Physics

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Module 1:
Energy for the Home

P1a: Temperature and Energy

Temperature: Measured in degrees '^{O}C' or Kelvin 'K'

Thermal Energy is measured Joules 'J'

Things are cold because the average energy is low

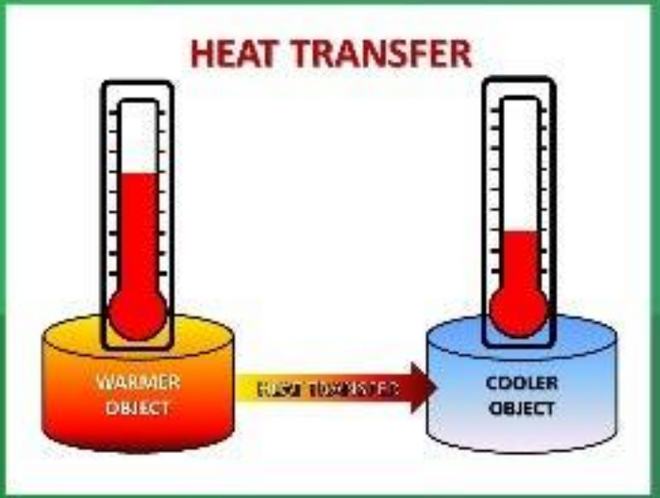
Things are hot because the average energy is high

Temperature: the average of thermal energy per particle

Thermal Energy: the total amount of energy altogether

Temperature is an arbitrary scale.

Arbitrary: comparing things to each other



Heat travels:
Hot to Cold
-Thermal energy is lost by hot objects
-Keep losing heat until equilibrium is reached
-Thermal energy is lost quicker by hot objects than cold objects

P1a: Specific Heat Capacity

Specific Heat Capacity is also known as SHC

SHC: helps figure out how much energy you need for a substance.

The amount of the substance matters as it changes the amount of energy needed.

The substance also matters as different substances need different amount of energy

SHC is about how much energy is needed to warm a material up- to increase the temperature up by an amount . *It is different for every substance!*

The Formula:

Energy Change = SHC x Mass x Temperature

(J) (J/Kg^{O}C) (Kg) (^{O}C)

Manipulate the formula to the questions need

**Change the mass to KG if needed*

Double the amount- Double the energy

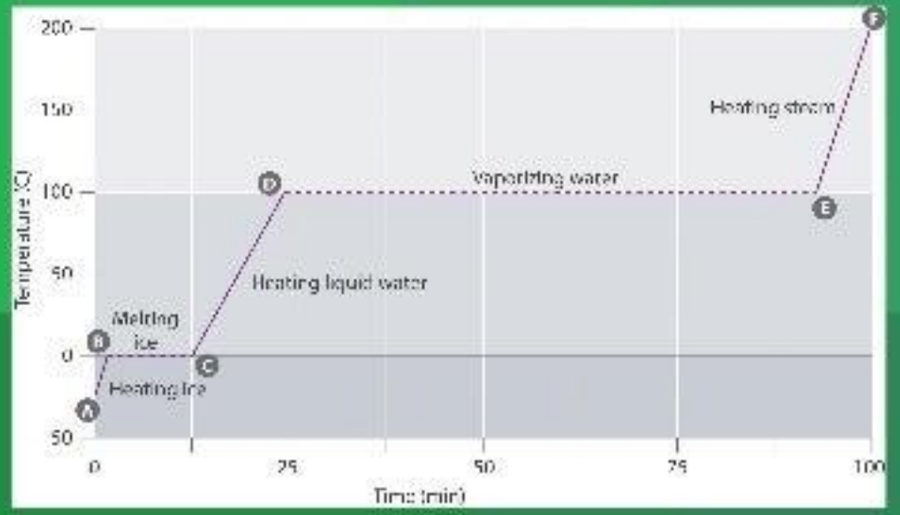
Double the time- Double the energy

Specific Latent Heat is also known as SLH

SLH is about the amount of energy used to overcome the bonds to change state.

The material doesn't get hotter while changing state because the energy is being used to break the intermolecular bonds.

P1a: Specific Latent Heat



The amount of energy used in SLH is different for each material or substance

*Change the mass to KG if needed

The Formula:

Energy = SLH x Mass

(J) (J/Kg^{O}C) (Kg)

