A-LEVEL PHYSICS • HOLIDAY HOMEWORK 假期作业

7 Waves – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
wave	波			
amplitude	振幅			
wavelength	波长			
frequency	频率			
period	周期			
transverse wave	横波			
longitudinal wave	纵波			
progressive wave	行波			
electromagnetic spectrum	电磁波谱			
Polarisation	偏振			

Recall

At IGCSE you studied waves. Bring this with you:

- A **wave** 波 carries energy from place to place without moving matter along with it.
- You used wavelength and frequency, and the wave equation $v = f\lambda$.

At AS we define the wave quantities carefully and meet a new idea: polarisation.

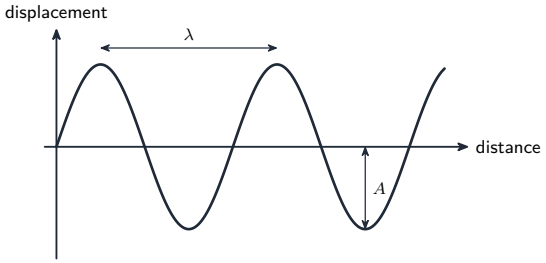
New ideas

Read these first. Each idea has a short worked example. Then do the Practice.

1 Describing a wave

- **amplitude** 振幅: the largest distance a point moves from its rest position.
- **wavelength** 波长 λ: the length of one complete wave.
- **frequency** 频率 f: the number of waves passing each second, in hertz (Hz).
- **period** 周期 T: the time for one complete wave, with $T = \dfrac{1}{f}$.

These link through the wave equation $v = f\lambda$.

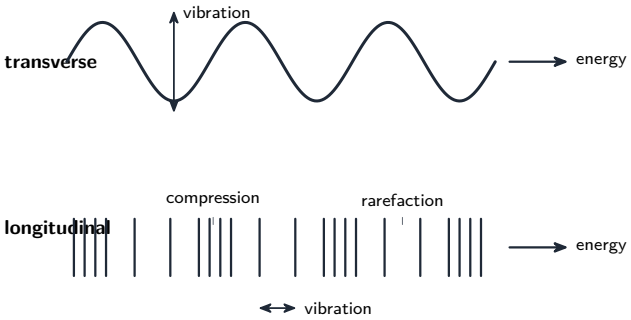


Worked example. A wave has $f = 50$ Hz and $\lambda = 6.0$ m: $v = f\lambda = 50 \times 6.0 = 300$ m s^{-1}, and $T = \dfrac{1}{50} = 0.020$ s.

Watch out: in $v = f\lambda$ keep the units matched — f in Hz and λ in metres give v in m s^{-1}.

2 Transverse and longitudinal waves

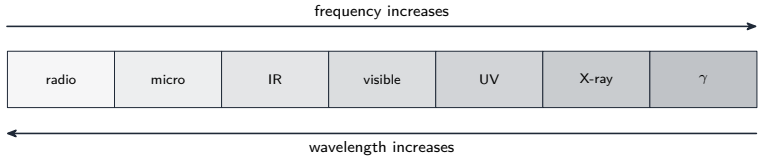
- In a **transverse wave** 横波 the points move at right angles to the wave's travel (light, water waves).
- In a **longitudinal wave** 纵波 the points move along the travel direction (sound).
- A **progressive wave** 行波 is one that travels and carries energy.



Worked example. Shaking a rope up and down sends a transverse wave (the rope moves across the travel); pushing a slinky back and forth sends a longitudinal wave (the coils move along the travel).

■ 3 The electromagnetic spectrum and polarisation

All electromagnetic waves (radio, micro, infrared, visible, ultraviolet, X-rays, gamma) travel at 3.0×10^8 m s^{-1} in a vacuum; arranged by wavelength they form the **electromagnetic spectrum** 电磁波谱.



Only transverse waves can be polarised. **Polarisation** 偏振 makes all the oscillations lie in a single plane; a polarising filter lets through only that plane and blocks the rest.

Worked example. Two polarising filters at right angles block almost all light: the first passes one plane, and the second (crossed) blocks that plane.

Practice

7.1 A sound wave has frequency 200 Hz and wavelength 1.7 m. Find its speed. [2]

7.2 A wave has frequency 25 Hz. Find its period. [1]

7.3 Light travels at 3.0×10^8 m s^{-1}. Find the wavelength of light with frequency 5.0×10^{14} Hz. [2]

7.4 State whether each is transverse or longitudinal: (a) sound, (b) light. [2]

7.5 Light can be polarised but sound cannot. Explain why. [2]

7.6 All colours of light travel at the same speed in a vacuum but have different wavelengths. Explain how this fits the wave equation. [2]

7.7 Challenge. Two polarising filters are first lined up so light passes through. Describe and explain what happens to the brightness as the second filter is slowly rotated by 90°. [2]