radiation dose

The **radiation dose**, measured in sieverts, is a measure of the risk of harm from the body being exposed to radiation (it's not just a measure of the quantity of radiation that hits someone). Radiation dose takes into account:

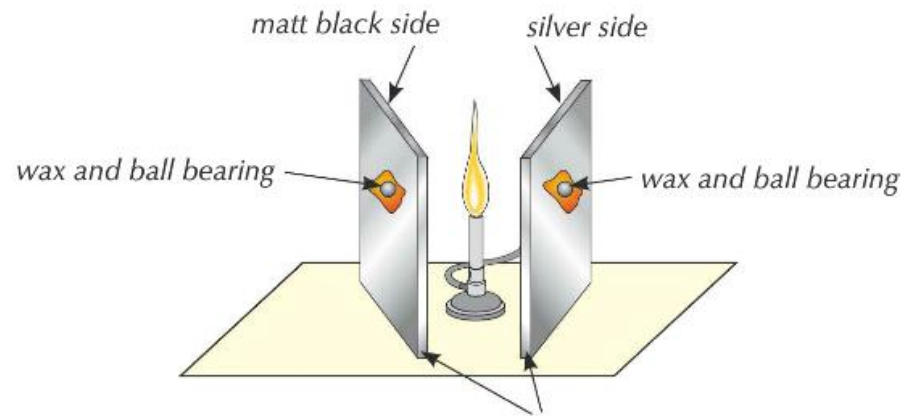
- The total amount of radiation absorbed.
- How harmful the type of radiation is.
- The type of body tissue absorbing the radiation. Some types of body tissue are more easily damaged by radiation than others.

A CT scan uses **X-rays** and a **computer** to build up a picture of the inside of a patient's body. The table shows the **radiation dose** received by two **different parts** of a patient's body when having CT scans.

	Radiation dose (mSv)
Head	2.0
Chest	8.0

If a patient has a CT scan on their **chest**, they are **four times more likely** to suffer damage to their genes (and their **added risk** of harm is **four times higher**) than if they had a **head** scan.

Investigating Infrared Absorption



The ball bearing on the black plate will fall first as the black surface absorbs more infrared radiation — transferring more energy to the thermal energy store of the wax. This means the wax on the black plate melts before the wax on the silver plate.

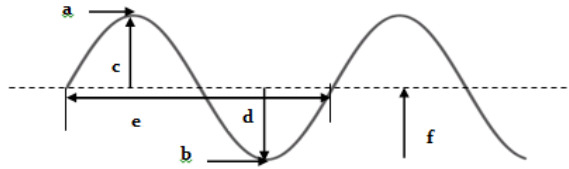
Worksheet on Wave Basics

Name: _____

Class: _____

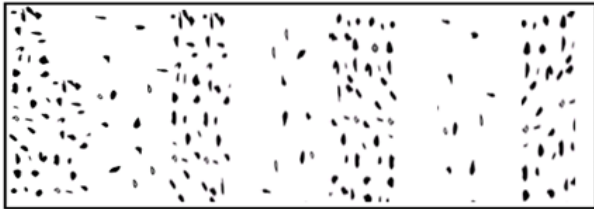
1. Label each part of the transverse wave in the space provided:

- a)
- b)
- c)
- d)
- e)
- f)



Fill in the blanks:

2. In a wave is carried from one place to another.
3. _____ is a substance/material that carries the wave.
4. The two types of waves are _____ wave and _____ wave.
5. In a _____ wave, the particles of the medium move in a direction **parallel** to the direction which the wave moves.
6. In a _____ wave, the particles of the medium move in a direction **perpendicular** to the direction which the wave moves.
7. Sound wave is an example of _____ wave.
8. Label compression and rarefaction in the given figure:



9. Match the following:

a) Low pressure region in a longitudinal wave	Ultrasonic
b) Sound frequency less than 20 Hz	20 Hz -20 KHz
c) High pressure region in a longitudinal wave	crest
d) Low point in a transverse wave	Infrasonic
e) Sound frequency more than 20 KHz	Rarefaction
f) High point in a transverse wave	Compression
g) Audible frequency	Trough

10. Define:

- a) Period:
- b) Amplitude:
- c) Wavelength:

11. Give the mathematical relationship between:

- a) Frequency, wavelength and speed of a wave:
- b) Frequency and period:
- c) Wavelength and period:

12 a). What happens to the wavelength of a wave if you double the frequency?

.....

b) What happens to the wavelength of a wave if you halve the frequency?

.....

What are the properties of reflection, refraction and diffraction?

Task 1: Copy and fill out the table below

	Definition	Properties	Examples
Reflection		e.g. the law of reflection states that ...	
Refraction	The change in _____ of _____ when they travel across a b_____		S_____ pool appearing s_____ than it is
Diffraction		<ul style="list-style-type: none">• The n_____ a gap is, the g_____ the diffraction• The w_____ a gap is, the _____ the diffraction	