FOCUSED REVIEW

Focused Review: Mechanical Waves and Wave Speed

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

◷ TIME	◎ BEST FOR	✓ FINISH WITH
15–20 minutes	Focused review	Greater confidence

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

interpret sinusoidal traveling-wave functions, connect k and ω to λ and f, and analyze wave speed and particle motion with calculus.

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 • 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: Calculus-based introductory university 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 focused stages in order. Each stage reinforces your understanding and prepares you for a final confidence check.

6 stages • Approximately 15–20 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 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

Recall the component definitions of velocity and acceleration.

For $y(x,t) = 0.020 \sin(4x - 12t)$, identify k and ω.

WARM-UP 2

Common Mistakes

Identify the relationship that controls the wave quantity.

Using $k = 4$ rad/m and $\omega = 12$ rad/s, find the wave speed.

FR-04 • WARM-UP CHECK CONTINUED

WARM-UP 3

Quick Application

Distinguish circular speed from circular velocity.

For $y = A \sin(kx - \omega t)$, what derivative gives the transverse velocity of a string element?

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

Sinusoidal Traveling Waves and Phase

Write a traveling wave as y(x,t) = A sin(kx – ωt + ϕ). The wave number k measures spatial phase change and angular frequency ω measures temporal phase change. Constant phase gives the propagation speed.

$$k=\frac{2\pi}{\lambda};\omega=2\pi f;v=\frac{\omega}{k}=f\lambda$$

EXAMPLE For y = 0.030 sin(5x – 20t), λ = 2π/5 = 1.26 m, f = 20/(2π) = 3.18 Hz, and v = 4.0 m/s.

SENSEI NOTE The sign of the kx and ωt terms determines propagation direction; kx – ωt moves in +x.

KEY CONCEPT 2

String Dynamics and Local Particle Motion

The wave speed on a stretched string follows from tension and linear density. The wave function also lets you calculate the transverse velocity and acceleration of a particular string element by partial differentiation at fixed position.

$$v=\sqrt{\frac{F_T}{\mu}};u_y=\frac{\partial y}{\partial t};a_y=\frac{\partial^2 y}{\partial t^2}$$

EXAMPLE For y = A sin(kx – ωt), u_y = –Aω cos(kx – ωt) and a_y = –ω²y.

SENSEI NOTE The local transverse particle speed is not the same quantity as the wave propagation speed ω/k.

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

Use independent components connected by one elapsed time.

For $y = 0.040 \sin(2.5x - 15t)$, find λ, f, and wave speed.

PRACTICE 2

Independent Check

Add the velocities in a common coordinate system.

For the same wave, find the maximum transverse speed of a string element.

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

Wave Relationship Check

Identify velocity and acceleration at the top of the path.

A wave is $y = A \sin(kx + \omega t)$. Which direction does it propagate?

CONFIDENCE CHECK 2

Circular and Relative Directions

State both directions explicitly.

For a sinusoidal wave, how is local transverse acceleration related to displacement?

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

Read Physics Directly From Phase

From $y = A\sin(kx \mp \omega t + \phi)$, identify k, ω, direction, λ, f, and $v = \omega/k$.

KEY TAKEAWAY 2

Separate Propagation From Particle Motion

Use ω/k for wave speed, but use time derivatives of $y(x,t)$ for the motion of individual medium elements.

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. Use each answer and explanation to check both the setup and the physical interpretation.

WARM-UP • ACTIVITY 1

Key Ideas

$k = 4$ rad/m and $\omega = 12$ rad/s.

WHY IT WORKS Compare the function with $y = A \sin(kx - \omega t + \phi)$.

WARM-UP • ACTIVITY 2

Common Mistakes

$v = \omega/k = 3.0$ m/s.

WHY IT WORKS A point of constant phase moves so that $kx - \omega t$ is constant.

WARM-UP • ACTIVITY 3

Quick Application

$\partial y/\partial t$.

WHY IT WORKS The element's position changes in time at fixed x.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Guided Example

$\lambda = 2\pi/2.5 = 2.51$ m; $f = 15/(2\pi) = 2.39$ Hz; $v = 15/2.5 = 6.0$ m/s.

WHY IT WORKS Read k and ω directly, then use their definitions and $v = \omega/k$.

PRACTICE 2

Independent Check

$u_{max} = A\omega = (0.040)(15) = 0.60$ m/s.

WHY IT WORKS Differentiate with respect to time and take the maximum magnitude of the cosine factor.

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE CHECK 1

Wave Relationship Check

In the −x direction.

WHY IT WORKS Constant phase $kx + \omega t$ = constant gives $x = -(\omega/k)t$ + constant.

CONFIDENCE CHECK 2

Circular and Relative Directions

$a_y = -\omega^2 y$.

WHY IT WORKS Two time derivatives of a sinusoid reproduce the displacement with a factor $-\omega^2$.

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	◎ I Need More Practice	✓ I'm Ready
Review the focused review again to strengthen the essential concepts.	Build confidence with additional practice problems.	Continue to the next topic or learning 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