AQA Physics GCSE Student Progress

Unit 4.6 - Waves

4.6.1. Waves in Air, Fluids and Solids

4.6.1.1. Transverse and Longitudinal Waves

a	I know that waves may be either transverse (e.g. ripples on a water surface) or longitudinal (e.g. sound waves travelling through air).			
b	I know that longitudinal waves show areas of compression and rarefaction.			
c	I can describe the difference between longitudinal and transverse waves.			
d	I can describe the evidence that shows, for both ripples on a water surface and sound waves in air, it is the wave and not the water or air itself that travels.			

4.6.1.2. Properties of Waves

a	I can identify amplitude and wavelength from given diagrams.			
b	I can describe wave motion in terms of their amplitude, wavelength, frequency and period: • the amplitude of a wave is the maximum displacement of a point on a wave away from its undisturbed position; • the wavelength of a wave is the distance from a point on one wave to the equivalent point on the adjacent wave; • the frequency of a wave is the number of waves passing a point each second.			
c	I can apply the following equation (given on the physics equation sheet): period = 1 / frequency $T = 1 / f$ period, T, in seconds, (s) frequency, f, in hertz, (Hz)			
d	I know that the wave speed is the speed at which the energy is transferred (or the wave moves) through the medium.			
e	I can recall and apply the following equation: wave speed = frequency × wavelength $v = f \lambda$ wave speed, v, in metres per second, (m/s) frequency, f, in hertz, (Hz) wavelength, λ, in metres, (m)			
f	I can describe a method to measure the speed of sound waves in air.			
g	I can describe a method to measure the speed of ripples on a water surface.			

4.6.1.3. Reflection of Waves (Physics Only)

a	I know that waves can be reflected at the boundary between two different materials.			
b	I know that waves can be absorbed or transmitted at the boundary between two different materials.			
c	I can construct ray diagrams to illustrate the reflection of a wave at a surface.			
d	I can describe the effects of reflection, transmission and absorption of waves at material interfaces.			

4.6.1.4. Sound Waves (Physics Only) (HT Only)

a	I know that sound waves can travel through solids causing vibrations in the solid.			
b	I know that, within the ear, sound waves cause the ear drum and other parts to vibrate which causes the sensation of sound.			
c	I know that the conversion of sound waves to vibrations of solids works over a limited frequency range and that this restricts the limits of human hearing.			
d	I know that the range of normal human hearing is from 20 Hz to 20 kHz.			
e	I can describe, with examples (including the effect of sound waves on the ear drum), processes which convert wave disturbances between sound waves and vibrations in solids.			

4.6.1.5. Waves for Detection and Exploration (Physics Only) (HT Only)

a	I know that ultrasound waves have a frequency higher than the upper limit of hearing for humans.			
b	I know that ultrasound waves are partially reflected when they meet a boundary between two different media.			
c	I know that the time taken for the reflections to reach a detector can be used to determine how far away such a boundary is. This allows ultrasound waves to be used for both medical and industrial imaging.			
d	I can explain in qualitative terms how the differences in velocity, absorption and reflection between different types of wave in solids and liquids can be used both for detection and exploration of structures which are hidden from direct observation.			
e	I know that seismic waves (P-waves and S-waves) are produced by earthquakes.			
f	I know that P-waves are longitudinal, seismic waves and that they travel at different speeds through solids and liquids.			
g	I know that S-waves are transverse, seismic waves and that they cannot travel through a liquid.			
h	I know that P-waves and S-waves provide evidence for the structure and size of the Earth's core.			
i	I know that echo sounding using high frequency sound waves is used to detect objects in deep water and measure water depth.			
j	I can describe how the study of seismic waves provided new evidence that led to discoveries about parts of the Earth which are not directly observable.			

4.6.2. Electromagnetic Waves

4.6.2.1. Types of Electromagnetic Waves

a	I know that electromagnetic waves are transverse waves that transfer energy from the source of the waves to an absorber.			
b	I know that electromagnetic waves form a continuous spectrum and all types of electromagnetic wave travel at the same velocity through a vacuum (space) or air.			
c	I know that the waves that form the electromagnetic spectrum are grouped in terms of their wavelength and their frequency. Going from long to short wavelength (or from low to high frequency) the groups are: radio, microwave, infrared, visible light (red to violet), ultraviolet, X rays and gamma rays.			
d	I know that our eyes only detect visible light and so can detect a limited range of electromagnetic waves.			
e	I can give examples that illustrate the transfer of energy by electromagnetic waves.			

4.6.2.2. Properties of Electromagnetic Waves 1

a	I know that different substances may absorb, transmit, refract or reflect electromagnetic waves in ways that vary with wavelength (HT Only).			
b	I know that some effects, for example refraction, are due to the difference in velocity of the waves in different substances (HT Only).			
c	I can use wave front diagrams to explain refraction in terms of the change of speed that happens when a wave travels from one medium to a different medium (HT Only).			
d	I can construct ray diagrams to illustrate the refraction of a wave at the boundary between two different media.			

