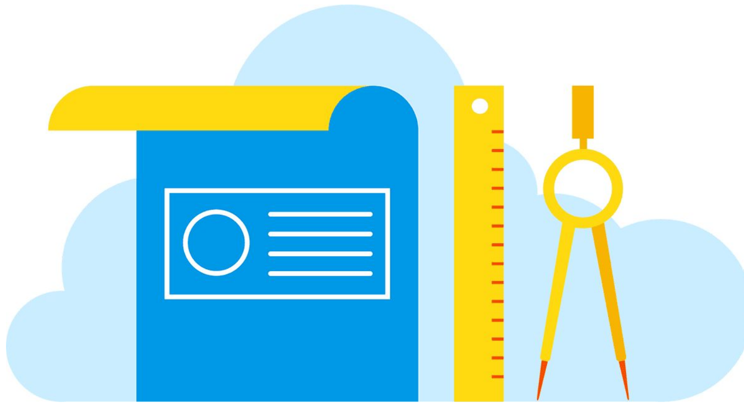


Waves

AQA Separate Physics

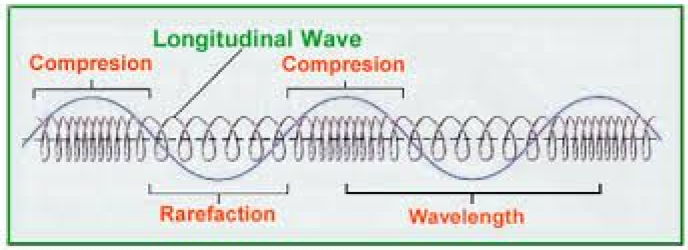
What are waves and what do they all have in common?

Waves are oscillations that transfer energy without transferring any matter. They make the particles of the object they are travelling through vibrate/oscillate. For example, ripples of water cause floating objects to bob up and down, not to move across the water. This proves that only the wave moves, not the water.

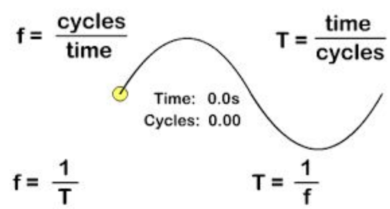
What are the two broad categories of waves?

The two broad categories of waves are transverse and longitudinal. Waves transfer energy in the same direction that they travel, so transverse waves oscillate at right angles (or perpendicular) to the direction that they travel.

Then there is longitudinal waves. These waves have oscillations parallel to the direction of travel.They also have parts of the wave where compressions take place (the particles are bunched together) and places where rarefraction takes place (the particles are spread out). Examples of longitudinal waves include sound waves and springs.



Which two equations are important when working with waves?

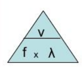


When working with waves, one of the most important calculations is the wave's period. This is the time it takes for a full cycle of a wave to be completed. We find this using the following equation : Another important equation is the speed of the wave or the speed at which energy is transferred :

V = speed of wave (m/s)

f = frequency of wave (Hz)

λ = wavelength (m)



$$v = f\lambda$$

Describe the experiments to help you calculate the speed of a wave in water and on a string.

To calculate the speed of a wave in water, you would need a lamp, signal generator, water, a ripple tank, a clear screen and a metre ruler. First, fill your ripple tank with 5mm of water. Then, connect your dipper to the signal generator and set it off at a known frequency. Dim the lights and turn on the lamp - you'll see a wave pattern made by the shadows on the screen of the wave tank. The distance between each shadow line is equal to one wavelength (the distance between one peak of a wave and the next), you should then measure the distance between shadow lines that are 10 wavelengths apart to get a more accurate result. To find the average wavelength, divide this number by 10. Finally, you can use the wavelength formula, mentioned previously, to find the speed of the ripples.

You can also measure waves on a string. To do this, you'd need a piece of string and vibration transducer (this converts the electrical signal to vibrations). To make sure your string is tight enough to form waves, connect one end to the vibration transducer and attach it to a pulley, weighed down by masses. Once this is set up, adjust the frequency of the signal generator until there's a clear wave on the string. Then, measure the wavelength of the waves on the string by measuring the length of 4-5 half wavelengths in one go and dividing to get the average. Finally, double this answer to get the full wavelength. The frequency will be read on the signal generator and you can find the speed.

