

FOCUSED REVIEW

Focused Review: Superposition, Standing Waves, and Sound

Review the most important ideas, reinforce the essential skills, and confirm you're ready to move on.

 TIME 15–20 minutes	 BEST FOR Focused review	 FINISH WITH Greater confidence
---	--	---

After this focused review, you'll be able to...

recognize the key concepts, reinforce your problem-solving skills, and continue with greater confidence.

HOW TO USE THIS GUIDE

Work through the stages in order. Write directly in the spaces provided, check your work in the Solutions section, and finish by choosing the next resource that matches your confidence.

Choose how you want to review: work through this guide, follow the online review, or watch the video review.

[Start the Review Online →](#)

[Watch the Video Review →](#)

YOU WILL NEED

Pencil or pen • Calculator if needed • Approximately 15–20 minutes

FR-02 • UNIT ALIGNMENT

Unit Alignment

This bundle is aligned to the approved Physics Sensei unit specification below. Use it to recover the unit structure, reinforce key decisions, and confirm readiness for the next study task.

ARCHITECTURE: Physics Sensei Independent Mechanics UNIT: MEC-U12 — Superposition, Standing Waves, and Sound RESOURCE: Unit Review PROFILE: Foundational • Conceptual Physics	BEST USED ✓ Before homework on waves or sound ✓ Before a quiz or exam ✓ When interference, resonance, or sound relationships need reinforcement
---	--

Review Prerequisites → Review Prerequisites →

Physics Sensei is an independent educational resource designed to complement independently authored Physics Sensei materials. Physics Sensei content is independently authored and organized under the approved topic architecture.

FR-03 • YOUR REVIEW PLAN

Your Review Plan

Complete these six focused stages in order. Each stage reinforces your understanding and prepares you for a final confidence check.

6 stages • Approximately 15–20 minutes

1 Warm-Up Check — page 4 Refresh key ideas.	2 Core Concepts — page 6 Reinforce the essentials.	3 Guided Practice — page 7 Strengthen key skills.
4 Confidence Check — page 8 Confirm your understanding.	5 Summary — page 10 Remember the essentials.	6 Next Step — page 14 Choose your next step.

PRINTING TIP

For student copies, print double-sided and keep the Solutions section after the student activities so learners attempt each activity before checking their work.

FR-04 • STAGE 1 OF 6

Warm-Up Check

Before you begin, take a minute to reactivate what you already know. This quick warm-up will help you focus on the most important ideas before moving on.

WARM-UP 1**Key Ideas**

Think about what superposition means physically.

Two equal upward pulses overlap completely on a string. What happens to the displacement while they overlap?

WARM-UP 2**Common Mistakes**

Use the geometry of a standing wave.

Where are the points of zero displacement in a standing wave, and where is the oscillation largest?

FR-04 • WARM-UP CHECK CONTINUED

WARM-UP 3

Quick Application

Connect two nearby pitches to beats.

Two nearly equal tones are played together. What observable feature tells you that beats are occurring?

Ready to strengthen your understanding?

You've refreshed the most important ideas. Now reinforce the concepts you'll use most often.

Continue to Core Concepts — page 6 →

FR-05 • STAGE 2 OF 6

Core Concepts

Let's reinforce the most important concepts you'll need to solve problems with confidence. Focus on the ideas that appear most often in homework, quizzes, and exams.

KEY CONCEPT 1

Superposition and interference

When waves overlap, the medium responds to the algebraic sum of their displacements. In-phase waves reinforce; out-of-phase waves reduce the resultant and may cancel ideally.

$$y_{\text{total}} = y_1 + y_2 \quad \bullet \quad \text{interference depends on phase}$$

KEY RELATIONSHIP Relative phase controls the result: in phase gives reinforcement; opposite phase gives cancellation.

EXAMPLE Two equal crests meeting at the same place create a larger crest; a crest meeting an equal trough can momentarily cancel.

SENSEI NOTE Interference changes the resultant while waves overlap; it does not erase the original waves.

KEY CONCEPT 2

Standing waves and resonance

A standing wave forms from compatible waves traveling in opposite directions. Nodes and antinodes stay at fixed positions. Resonance occurs only when the system can support the required boundary pattern.

$$\text{fixed/open-open: } \lambda_n = 2L/n \quad \bullet \quad \text{closed-open: } \lambda_n = 4L/n \text{ (n odd)}$$

KEY RELATIONSHIP Boundary conditions set where nodes and antinodes must occur, which selects only certain wavelengths and resonant frequencies.

EXAMPLE A string fixed at both ends must have nodes at both ends, so only patterns that fit those endpoint conditions can persist strongly.

SENSEI NOTE Sketch the endpoint conditions before trying to remember a harmonic formula.

Ready to apply these ideas?

