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…

solve wave-speed and wavelength problems, analyze strings using tension and linear density, and reason about energy transport in mechanical waves.

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: Algebra-based 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

1 **Warm-Up Check — page 4** Activate prior knowledge.	2 **Core Concepts — page 6** Review the essential ideas.	3 **Guided Practice — page 8** Apply what you learned.
4 **Confidence Check — page 10** Confirm your understanding.	5 **Summary — page 12** Review the key ideas.	6 **Next Step — page 16** Continue your learning.

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 travels at 24 m/s with wavelength 3.0 m. Find its frequency.

ACTIVITY 2

Recall Activity 2

Use the defining relation and keep units consistent.

A 5.0 Hz oscillator drives a wave. What is the period?

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Recall Activity 3

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

If string tension increases by a factor of 4 while μ is unchanged, how does the wave speed change?

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 Variables and Traveling-Wave Speed

A periodic mechanical wave is described by amplitude A, wavelength λ, frequency f, and period T. Frequency is set by the source. The medium determines the propagation speed. Once v and f are known, λ follows from v = fλ.

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

EXAMPLE A 15 Hz wave traveling at 45 m/s has λ = 3.0 m.

SENSEI NOTE When a wave enters a new medium, frequency remains tied to the source while speed and wavelength can change.

KEY CONCEPT 2

Wave Speed on a Stretched String

For a stretched string, the wave speed increases with tension F_T and decreases with linear mass density μ = m/L. This gives a direct algebraic model for how the physical properties of the medium control propagation.

$$\mu=\frac{m}{L};v=\sqrt{\frac{F_T}{\mu}}$$

EXAMPLE For F_T = 100 N and μ = 0.040 kg/m, v = √(2500) = 50 m/s.

SENSEI NOTE Use tension in newtons and μ in kilograms per meter before applying the square root.

KEY CONCEPT 3

Energy and Power in Sinusoidal String Waves

A sinusoidal wave on a string carries energy because each string element has kinetic and elastic potential energy. The average power increases with string density, angular frequency, wave-speed, and the square of amplitude.

$$\omega = 2\pi f \; ; P_{avg} = \frac{1}{2}\mu\omega^2 A^2 v$$

EXAMPLE Doubling amplitude on the same string at the same frequency multiplies the average power by four.
SENSEI NOTE Power depends on A^2, so amplitude changes have a strong effect on energy transport.

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 = 12 Hz and travels at 36 m/s. Find λ and T.

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Guided Problem

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

A 0.80 kg string is 20 m long and held at 72 N tension. Find the wave speed.

PRACTICE 3

Independent Problem

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

A string has μ = 0.020 kg/m, tension 50 N, and supports a 10 Hz wave of amplitude 0.030 m. Find v and Pavg.

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 string-wave speed is 30 m/s. If the tension is multiplied by 9 at the same μ, what is the new speed?

QUICK CHECK 2

Check the Medium–Source Distinction

Choose the correct statement and justify it physically.

A 20 Hz source sends waves into two strings. The second string supports twice the wave speed. Compare their wavelengths.

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Connect Propagation and Local Motion

State the relevant physical distinction clearly.

If amplitude triples while all other string-wave quantities stay fixed, by what factor does average power change?

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

Use the Source–Medium Separation

The source fixes frequency; the medium fixes wave speed; wavelength adjusts through $v = f\lambda$.

KEY TAKEAWAY 2

Connect String Properties to Speed

On a stretched string, $v = \sqrt{(F\_T/\mu)}$: more tension raises speed, while greater linear density lowers it.

KEY TAKEAWAY 3

Amplitude Controls Energy Transport Strongly

For sinusoidal string waves, average power scales as A^2 and also depends on frequency and medium properties.

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

$f = v/\lambda = 24/3.0 = 8.0$ Hz.

WHY IT WORKS Use $v = f\lambda$ and solve for the unknown wave quantity.

WARM-UP • ACTIVITY 2

Recall Activity 2

$T = 1/f = 0.200$ s.

WHY IT WORKS Frequency and period are reciprocals.

WARM-UP • ACTIVITY 3

Recall Activity 3

The speed doubles.

WHY IT WORKS For a string $v = \sqrt{(F_T/\mu)}$, so v scales with the square root of tension.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Worked Example

λ = 36/12 = 3.0 m; T = 1/12 = 0.0833 s.

WHY IT WORKS Use v = fλ for space and T = 1/f for time.

PRACTICE 2

Guided Problem

μ = 0.80/20 = 0.040 kg/m; v = √(72/0.040) = 42.4 m/s.

WHY IT WORKS Compute the linear mass density first, then use the string-speed relation.

PRACTICE 3

Independent Problem

v = 50 m/s; ω = 62.8 rad/s; Pavg ≈ 1.78 W.

WHY IT WORKS First use v = √(F_T/μ), then substitute into Pavg = (1/2) $\mu\omega^2A^2v$.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Read a Wave Description

90 m/s.

WHY IT WORKS $v \propto \sqrt{F_T}$, so multiplying tension by 9 multiplies speed by 3.

QUICK CHECK 2

Check the Medium–Source Distinction

The second wavelength is twice as large.

WHY IT WORKS The source frequency stays 20 Hz, so $\lambda = v/f$ is proportional to wave speed.

QUICK CHECK 3

Connect Propagation and Local Motion

By a factor of 9.

WHY IT WORKS P_{avg} is proportional to A^2.

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