FULL REVIEW

Full Review: Mechanical Waves and Wave Speed

Review the essential ideas, relationships, and problem-solving tools for mechanical waves and wave speed.

◷ TIME	◎ BEST FOR	✓ FINISH WITH
45–60 minutes	A complete topic review	A readiness check

After this full review, you'll be able to…
describe mechanical-wave propagation, connect wave quantities, explain medium effects, and solve representative wave-speed problems.

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 45–60 minutes

FR-02 • COURSE ALIGNMENT

Course Alignment

This bundle is designed to complement the chapter listed below. Use it to reinforce key concepts, prepare for homework, or review before a quiz or exam.

TEXTBOOK: OpenStax University Physics Volume 1 **CHAPTER: Volume 1, Chapter 16** **TOPIC: Mechanical Waves and Wave Speed** **COURSE LEVEL: Foundational introductory college physics**	**BEST USED** ✓ After reading the chapter ✓ Before starting homework ✓ Before a quiz or exam

Read the OpenStax Chapter →

FR-03 • YOUR REVIEW PLAN

Your Review Plan

Complete these six stages in order. Each stage builds on the previous one and prepares you for the final readiness check.

6 stages • Approximately 45–60 minutes

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 moment to see what you already remember. Do not worry about getting everything right. This is only a starting point.

ACTIVITY 1

Recall Activity 1

Identify the relevant wave quantities and connect them using the simplest wave relation.

A wave pulse moves along a rope. Does the rope itself travel with the pulse? Explain.

ACTIVITY 2

Recall Activity 2

Use the defining relation and keep units consistent.

A wave completes 4 cycles each second. What is its frequency and period?

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Recall Activity 3

Connect a qualitative change in the medium to the wave speed.

A transverse wave moves to the right. In what direction do points on the medium oscillate?

Ready to strengthen your understanding?

You've refreshed what you already know. Next, reinforce the essential concepts that will help you solve problems with confidence.

Continue to Core Concepts — page 6 →

FR-05 • STAGE 2 OF 6

Core Concepts

Let’s rebuild the key ideas one step at a time. Focus on understanding the relationships before worrying about solving problems.

KEY CONCEPT 1

Wave Quantities and the Basic Speed Relation

Amplitude measures maximum displacement from equilibrium. Wavelength λ is the distance between repeating points, frequency f is cycles per second, and period T is time per cycle. A traveling wave moves one wavelength during one period, giving $v = \lambda/T = f\lambda$.

$$T = \frac{1}{f}; v = f\lambda$$

EXAMPLE A 6.0 Hz wave with λ = 1.5 m travels at 9.0 m/s.

SENSEI NOTE For a fixed medium, changing the source frequency changes λ so that v remains set by the medium.

KEY CONCEPT 2

Transverse, Longitudinal, and Medium Effects

In a transverse wave, the medium oscillates perpendicular to propagation; in a longitudinal wave, it oscillates parallel to propagation, producing compressions and rarefactions. Wave speed depends on how strongly the medium restores disturbances and how much inertia the medium has.

stiffer restoring response → faster waves; greater inertia → slower waves.

EXAMPLE Increasing the tension of a string increases its wave speed; using a heavier string at the same tension decreases it.

SENSEI NOTE Do not confuse the speed of the wave with the speed of individual particles in the medium.

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Energy Transport and Wave Intensity Ideas

A mechanical wave transports energy. Larger-amplitude oscillations generally carry more energy. The energy moves with the disturbance while particles of the medium oscillate around equilibrium.

energy transport increases strongly with amplitude; no net transport of the medium is required.

EXAMPLE A larger-amplitude pulse on the same rope carries more energy than a smaller-amplitude pulse.

SENSEI NOTE Do not interpret a traveling crest as a chunk of matter moving from source to receiver.

Ready to apply these ideas?

You've reinforced the essential concepts. Now put them into practice by working through guided examples and building your problem-solving confidence.

Continue to Guided Practice — page 8 →

FR-06 • STAGE 3 OF 6

Guided Practice

Now it's time to apply what you've reviewed. Work through each activity in order. The examples become gradually more challenging, and each prepares you for the final readiness check.

PRACTICE 1

Worked Example

Use the central wave relations and show each algebraic step.

A wave has $f = 8.0$ Hz and $\lambda = 2.5$ m. Find its speed.