Manipulate the formula to the questions need

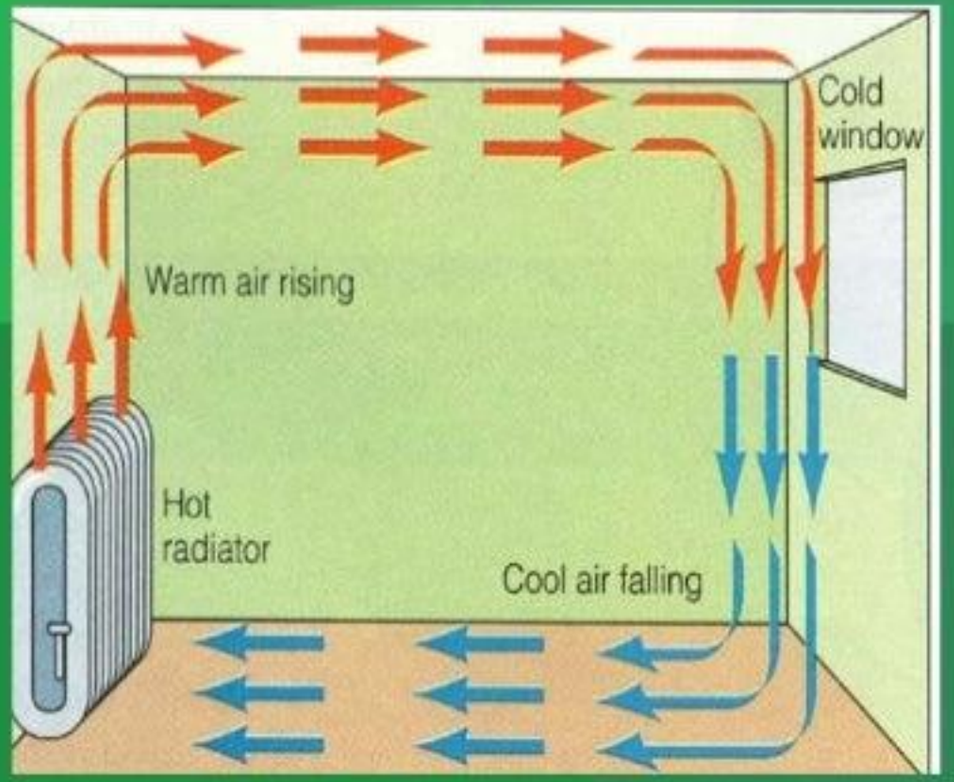
P1b: How to Lose Heat

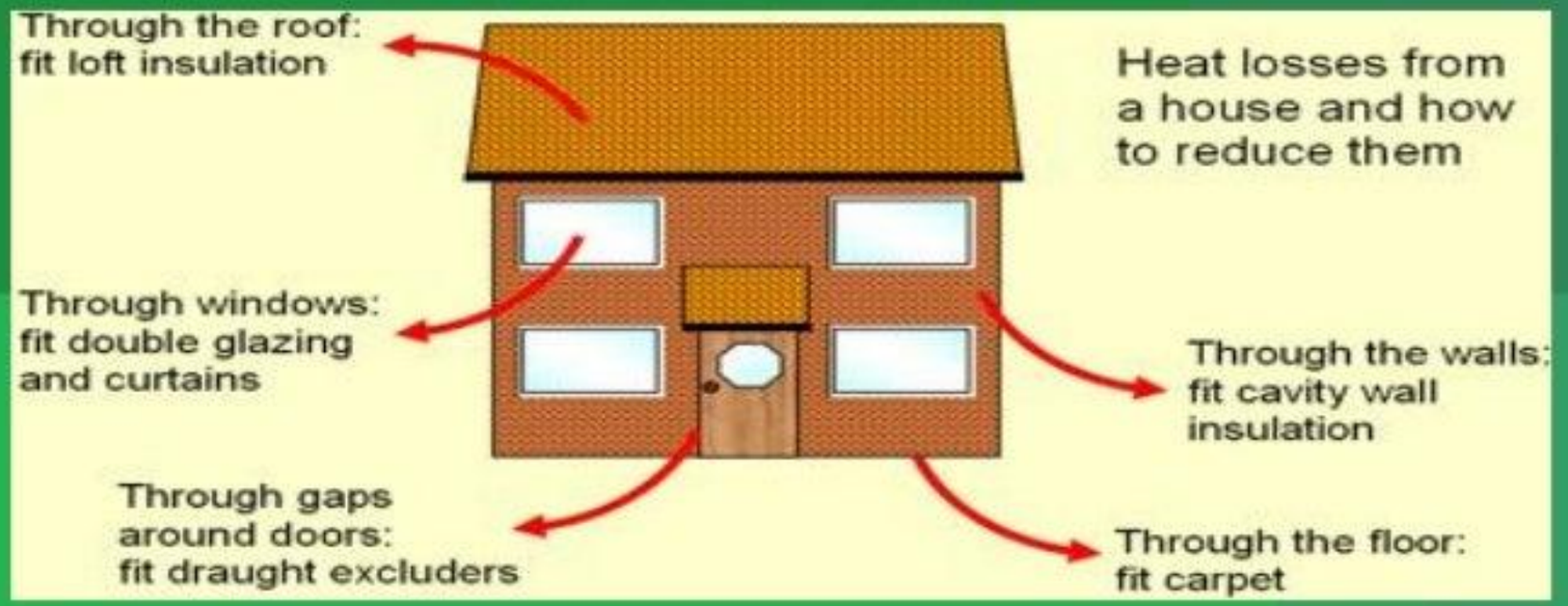
There are several ways to lose heat; they are: Convection, Conduction and Radiation

Conduction: is the transfer of thermal energy as it is passed on particle to particle. ONLY occurs in SOLIDS

Convection: is the transfer of thermal energy as it is carried by a particle. Warm particles are less dense and rise whereas cold particles are more dense and fall. This is called a current- and occurs in fluids (LIQUIDS and GASES)

Radiation: is the transfer of thermal energy from hot objects; it is energy passed on a WAVE and doesn't need any particles to pass on thermal energy. Travels in all directions.





