A-LEVEL PHYSICS • EXERCISE SHEET

7.2 Transverse and longitudinal waves

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

KEY WORDS longitudinal 纵波 • transverse 横波 • electromagnetic wave 电磁波 • wave 波 • compression 压缩

Objective

Build the skills to answer exam questions on **transverse and longitudinal waves** — comparing them and reading their graphs.

You must be able to:

- compare **transverse** 横波 and **longitudinal** 纵波 waves
- give examples of each and identify **compressions** and **rarefactions**
- interpret displacement–distance and displacement–time graphs

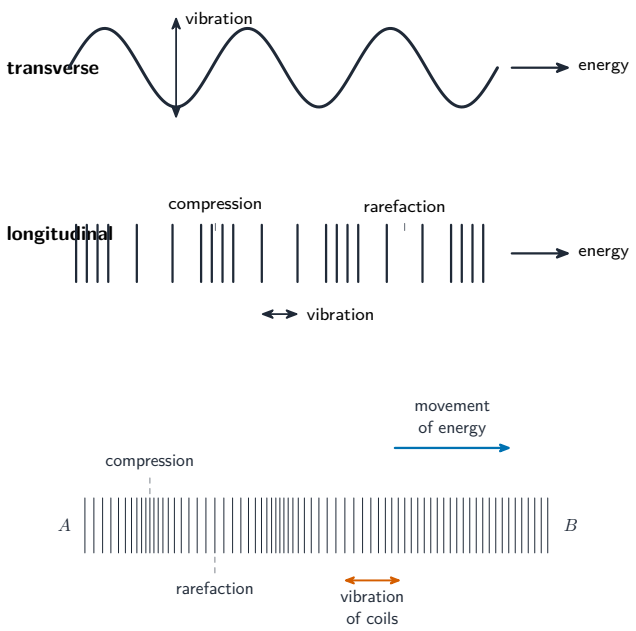
1 Worked examples

Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

Transverse vs longitudinal

- **Transverse:** particles vibrate **perpendicular** to the energy travel (rope, all EM waves, water ripples).
- **Longitudinal:** particles vibrate **parallel** to the energy travel; the wave is **compressions** and **rarefactions** (sound, slinky squashes).

A key difference often tested: only **transverse** waves can be **polarised** (restricted to one plane of vibration); longitudinal waves **cannot** (covered fully in 7.5).



A longitudinal wave on a slinky

Graphs

Both look like a **sine curve**. A **displacement–distance** graph gives the **wavelength** λ; a **displacement–time** graph gives the **period** T (then $f = 1/T$).

2 Practice

Now apply the methods above.

2.1 State the difference between a **transverse** and a **longitudinal** wave. [2]

2.2 Give **one** example of a transverse wave and **one** of a longitudinal wave. [2]

2.3 Name the two features that make up a **longitudinal** wave. [1]

2.4 State what you read from a **displacement–time** graph and from a **displacement–distance** graph. [2]

3 Exam-style questions

3.1 Which of these is a **longitudinal** wave? [1]

- **A** light
- **B** a wave on a rope
- **C** sound
- **D** water ripples

3.2 Sound is a longitudinal wave. Describe how the **air particles** move as the wave passes. [2]

3.3 State whether **all electromagnetic waves** are transverse or longitudinal. [1]

3.4 A displacement–time graph for a wave shows a period of 0.020 s. Calculate the **frequency**. [2]

3.5 State **one** property that a **transverse** wave has but a **longitudinal** wave does not. [1]

Solutions

Each answer shows the steps, then the **result**.

2.1

- **transverse**: particles vibrate **perpendicular** to the energy-travel direction
- **longitudinal**: particles vibrate **parallel** to it

2.2

- transverse — any one: light / EM wave, wave on a rope, water ripple
- longitudinal — sound, slinky compression wave

2.3

- **compressions** and **rarefactions**

2.4

- displacement–time graph → the **period** T (and so frequency)
- displacement–distance graph → the **wavelength** λ

3.1 C

- sound is **longitudinal**: oscillation is **along** the direction of travel
- **A**, **B**, **D** are transverse (they can be polarised; sound cannot)

3.2

- air particles vibrate **back and forth parallel** to the wave's direction
- forming high-pressure **compressions** and low-pressure **rarefactions**

3.3

- **transverse**

3.4

- $f = 1/T$

$$f = \frac{1}{0.020\ \text{s}} = \mathbf{50}\ \text{Hz}$$

3.5

- it can be **polarised** (restricted to one plane of vibration) — a longitudinal wave cannot