Unit 1: Principles and Applications of Science I

C1: Working with Waves

☐ Define and use key wave terms: **frequency, wavelength, amplitude, period, wave speed**

☐ Use and rearrange the **wave speed equation**:

$$v = f \times \lambda$$

☐ Describe and compare **transverse and longitudinal waves**, giving examples of each

☐ Interpret **wave diagrams** and identify wavelength, amplitude and frequency

☐ Understand that **waves transfer energy but not matter**

☐ Describe **reflection** of waves from different surfaces

☐ Describe **refraction** at a boundary between materials

☐ Understand **interference** and **superposition** in terms of constructive and destructive effects

☐ Describe **diffraction**, including the effect of **gap size and wavelength** on the spreading of waves

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C2: Waves in Communication

☐ Understand **total internal reflection (TIR)** and the conditions needed for it to occur

☐ Explain how TIR is used in **optical fibres** for data transmission

☐ Explain how **signal loss** can occur in fibres due to:

- ☐ absorption
- ☐ scattering

☐ Explain how **modal dispersion and material dispersion** reduce signal quality

☐ Use and apply the **refractive index equation**:

n = c / v

☐ Explain how **cladding** improves communication signal transmission

☐ Interpret **ray diagrams** for refraction and TIR in optical fibres

☐ Understand why **shorter wavelengths** allow transmission of more information

C3: Electromagnetic Waves in Communication

☐ Recall the **order of the EM spectrum** and that all EM waves travel at the same speed in a vacuum

☐ Describe uses of different parts of the EM spectrum in communication

☐ Understand that **signal strength decreases with distance**

☐ Use and apply the **inverse square law**:

$$I \propto 1/d^2$$

☐ Explain how the **amplitude** or **intensity** of a wave affects the strength of a received signal

☐ State that EM waves are **transverse** and can be **polarised**

☐ Explain the advantages and limitations of EM waves in communication systems (e.g., range, absorption, interference)

☐ State safety considerations and risks associated with parts of the EM spectrum (e.g., microwaves, UV)