P1b: Efficiency and Payback Time

Efficiency is the amount of energy that is turned into useful energy

E.g.
A traditional coal fire is not the most efficient way to heat a room because for every 100J of energy stored in the coal only 25J of energy is used to heat the room. The remaining 75J to surroundings; meaning it is 25% efficient

Payback time is when how long it takes for you to get that value of money- the typical cost in time

E.g.
Wall Cavities:
Cost: £400
Save: £80 (yearly)

$$\frac{400}{80} = 5$$

5 years to get money back

The Formula:

$$\text{Efficiency} = \frac{\text{Useful Energy output}}{\text{Total Energy Input}}$$

Manipulate the formula to the questions need (x100 for percentage)

The Formula:

$$\text{Payback Time} = \frac{\text{Cost}}{\text{Savings}}$$

Manipulate the formula to the questions need

A wave moves energy but no matter i.e. if you place a cork in the middle of a tank and put your hand in and out of it you get a wave however the cork doesn't move only the energy produced

There are two types of wave:
-Transverse
-Longitudinal

Transverse:
They are like a mexican wave because it ripples around a stadium by the people as they stand up and sit down.
Water particles move up and down as the wave spreads out from where a pebble is dropped in the water.
They travel in right-angles to the wave vibration.

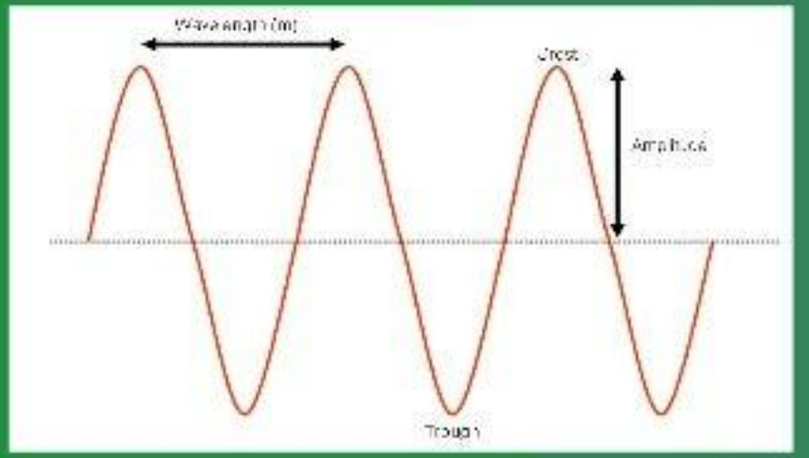
P1c: Waves

Light is an example of a transverse wave.

The Formula:

Wave Speed (m/s) = Frequency (Hertz (Hz)) x Wavelength (m)

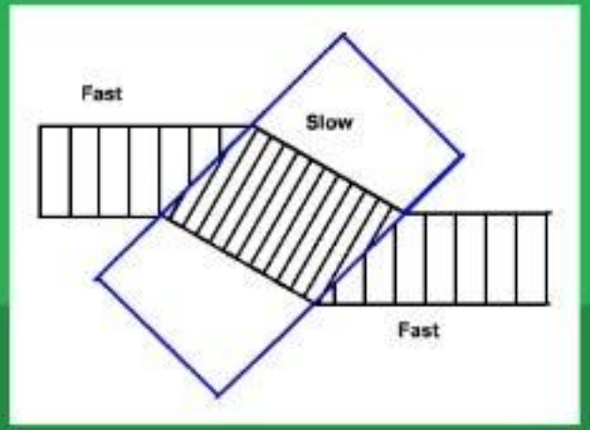
Manipulate the formula to the questions need



They can be:
-reflected: bounce back towards you
-refracted: bend as they enter/ leave a material
-diffracted: spread out when doing through a gap or hit a barrier

P1c: Reflection, Refraction, Diffraction

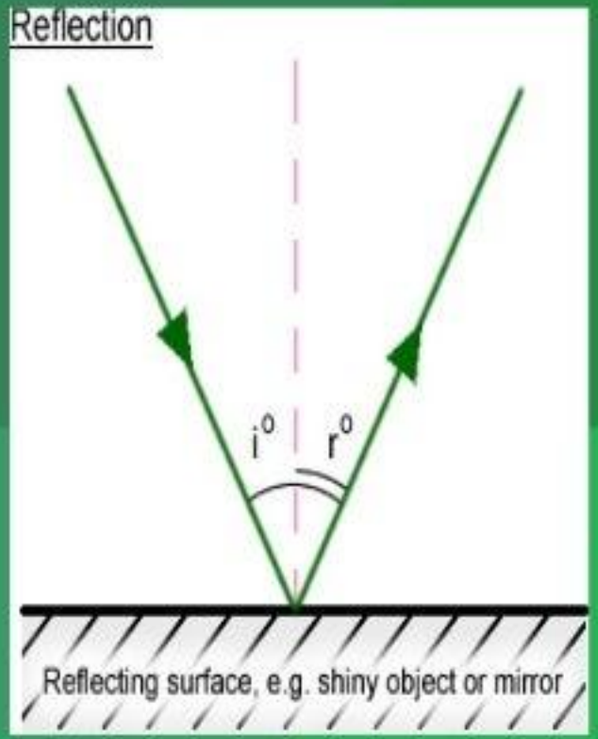
REFRACTION:
Bends the wave when entering/leaving a substance to another