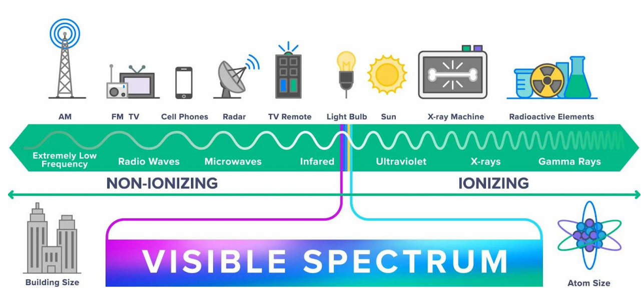
Longitudinal waves: Ultrasound and Seismic waves

Ultrasound waves are sound waves that cannot be heard by people as they have frequencies greater than 20kHz. These can be used bby fishing boats to measure the depth of the water they're in and to locate objects in the water. This is done by a pulse of sound waves being emitted into the water from the boat, and then the time taken for the echo to return is measured.

Seismic waves (S-waves - transverse, P-waves - longitudinal) are produced by earthquakes and are used to detect the origin of earthquakes. They are able to do this as the waves are detected at different points on the planet's surface using seismometers. It also helps scientists develop an understanding of the inner structure of the earth.

Electromagnetic waves

Electromagnetic waves are a group of transverse waves that consist of vibrating electric and magnetic fields. These waves form a continuous spectrum of waves with different wavelengths. The ones with longer wavelengths have shorter frequencies (Radiowaves and microwaves), whilst those with shorter wavelengths have longer frequencies (X Rays and gamma rays). Each electromagnetic wave has a different use. For example, radio waves are used for communication (radios), microwaves are used for wireless networks, infrared are used for remote controls and security systems, visible light is used for photography and illumination, Ultra violet is used for medical and dental



practises, X rays are used to examine the body and gamma rays are used to treat cancer.

However, waves including X Rays and Gamma Rays can be dangerous as they can pass through the human body and damage cells and tissues.

Infrared

All objects absorb/emit infrared radiation. The hotter the object, the more radiation it emits and the cooler the object, the more it absorbs. Some surfaces absorb and emit radiation better than others. For example, a black surface is better at absorbing/emitting radiation that a white one, similar to a matter surface being better than a shiny one.

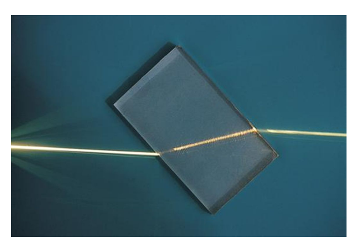
The overall temperature of the earth depends on how much radiation is emitted/absorbed. During the day, more radiation is absorbed to increase the temperature, whereas at night more radiation is emitted, cooling the temperature.

Colour

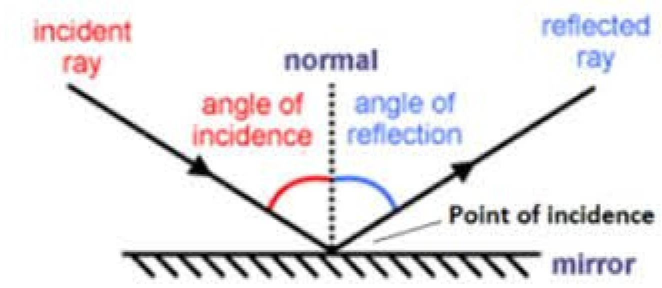
When any wave meets an object, it can either by transmitted, absorbed or reflected. The colour of the object depends on which wavelengths of light are mostly reflected. For example, a red apple appears red because the wavelengths corresponding to the red part of the visible spectrum is most strongly reflected, whilst all other colours are absorbed.

Use diagrams to describe reflection and refraction.

When a wave reaches the boundary between two different materials, it can be transmitted through, however if it hits at an angle, it changes direction; this is refraction.



A wave could also be reflected. This happens when the angle of incidence equals the angle of refraction. This is represented on a ray diagram.



Lenses

Lenses use refraction to bend light rays and form images. One type of lens is a convex lens. This lens bulges outwards it causes rays of light that are parallel to the axis of the lens to come together at the principal focus. The axis of the lens is the line passing through the middle, and the principal focus is the place where rays meet. Another type of lens is a concave lens. It caves inwards to cause parallel rays of light to spread out. Different to the convex lens, the concave lens has a principal focus that shows where the rays come from so you can trace them back to see the meeting point.