

14 Waves, sound, and the wave equation – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary

Write each word three times.

English	Write it 3 times (English)		
wave	_____	_____	_____
Transverse	_____	_____	_____
Longitudinal	_____	_____	_____
wavelength	_____	_____	_____
frequency	_____	_____	_____
amplitude	_____	_____	_____
wave speed	_____	_____	_____
Electromagnetic waves	_____	_____	_____
Doppler effect	_____	_____	_____

Recall

Waves are all around you:

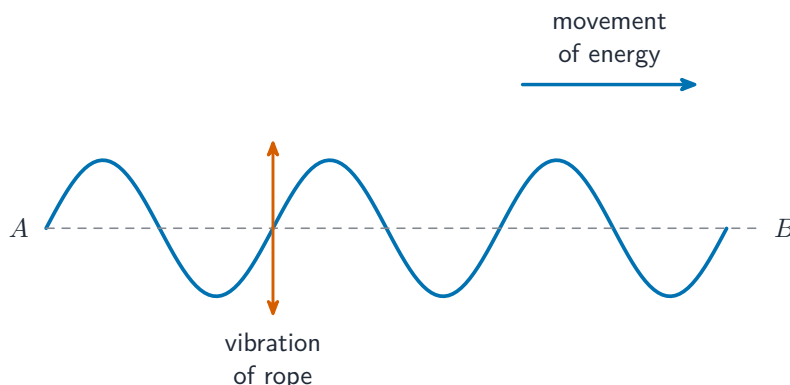
- Ripples spread across a pond; sound travels through the air; light reaches you from a lamp.
- A wave carries **energy** from place to place, but the water or air itself stays put.
- You have used $\text{speed} = \text{frequency} \times \text{wavelength}$ before.

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



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

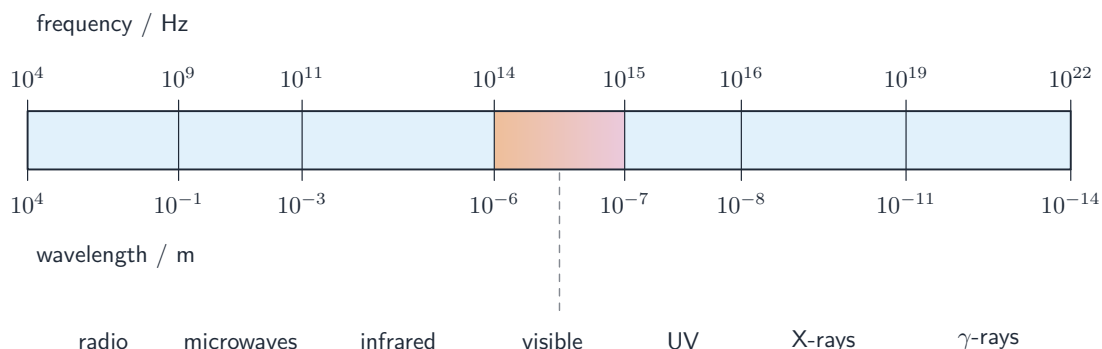
■ 2 Describing a wave

- **wavelength** λ – the distance between repeats,
- **frequency** f – cycles per second,
- **amplitude** A – the largest displacement (linked to energy),
- **wave speed** : $v = f\lambda$, 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 $\lambda = \frac{v}{f} = \frac{340}{340} = 1.0$ m.

■ 3 Electromagnetic waves

Electromagnetic waves (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** 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]