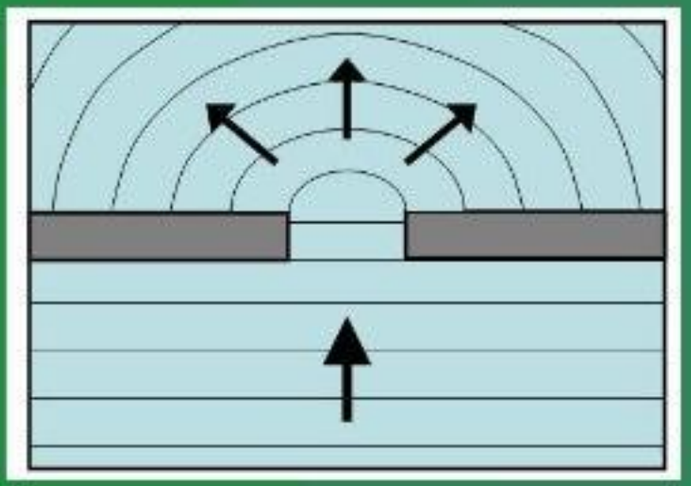


They slow down because the substance would be a different density to another substance.

DIFFRACTION:
Spreads the wave out when going through a gap or barrier

REFLECTION:
Bounces the wave back towards where it came from





All wave can be reflected and refracted

Law of Reflection:
Angle of incidence = Angle of Reflection

Maximum diffraction occurs when: the gap is equal to the wave.

Minimum diffraction occurs when: the gap is smaller or larger than the wave.

Properties of electromagnetic waves:
-they transfer energy from one place to another
-they can be reflected, refracted and diffracted
-they can travel through a vacuum (space)
-the shorter the wavelength the more dangerous they are

Types of electromagnetic waves:

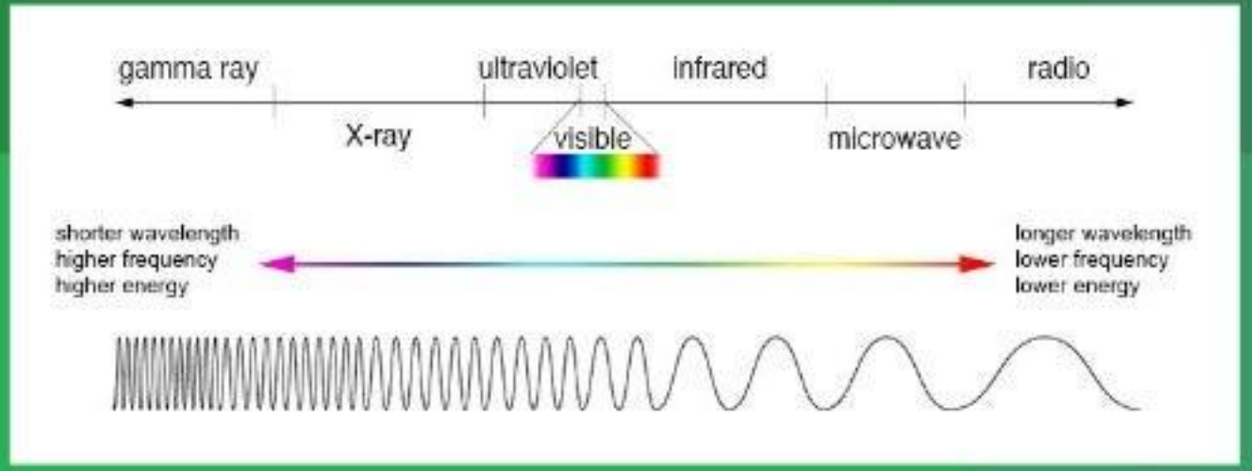
Radiowaves	*Rabbits*
Microwaves	*Mate*
Infrared	*In*
Visible light	*Very*
Ultraviolet	*Unusual*
X-ray	*eXpensive*
Gamma	*Gardens*

P1c: Electromagnetic Waves

The Formula:

Wave Speed = Frequency x Wavelength

Manipulate the formula to the questions need



TIR: stands for total internal reflection

TIR occurs when the angle of light is larger than the critical angle

The critical angle is the angle at which the the wave is neither reflected or refracted

If the angle:
-is bigger than the critical angle the light is reflected
-is smaller than the critical angle the light is refracted

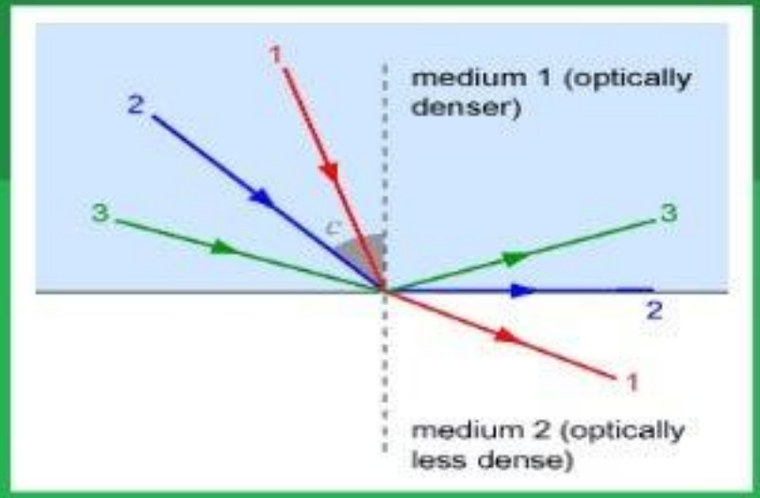
If all the ave is reflected then it is called Total Internal Reflection

