14 Waves, sound, and the wave equation – 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			
Transverse	横波			
Longitudinal	纵波			
wavelength	波长			
frequency	频率			
amplitude	振幅			
wave speed	波速			
Electromagnetic waves	电磁波			
Doppler effect	多普勒效应			

Recall

Waves are all around you:

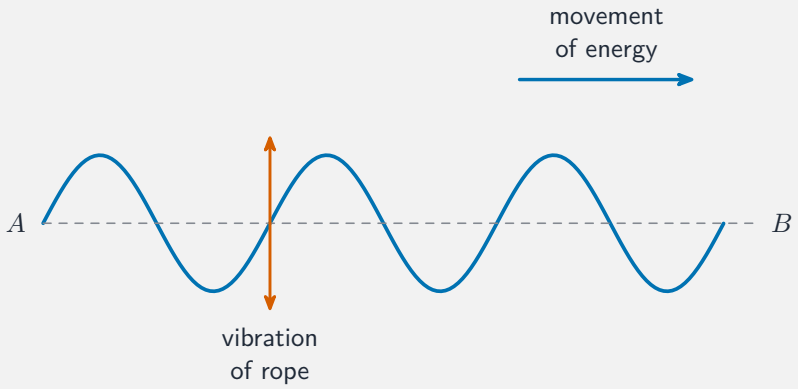
- Ripples spread across a pond; sound travels through the air; light reaches you from a lamp.
- A wave carries **energy** from place to place, but the water or air itself stays put.
- You have used speed = frequency × wavelength before.

This sheet lines up the wave ideas the AP course builds on. Each idea has a worked example.

New ideas

1 What a wave is

A **wave** 波 carries energy without carrying the material along. There are two kinds:



- **Transverse** 横波: the material moves at right angles to the wave (a rope wave, light).
- **Longitudinal** 纵波: the material moves back and forth along the wave (sound).

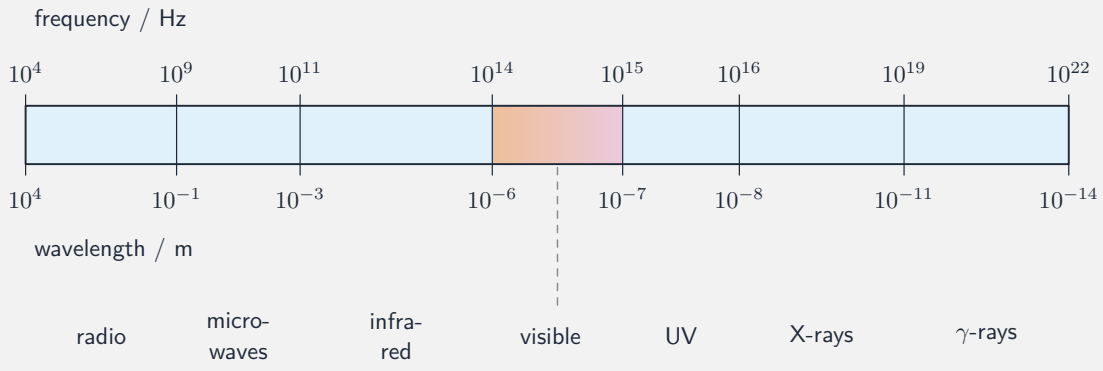
2 Describing a wave

- **wavelength** 波长 λ –the distance between repeats,
- **frequency** 频率 f –cycles per second,
- **amplitude** 振幅 A –the largest displacement (linked to energy),
- **wave speed** 波速: $v = f\lambda$, set by the material the wave travels in.

Worked example. A note of frequency 340 Hz travels through air at 340 m/s, so its wavelength is $\lambda = \dfrac{v}{f} = \dfrac{340}{340} = 1.0$ m.

3 Electromagnetic waves

Electromagnetic waves 电磁波 (radio, light, X-rays) are made of oscillating electric and magnetic fields. They all travel through empty space at the speed of light $c = 3.0 \times 10^8$ m/s and need no material.



■ 4 The Doppler effect

The **Doppler effect** 多普勒效应 is the change in the frequency you hear when a source moves toward or away from you: approaching sounds higher-pitched, moving away sounds lower. It is why a passing siren drops in pitch.

Watch out: when a wave moves into a new material, its **frequency stays the same** (set by the source) but its **speed and wavelength change**. Do not assume the wavelength is fixed.

Practice

Try these in order. The methods are all above.

2.1 State the difference between a transverse and a longitudinal wave, with one example of each. [2]

2.2 A wave has frequency 50 Hz and wavelength 0.40 m. Find its speed. [2]

2.3 A radio wave travels at 3.0×10^8 m/s with frequency 1.0×10^8 Hz. Find its wavelength. [2]

2.4 A siren passes you at speed. Describe how the pitch you hear changes as it approaches and then moves away. [2]

2.5 A sound of frequency 200 Hz passes from air (speed 340 m/s) into water (speed

1500 m/s). State what happens to its frequency and to its wavelength. [2]