You've reinforced the essential concepts. Now strengthen your problem-solving skills by working through a few guided examples.

Continue to Guided Practice — page 7 →

FR-06 • STAGE 3 OF 6

Guided Practice

Now apply the key concepts you've just reviewed. Work through these focused practice activities to reinforce your problem-solving skills before the final confidence check.

PRACTICE 1**Guided Example**

Reason from the endpoint pattern before calculating.

A string fixed at both ends shows three loops in its standing-wave pattern. Which harmonic is present, and how many antinodes are there?

PRACTICE 2**Independent Check**

Use the inverse-square idea qualitatively and quantitatively.

The intensity from an ideal point source is I at distance r . What is the intensity at $3r$?

Ready for a confidence check?

You've reinforced the essential skills through focused practice. Now confirm your understanding with two short questions.

Continue to Confidence Check — page 8 →

FR-07 • STAGE 4 OF 6

Confidence Check

You've reinforced the key concepts and practiced the essential skills. Now confirm you're ready to move forward by completing these short confidence checks.

CONFIDENCE CHECK 1

Interference pattern

Classify the interference from phase.

Two equal waves arrive exactly half a cycle out of phase. What kind of interference occurs?

CONFIDENCE CHECK 2

Standing-wave spacing

Use the fixed geometry of nodes and antinodes.

How far is the nearest antinode from a node?

HOW DID IT GO?

I answered ____ of 2 questions correctly.

Use the Solutions section to check your reasoning, then take one final look at the essential ideas.

You've confirmed your understanding.

Take one final look at the essential ideas before choosing your next step.

Continue to Summary — page 10 →

FR-08 • STAGE 5 OF 6

Summary

Before moving on, take one final look at the essential ideas you'll want to remember.

KEY TAKEAWAY 1**Add the displacements**

Superposition means overlapping wave displacements add at each place and time.

KEY TAKEAWAY 2**Let boundaries choose the modes**

Standing-wave resonances are fixed by endpoint conditions, which determine nodes, antinodes, and allowed wavelengths.

MY ONE-SENTENCE SUMMARY

In my own words, the most important idea is:

Ready for your next step?

You've reviewed the essential ideas one last time. Now choose the resource that best matches how confident you feel.

Continue to Next Step — page 14 →

ANSWER KEY • CHECK AFTER ATTEMPTING

Solutions and Explanations

Use these solutions to check your reasoning—not only your final answer. Replace each placeholder with a concise answer and the essential explanation.

WARM-UP • ACTIVITY 1

Key Ideas

The displacement is twice as large upward.

WHY IT WORKS Superposition adds the instantaneous displacements. The pulses later continue through one another.

WARM-UP • ACTIVITY 2

Common Mistakes

Nodes have zero displacement; antinodes oscillate with the largest amplitude.

WHY IT WORKS A standing wave separates space into fixed nodes and strongly oscillating antinodes.

WARM-UP • ACTIVITY 3

Quick Application

The loudness rises and falls periodically.

WHY IT WORKS The waves repeatedly move into and out of phase, creating an amplitude envelope.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1**Guided Example**

Third harmonic; three antinodes.

WHY IT WORKS Each loop corresponds to one antinode. For a fixed-fixed string, the number of loops equals the harmonic number.

PRACTICE 2**Independent Check**

1/9.

WHY IT WORKS Spherical area grows as r^2 , so tripling distance increases area by 9 and reduces intensity by 9.

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE CHECK 1

Interference pattern

Destructive interference.

WHY IT WORKS Half a cycle corresponds to a phase difference of π , so equal displacements oppose one another.

CONFIDENCE CHECK 2

Standing-wave spacing

$\lambda/4$.

WHY IT WORKS An antinode lies halfway between adjacent nodes, and adjacent nodes are $\lambda/2$ apart.

READINESS GUIDE

2 correct: You're ready to continue. • 1 correct: Review the missed idea, then continue. • 0 correct: Revisit Core Concepts or choose more practice.

FR-09 • STAGE 6 OF 6

Next Step: Continue Learning

Great work! You've completed this focused review. Choose the next resource that best matches how confident you feel.

? I'm Still Unsure Review the focused review again to strengthen the essential concepts. Review again: return to Warm-Up Check on page 4.	🕒 I Need More Practice Build confidence with additional practice problems. Go to Practice →	✓ I'm Ready Continue to the next topic or learning resource. Continue →
--	--	--

RECOMMENDED LINKS

Review again: return to Warm-Up Check on page 4.

Find additional practice →

Choose another type of physics help →

Continue reviewing with these companion resources.

Start the Review Online →

Watch the Video Review →

PHYSICS HELP THAT MAKES SENSE

A Physics Sensei review never ends at the last question. It always guides you toward the next useful step.

PhysicsSensei.com