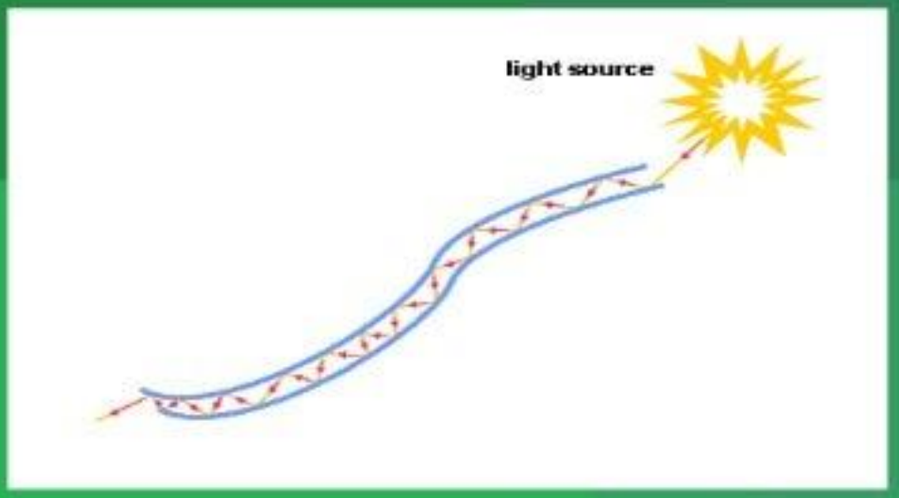
P1d: TIR and Fibre Optics

Fibre Optics:
fibre optics are solid cables that are made of the a substance that is denser than the air around.
The cables must be thin because the thinner the wire the more likely it will reflects

*this is opposite for thicker cables

Uses of TIR:
-Endoscopes to look into peoples bodies and look for any defects
-Communications
-TV





P1d: Using Light

Light has been used for sending messages. This allowed messages to be sent quickly.
However the disadvantage of this was that a code as needed.

Lasers are another way of using light.

Lasers are:
-in phase; in sync- all crests and trough match up
-Monochromatic; one colour usually red but also green, blue and purple
-Coherent; in phase
-Low Divergence; doesn't spread out, narrow beam of light even over long distances

White light spreads out when travelling long distances.

CDs and DVDs have microscopic pits which act like the absence of light in morse code. The laser reflect s when it hits a shiny surface and doesn't reflect when it hits a pit. This then sends a message to computer chips which then send a visual or audio track to the player.

Lasers are used in CDs and DVDs

White/Shiny: are poor radiators and poor absorbers energy
Black/Matt: are good radiators and good absorbers of energy

P1e: Cooking with Infrared and Microwaves

Radiation:
Heat travels in a wave; it is the transfer of kinetic energy; doesn't use particles; you can feel its effects (warmth)

Frequency:
The higher the frequency the more energy is has and the more dangerous it is

Wavelength: must be short

Infrared Radiation	Microwaves
Shiny surfaces at the bottom; reflects infrared rays back towards food	Kinetic energy is given to water or fat molecules
Helps heat surfaces of the food	energy is transferred by conduction or convection
Energy is transferred by conduction (solid) and convection (fluids)	Shiny surfaces reflect any waves back to food
Travels to the centre of the food	Sent 1 cm into the food

