

Definitions and Concepts for CAIE Physics GCSE

Topic 3: Properties of Waves, Including Light and Sound

*Definitions in **bold** are for extended students only*

3.1 General Wave Properties

Amplitude: The maximum displacement of a wave from its undisturbed (equilibrium) position.

Diffraction: It is the bending of waves around gaps or corners. **It occurs when the size of the aperture or obstacle is of the same order of magnitude as the wavelength of the incident wave.**

Frequency: The number of waves passing a given point in a second. It is the inverse of the wave's time period.

Longitudinal waves: Waves with oscillations that are parallel to the direction of travel/energy transfer.

Reflection: The bouncing back of a wave at a boundary.

Refraction: The changing of speed, and consequently the direction, of a wave as it changes medium. The wavelength of the wave will also change but the frequency remains constant.

Speed of a wave: The speed is the distance traveled by a given point on the wave in a given interval of time.

Transverse waves: Waves with oscillations that are perpendicular to the direction of travel/energy transfer.

Vibration: Is a mechanical phenomenon whereby oscillations occur about an equilibrium point.

Water waves: They are waves propagating on the water surface.

Wave: A process of energy transfer through oscillations, without matter being transferred with it.

Wavefront: An imaginary surface representing points of a wave that are at the same point in their cycle.

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Wavelength: The distance from a point on one wave to the same point on the adjacent wave (ie. peak to peak or trough to trough).

3.2 Light

3.2.1 Reflection of Light

Angle of incidence: The angle which an incident line or ray makes with a perpendicular to the surface at the point of incidence.

Angle of reflection: The angle made by a reflected ray with a perpendicular to the reflecting surface.

Optical image: It is the apparent reproduction of an object, formed by a lens or mirror system from reflected, refracted, or diffracted light waves.

Plane mirror: It is a flat reflective surface. **The image formed by a plane mirror is always virtual, upright, and of the same shape and size as the object it is reflecting.**

3.2.2 Refraction of Light

Critical angle: The angle of incidence beyond which all the wave is totally internally reflected when it meets a boundary.

Optical fibres: A thin flexible fibre with a glass core through which light signals can be transmitted along its axis, by the process of total internal reflection.

Parallel: Two lines that are always the same distance apart and never meet.

Refractive Index: The ratio of the speed of the wave in a vacuum to the speed of the wave in a given medium.

Transparent: A material allowing light to pass through.

Total internal reflection: The process of all a wave being reflected when it meets a boundary. It occurs when the angle of incidence is greater than the critical angle, and only when going from a higher refractive index to a lower one.

3.2.3 Thin Converging Lens

Diminished: Made smaller or less.

Enlarged: Having become or been made larger.

Focal length: Is the distance between the centre of the lens and the principal focus.

Focus: Is the point where light rays originating from a point on the object converge.



Magnifying glass: It is a convex lens that lets the observer see a larger image of the object under observation.

Principal focus: Is the point where rays of light travelling parallel to the principal axis intersect the principal axis and converge.

Real Image: An image produced by light-rays physically converging. Real images are ones that can be projected onto a screen.

Single lens: A lens that consists of a single piece of transparent material.

Thin converging lens: Lens that focuses the diverging, or blurred, light rays from a distant object by refracting (bending) the rays.

Virtual image: An image produced by the apparent, but not actual, divergence of light-rays. Virtual images cannot be projected onto a screen.

3.2.4 Dispersion of Light

Dispersion: Is defined to be the spreading of white light into its full spectrum of wavelengths.

Glass prism: Is a transparent optical element with flat, polished surfaces that refract light.

Monochromatic light: Is light where the optical spectrum contains only a single optical frequency.

Spectrum: Is the range of frequencies of electromagnetic radiation and their respective wavelengths and photon energies.

3.3 Electromagnetic Spectrum

Electromagnetic spectrum: A group of transverse waves that cover a large range of frequencies and wavelengths. The highest frequency waves in the spectrum are gamma-rays and the lowest are radio waves. **Speed of electromagnetic waves in a vacuum is 3.0×10^8 m/s and is approximately the same in air.**

Infrared: Used for cooking food, thermal imaging and short range communications. It can cause skin burns.

Microwaves: Used for satellite communications and for cooking food. They can cause internal heating of body cells.

Radio Waves: Used for television and radio signals. **They can be produced by oscillations in electrical circuits, or can induce these oscillations themselves.**

Vacuum: Space in which there is no matter



Wavelength: The distance from a point on one wave to the same point on the adjacent wave (ie. peak to peak or trough to trough).

X-Rays: Used for medical imaging and security scanners. They can cause cell damage and mutations.

3.4 Sound

Audible frequencies: It is a periodic vibration whose frequency is in the band audible to the average human, the human hearing range, which is 20Hz to 20000Hz

Compressions: They are regions of high pressure due to particles being close together.

Echo: Is a distinct, reflected sound wave from a surface.

Loudness: A measure of the amplitude of the oscillations of a sound wave. The larger the amplitude, the louder the sound will be.

Pitch: A measure of the frequency of the oscillations of a sound wave. The higher the frequency, the higher the pitch of the sound.

Rarefactions: They are regions of low pressure due to particles being spread further apart.

Sound waves: The longitudinal waves responsible for sound. They are produced by vibrating sources and they require a medium to travel through, transmitted by the vibrations of the medium's particles.

Speed of sound: The speed of sound is the distance travelled per unit of time by a sound wave as it propagates through a medium.

Ultrasound waves: Waves that have a frequency higher than the upper limit of human hearing (20kHz).