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Guided Problem

Identify the medium quantities before applying the propagation-speed relation.

A wave travels at 12 m/s with frequency 3.0 Hz. Find its wavelength.

PRACTICE 3

Independent Problem

Connect the wave model to energy transport or a change in conditions.

Two waves move through the same rope. Wave A has twice the frequency of wave B. Compare their speeds and wavelengths.

Ready to check your understanding?

You've practiced the essential skills with guidance. Now solve a few short problems on your own and confirm you're ready to move forward.

Continue to Confidence Check — page 10 →

FR-07 • STAGE 4 OF 6

Confidence Check

You've rebuilt the key ideas and practiced them with guidance. Now try these short questions on your own to check your understanding before moving on.

QUICK CHECK 1

Read a Wave Description

State the relationship first, then evaluate.

A source doubles its frequency while the wave stays in the same medium. What happens to wave speed and wavelength?

QUICK CHECK 2

Check the Medium–Source Distinction

Choose the correct statement and justify it physically.

State one difference between transverse and longitudinal mechanical waves.

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Connect Propagation and Local Motion

State the relevant physical distinction clearly.

A pulse reaches a junction with a different rope. Which wave quantity is guaranteed to remain tied to the source for a continuing periodic wave?

HOW DID IT GO?

I answered ____ of 3 questions correctly.

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

You've checked your understanding.

Take one final look at the essential ideas before deciding what to do next.

Continue to Summary — page 12 →

FR-08 • STAGE 5 OF 6

Summary

Before moving on, take one final look at the most important ideas from this review.

KEY TAKEAWAY 1

Describe the Wave With Four Linked Quantities

Use amplitude, wavelength, frequency, and period to describe a periodic wave; connect them with $T = 1/f$ and $v = f\lambda$.

KEY TAKEAWAY 2

Separate Medium Motion From Wave Motion

Matter oscillates locally while the disturbance and energy propagate through the medium.

KEY TAKEAWAY 3

The Medium Sets the Speed

Wave speed depends on the physical properties of the medium; the source sets frequency and wavelength adjusts.

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 16 →

ANSWER KEY • CHECK AFTER ATTEMPTING

Solutions and Explanations

Use these solutions to check your reasoning—not only your final answer. Use each answer and explanation to identify the step that supports the result.

WARM-UP • ACTIVITY 1

Recall Activity 1

No. Individual rope elements move locally while the disturbance and energy travel along the rope.

WHY IT WORKS A mechanical wave transfers energy through a medium without transporting the medium as a whole.

WARM-UP • ACTIVITY 2

Recall Activity 2

$f = 4$ Hz and $T = 1/f = 0.25$ s.

WHY IT WORKS Frequency counts cycles per second; period is the time for one cycle.

WARM-UP • ACTIVITY 3

Recall Activity 3

Perpendicular to the direction the wave travels.

WHY IT WORKS Transverse describes the direction of medium motion relative to propagation.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Worked Example

$v = f\lambda = (8.0)(2.5) = 20$ m/s.

WHY IT WORKS A periodic wave advances one wavelength during each cycle.

PRACTICE 2

Guided Problem

$\lambda = v/f = 12/3.0 = 4.0$ m.

WHY IT WORKS Rearrange $v = f\lambda$ while keeping the medium speed fixed.

PRACTICE 3

Independent Problem

Their speeds are equal; wave A has half the wavelength.

WHY IT WORKS The rope fixes wave speed, and $\lambda = v/f$.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Read a Wave Description

The speed stays the same; the wavelength is cut in half.

WHY IT WORKS The medium sets v, so $\lambda = v/f$ decreases when f increases.

QUICK CHECK 2

Check the Medium–Source Distinction

Transverse motion is perpendicular to propagation; longitudinal motion is parallel to propagation.

WHY IT WORKS The classification refers to the direction of particle motion relative to the direction energy travels.

QUICK CHECK 3

Connect Propagation and Local Motion

The frequency.

WHY IT WORKS The source oscillation rate remains the same even when the propagation speed and wavelength change.

READINESS GUIDE

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

FR-09 • STAGE 6 OF 6

Next Step: Continue Learning

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

? I'm Still Unsure	◎ I Need More Practice	✓ I'm Ready
Review the key ideas and examples again.	Continue with additional practice for this topic.	Continue to the next recommended resource.
Review again: return to Warm-Up Check on page 4.	Go to Practice →	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