P1e: Phone Signals

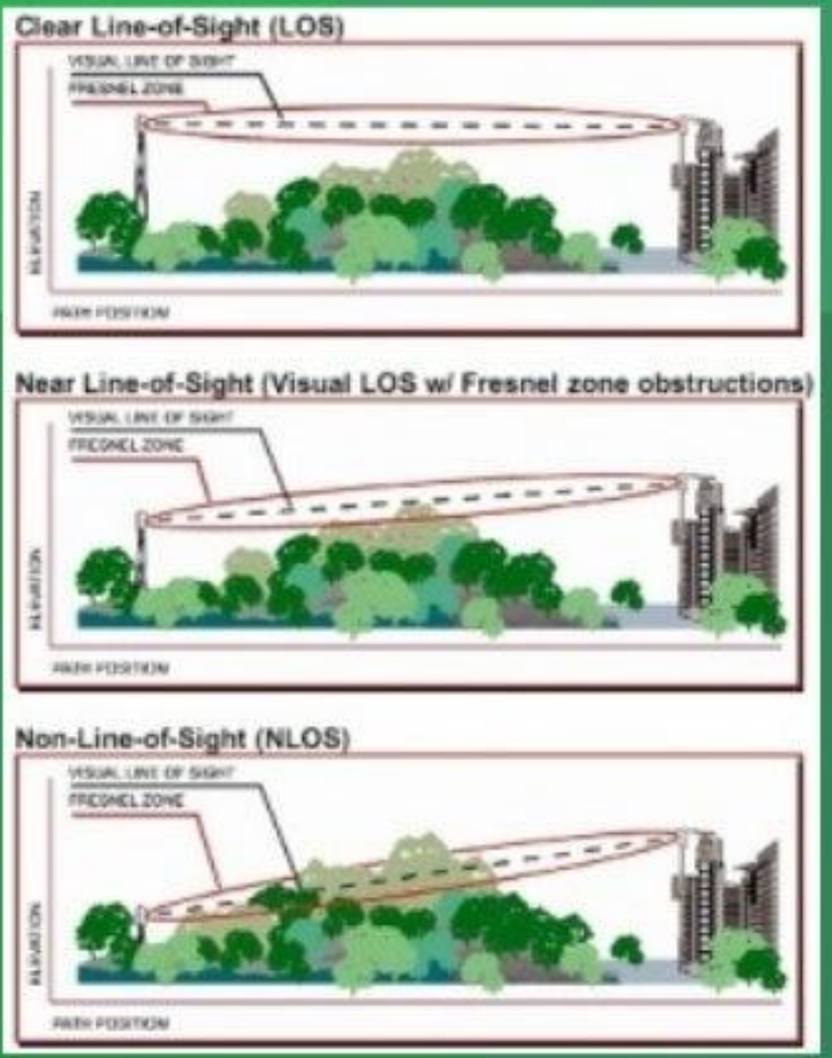
Phone signals travel at $3x10^8$ m/s

The waves are transmitted and received.
If the are not 'in line of sight' the signal may be lost.

All types of phones receive waves

When you talk into your phone; it converts the sound into a microwave signal and is sent to the nearest phone mast.

Microwave signals are affected by:
-Poor weather conditions
-large surfaces of water



Weather conditions can scatter the signal
Radiowaves spread out (diffract) signals when passing through a gap i.e. between buildings

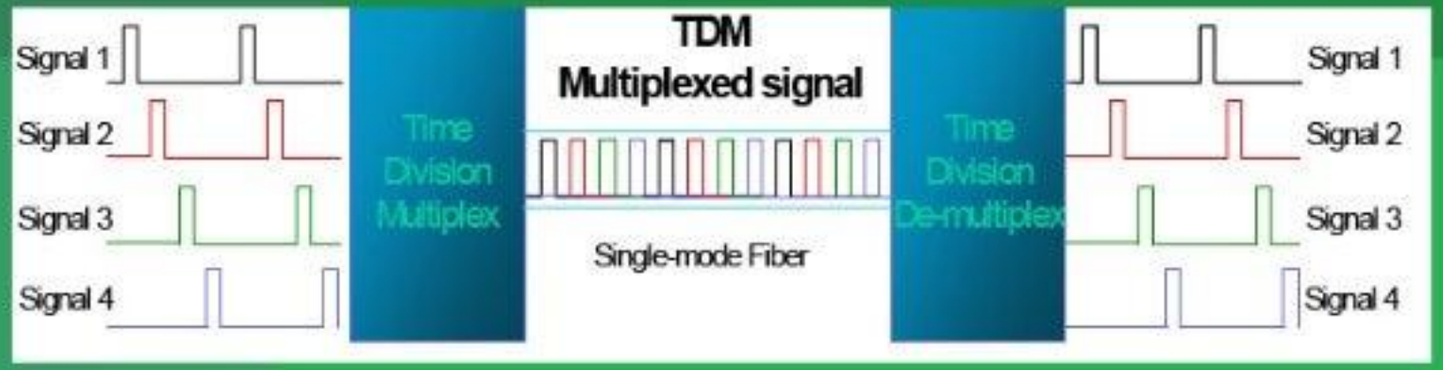
Mobile phones can damage your brain by heating; but there is not answer that is set in stone that they can radically damage your brain

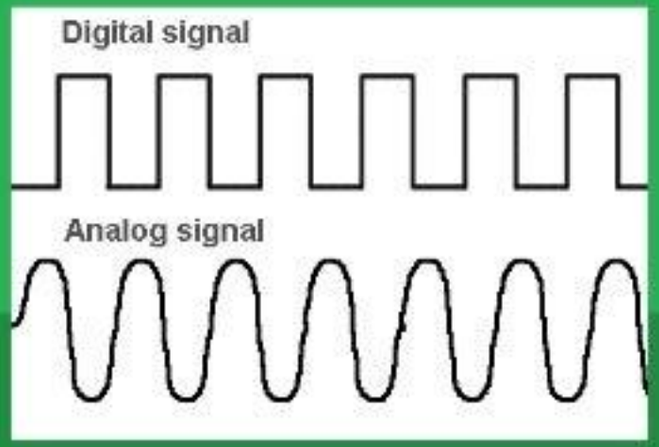
P1f: Analogue and Digital Signals

Analogue Signals: are signals that continuously changes in values i.e. analogue clocks.;
It can be anything from the lowest value to the highest value.