4.6.2.3. Properties of Electromagnetic Waves 2

a	I know that radio waves can be produced by oscillations in electrical circuits (HT Only).			
b	I know that when radio waves are absorbed they may create an alternating current with the same frequency as the radio wave itself, so radio waves can themselves induce oscillations in an electrical circuit (HT Only).			
c	I know that changes in atoms and the nuclei of atoms can result in electromagnetic waves being generated or absorbed over a wide frequency range (such as gamma rays originating from changes in the nucleus of an atom).			
d	I know that ultraviolet waves, X-rays and gamma rays can have hazardous effects on human body tissue and that these effects depend on the type of radiation and the size of the dose.			
e	I know that radiation dose (in sieverts) is a measure of the risk of harm resulting from an exposure of the body to the radiation. 1000 millisieverts (mSv) = 1 sievert (Sv)			
f	I know that ultraviolet rays, X-rays and gamma rays are ionising radiation that can cause the mutation of genes that can lead to cancer.			
g	I can draw conclusions from given data about the risks and consequences of exposure to radiation.			

4.6.2.4. Uses and Applications of Electromagnetic Waves

a	I can describe some practical applications of electromagnetic waves. For example: • radio waves – television and radio; • microwaves – satellite communications, cooking food; • infrared – electrical heaters, cooking food, infrared cameras; • visible light – fibre optic communications; • ultraviolet – energy efficient lamps, sun tanning; • X-rays and gamma rays – medical imaging and treatments.			
b	I can explain why each type of electromagnetic wave is suitable for the practical applications listed above (HT Only).			

4.6.2.5. Lenses (Physics Only)

a	I know that a lens forms an image by refracting light.			
b	I know that in a convex lens, parallel rays of light are brought to a focus at the principal focus and that the distance from the lens to the principal focus is called the focal length.			
c	I know that the image produced by a convex lens can be either real or virtual.			
d	I know that the image produced by a concave lens is always virtual.			
e	I can construct ray diagrams to illustrate the similarities and differences between convex and concave lenses.			
f	In ray diagrams; a convex lens will be represented by:  and a concave lens will be represented by: 			
g	I can apply the equation (given on the physics equation sheet) to calculate the magnification produced by a lens: $\text{magnification} = \frac{\text{image height}}{\text{object height}}$			
h	I know that image height and object height should both be measured in either mm or cm but that magnification is a ratio and so has no units.			
i	I can describe an experiment to investigate the magnification produced by a range of convex lenses.			

4.6.2.6. Visible Light (Physics Only)

a	I know that each colour within the visible light spectrum has its own narrow band of wavelength and frequency.			
b	I know that reflection from a smooth surface in a single direction is called specular reflection.			
c	I know that reflection from a rough surface causes scattering and that this is called diffuse reflection.			
d	I know that colour filters work by absorbing certain colours (wavelengths) and transmitting other colours (wavelengths).			
e	I can explain the effect of viewing objects through filters or the effect on light of passing through filters.			
f	I know that the colour of an opaque object is determined by which wavelengths of light are more strongly reflected and that wavelengths that are not reflected are absorbed.			
g	I know that if all wavelengths are reflected equally the object appears white, whilst if all wavelengths are absorbed the object appears black.			
h	I can explain how the colour of an object is related to the differential absorption, transmission and reflection of different wavelengths of light by the object.			
i	I know that objects that transmit light are either transparent or translucent.			

4.6.3. Black Body Radiation (Physics Only)

4.6.3.1. Emission and Absorption of Infrared Radiation (Physics Only)

a	I know that all bodies (objects), no matter what temperature, emit and absorb infrared radiation.			
b	I know that, the hotter the body, the more infrared radiation it radiates in a given time.			
c	I know that a perfect black body is an object that absorbs all of the radiation incident on it; it does not reflect or transmit any radiation.			
d	I know that, as a good absorber is also a good emitter, a perfect black body would be the best possible emitter.			

4.6.3.2. Perfect Black Bodies and Radiation (Physics Only)

a	I know that all bodies (objects) emit radiation and that the intensity and wavelength distribution of any emission depends on the temperature of the body.			
b	I know that a body at constant temperature is absorbing radiation at the same rate as it is emitting radiation (HT Only).			
c	I know that the temperature of a body increases when the body absorbs radiation faster than it emits radiation (HT Only).			
d	I know that the temperature of the Earth depends on many factors including: the rates of absorption and emission of radiation, reflection of radiation into space (HT Only).			
e	I can use everyday examples to explain how the temperature of a body (such as the Earth) is related to the balance between incoming radiation absorbed and radiation (HT Only).			
f	I can use information, or draw / interpret diagrams to show how radiation affects the temperature of the Earth's surface and atmosphere (HT Only).			