



Standing Waves

Chapter: Waves • Level ★★★ • Time: 30 min

SCORE

___ / 20

Name _____ Class _____ Date _____

AFTER THIS WORKSHEET YOU CAN

- ✓ Understand: How Standing Waves Form
- ✓ Understand: Nodes and Antinodes
- ✓ Understand: Standing Waves on a String (Fixed at Both Ends)
- ✓ Understand: Fundamental Frequency and Harmonics



Section A • Concept Check

• BEGINNER

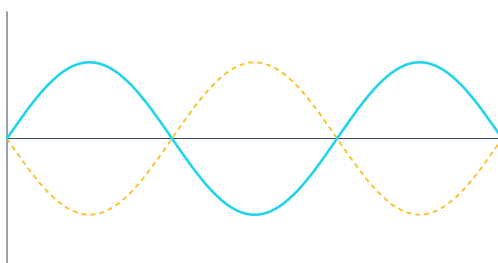
4 × 1 = 4

- 1 A string of length 1.5m is fixed at both ends. Find the fundamental wavelength.

- 2 A string's fundamental frequency is 220Hz. Find its 4th harmonic frequency.

- 3 A string of length 2m has a standing wave with $n=2$. Find its wavelength.

- 4 Why do only specific wavelengths 'fit' on a string fixed at both ends?



A standing wave pattern with nodes and antinodes



Section B • Problem Solving

• INTERMEDIATE

4 × 3 = 12

- 5 A guitar string produces a fundamental frequency of 330Hz. Find its 5th harmonic.

- 6 Why do musical instruments produce specific, distinguishable pitches rather than random noise?

- 7 How many nodes does the fundamental ($n=1$) standing wave have on a string fixed at both ends (not counting the two fixed ends, which are also nodes)?

- 8 How many antinodes does the fundamental ($n=1$) standing wave have?



9 A string has fundamental frequency 150Hz. Is 450Hz one of its harmonics? If so, which one?

10 Why is understanding standing waves essential for designing musical instruments?

Reflection — the most useful thing I learned: _____

A ___/4 B ___/12 C ___/4 **Total ___/20**

Teacher's Signature

Parent's Signature

ANSWER KEY — FOLD OR CUT BEFORE HANDING OUT

1 = 3m 2 = 880Hz 3 = $\lambda_2 = 2 \times 2 / 2 = 2\text{m}$ 4 = Both ends must be nodes (fixed, zero displacement), which only occurs for wavelengths that divide evenly into twice the string length | 5 = 1650Hz 6 = Standing waves only form at specific resonant frequencies (harmonics) determined by the instrument's length and boundary conditions 7 = 0 additional nodes between the ends (just the two endpoints) 8 = 1 antinode (in the middle) | 9 = Yes, the 3rd harmonic ($450 = 3 \times 150$) 10 = It determines exactly what pitches (frequencies) an instrument can naturally produce based on its physical dimensions