Digital Signals: have signals that are of set values i.e. on/off
Morse code is a digital signal

Multiplexing:
is when joining multiple digital signals together in one transmission





How they are Converted:

Analogue

ADC (analogue-digital converter)

Digital

DAC (digital-analogue converter)

Analogue

P1g:
Wireless Communication

Radiowave	part of the electromagnetic spectrum; mainly used for communication
Refraction	the change in direction of a wave when passing through one medium to another of different density
Frequency	the number of waves passing through a point in a space of time i.e 300 m/s
Microwaves	the shortest wavelength of radiowaves in the electromagnetic spectrum
Aerial	a device for receiving and transmitting radio signals
Ionosphere	a layer of the upper atmosphere
Interference	poor radio reception caused by overlapping waves
Electromagnetic Spectrum	the complete range of observed electromagnetic aves
Wavelength	Distance occupied by one complete cycle of a wave
Ghosting	the effect of two signals from the same source which have travelled distances to reach an aerial

P1g: Wireless Communication

Wireless Technologies:
- -appliances that communicate without wires
- -televisions and radios use radiowaves
- -mobile phones use microwaves
- -laptops and computers use microwaves
- -smartphones use microwaves and radiowaves

*appliances that use wireless communication need an aerial to receive signals

Long distance communication
- -signals can be refracted by different layers in the atmosphere allowing them to travel further
- -ionosphere refracts radiowaves
- -microwaves can be used to send signals to satellites

Problems that can occur:
- -signal can spread out
- -waves can refract when passing through different layers of atmosphere
- -makes it difficult to send signals when you want to
- -drop in quality

Appliances that use wireless means:
- -TVs and radios
- -Smartphones
- -laptops

Advantages:
- -no wired connection needed
- -portable and convenient
- -can be used on the move i.e. train, bus
- -can receive more than one signal at a time

Disadvantages:
- -wireless signals can be reflected or refracted off buildings or by the atmosphere
- -drop-in-quality: signal becomes weak or lose energy
- -too many reflections can drop in quality
- -signal be blocked by hills or buildings

Line of sight is a 'line' that is free from any obstructions i.e. tall building or trees

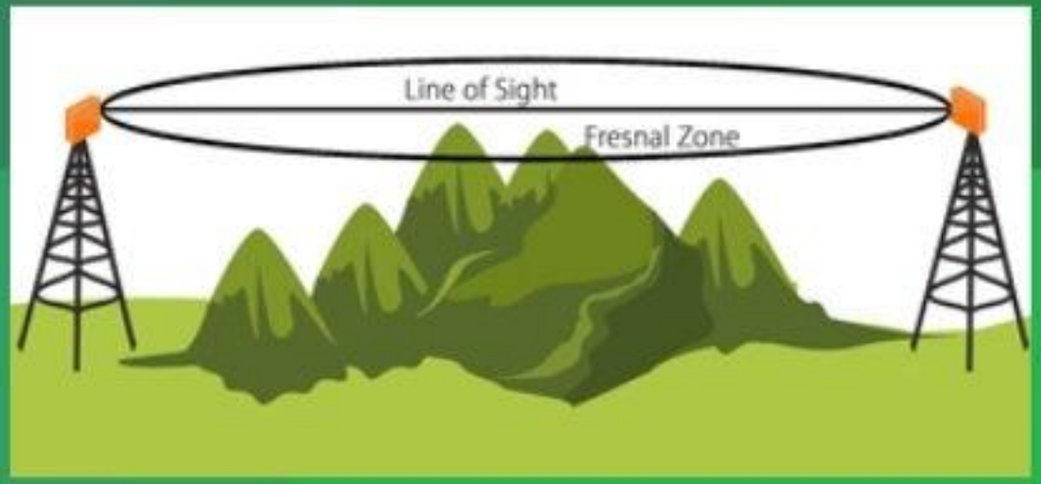
We use Bluetooth or Wi-Fi for short range communication. To send long distance communication we use different methods

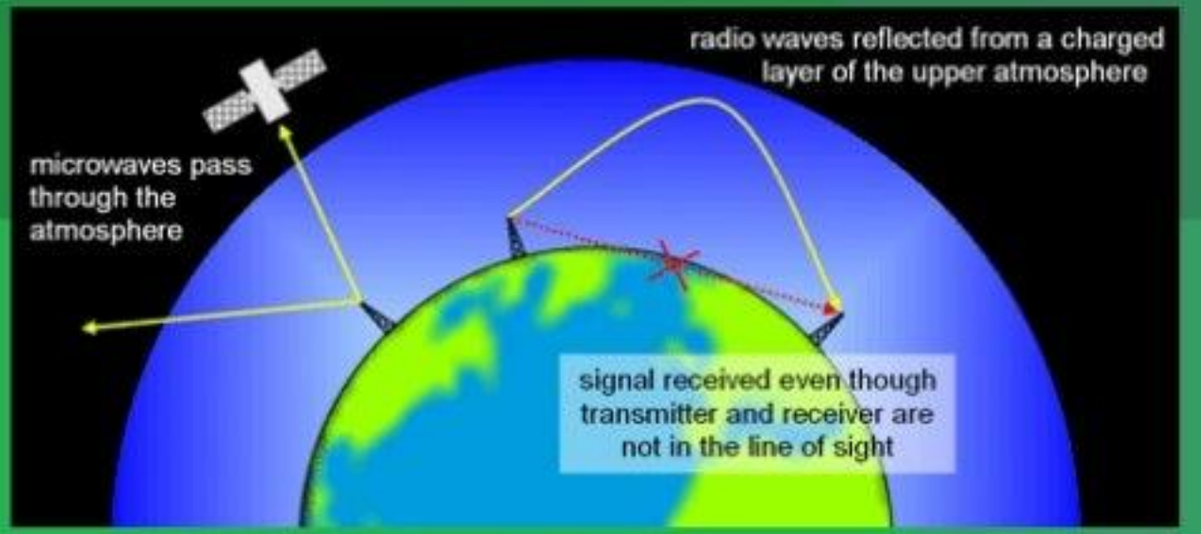
When there are obstructions the signal can drop in quality; so to fix this the microwave transmitters are placed close together on high hills to avoid the obstructions. Line of sight is an assured way of sending signals but we are not always in sight of them

You can't send a signal to a receiver if it far away because the Earth's curvature gets in the way like a large wall of water between the transmitter and aerial. Also only certain waves can be reflected in different parts of the atmosphere i.e. radiowaves are reflected off the ionosphere.

