

Exercise walk-through

Wave Interference and Standing Waves ■ 14.6

eXercise

You must be able to

- apply the **principle of superposition** 叠加原理 to combine overlapping waves
- distinguish **constructive** 相长 from **destructive** 相消 interference
- describe **standing waves** 驻波 with nodes and antinodes

Method — Superposition

Where waves overlap, their displacements **add**.

Method — Constructive and destructive

- **In phase** → crests meet crests → **constructive** (larger amplitude).
- **Out of phase** → crest meets trough → **destructive** (cancellation).

Method — Standing waves

Two waves travelling in opposite directions form a standing wave with fixed **nodes** (no motion) and **antinodes** (maximum motion) — as on a guitar string or in a pipe.

Practice 2.1 ■ 1 mark

State the principle of superposition.

Solution 2.1

Worked steps

where waves overlap, the total displacement is the sum of the individual displacements **B1**.

Practice 2.2 ■ 1 mark

State the condition for two waves to interfere destructively.

Solution 2.2

Worked steps

they must be exactly out of phase (crest meets trough) **B1**.

Practice 2.3 ■ 1 mark

Define a node on a standing wave.

Solution 2.3

Method: Standing waves

Worked steps

a point on a standing wave that stays at rest (zero displacement) **B1**.

Exam-style 3.1 ■ 1 mark

Two waves meeting in phase interfere

A destructively

B constructively

C not at all

D randomly

Solution 3.1

A destructively

B constructively 

C not at all

D randomly

Worked steps

B.

Exam-style 3.2 ■ 1 mark

A point of zero displacement on a standing wave is a

A antinode

B node

C crest

D trough

Solution 3.2

Method: Standing waves

A antinode

B node 

C crest

D trough

Worked steps

B.

Exam-style 3.3 ■ 1 mark

Two identical waves overlap.

- (a) State the result when they meet in phase.
- (b) State the result when they meet exactly out of phase.
- (c) Name the general principle used.

Solution 3.3

Worked steps

(a) a larger wave (constructive interference) **B1**. (b) they cancel (destructive interference) **B1**. (c) the principle of superposition **B1**.