P1g: Receiving Signals

An advantage of wired communication is that you can send rapid amount of data very quickly



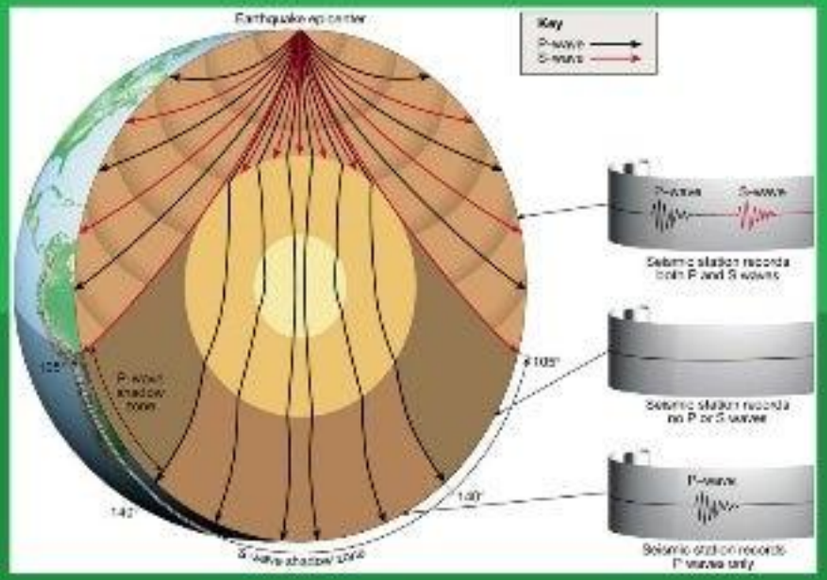


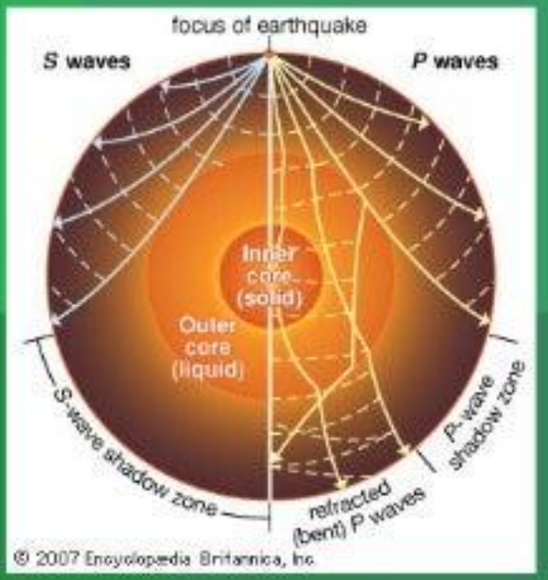
There are two major waves:
P-Waves: they are the primary waves
S-Waves: they are the secondary waves

P-Waves are the 'invincible' waves as they travel through solids and liquids.
S-Waves: these are the less 'invincible' waves as they can only go through solids

The other wave is an L-Wave: this travel the surface of the Earth. This help find the epi-centre of the earthquake after looking at the P and S waves.

P-Waves are longitudinal In longitudinal waves, the vibrations are along the same direction as the direction of travel.





P1h: Earthquakes

S-Waves are transverse In transverse waves, the vibrations are at right angles to the direction of travel.

They are recorded by seismometers. These are embedded into bedrock (rock that doesn't fall loose) . The simplest version is: a pen in a box with a roll of paper; and when a wave hits the pen will record it by marking the paper when dangling side to side

P1h: UV Radiation on People

UV radiation can damage people in a variety of ways;
it can affect us damaging our:
-skin
-eyes
are just two ways

Skin:
UV radiation can damage cells in our skin; this damage can cause cancer so you have to be wary when out in the sun. It can also cause our skin to age quicker

Eyes:
UV radiation can also affect your eyes; the damage by the radiation can cause cataracts

The sun gives off radiation

Sun cream and sunblock filter the radiation

People with *naturally dark skin* already have inherently high levels of melanin, and so are able to spend a longer amount of time in the sun before burning, if they burn at all. *Fair-skinned* people don't have it quite so easy - burning can occur within a relatively short amount of time.

SPF: this is what tells you how much more longer you can stay in the sun.

You get the burn time from the radiation; then multiply it by the SPF number on your sun cream *(SPF: Skin Protection Factor)*

Sunbeds use UV lights to give people a tan. It is an artificial sun that has increased in use; it is also the reason why skin cancer is increasing

Melanin is produced in your body; it is natural chemical that acts like sun cream

UV rays, for example, are necessary for our body to produce vitamin D, a substance that helps strengthen bones and safeguards against diseases