FOCUSED REVIEW

Focused Review: Damping, Driving, and Resonance — Foundational

Review the highest-leverage ideas about damping, driving, and resonance using the Foundational treatment.

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

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

explain how damping and periodic driving change an oscillator and recognize resonance from graphs and physical behavior.

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 Physics Sensei Unit Review supports MEC-U10 — Damping, Driving, and Resonance. Use it to reinforce concepts, prepare for homework, or review before a quiz or exam.

UNIT: MEC-U10 **TOPIC: Damping, Driving, and Resonance** **TREATMENT: Foundational** **RESOURCE: Physics Sensei Unit Review**	**BEST USED** ✓ After reading the chapter ✓ Before starting homework ✓ Before a quiz or exam

Explore Physics Sensei →

Physics Sensei is an independent physics learning resource. This review uses original Physics Sensei organization, explanations, examples, and practice.

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

Decide what damping does to energy.

A freely oscillating real system gradually loses amplitude. What happens to its mechanical energy?

WARM-UP 2

Common Mistakes

Separate natural and driving frequencies.

After the transient fades, does a periodically driven oscillator move at its natural frequency or at the driver's frequency?

FR-04 • WARM-UP CHECK CONTINUED

WARM-UP 3

Quick Application

Reason from a resonance curve.

Two otherwise identical oscillators have different damping. Which one has the taller, narrower resonance peak?

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

Damping Regimes and Energy Loss

Damping removes energy from an oscillator. Underdamped motion continues to cross equilibrium while its amplitude shrinks. Critical damping returns to equilibrium as quickly as possible without oscillating. Overdamped motion also avoids oscillation but returns more slowly.

$$v = dr/dt;\ a = dv/dt;\ v_{0x} = v_0 \cos(\theta);\ v_{0y} = v_0 \sin(\theta);\ x = x_0 + v_{0x} t;\ y = y_0 + v_{0y} t - (1/2)gt^2.$$

EXAMPLE A door closer designed to settle quickly without repeated swinging is ideally near critical damping.

SENSEI NOTE Critical damping is the fastest nonoscillatory return; overdamping is not faster.

KEY CONCEPT 2

Driving, Resonance, and Phase

A periodic driver continually supplies energy. The steady response follows the driving frequency. Near the natural response frequency, energy transfer can be especially effective and amplitude becomes large. Increasing damping lowers and broadens the resonance peak.

$$a_{rad} = v^2/r;\ a_{tan} = dv/dt;\ |a| = \sqrt{(a_{rad}^2 + a_{tan}^2)};\ v_{A/C} = v_{A/B} + v_{B/C}.$$

EXAMPLE A swing pushed with the right rhythm builds amplitude; pushes at a mismatched rhythm do not add energy efficiently.

SENSEI NOTE Resonance is about repeated energy transfer, not energy appearing from nowhere.

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

Compare qualitative time traces.

Trace A oscillates many times with slowly shrinking amplitude; Trace B returns to equilibrium without crossing it and does so faster than any other nonoscillatory trace. Identify the regimes.

PRACTICE 2

Independent Check

Compare resonance curves.

Curve X has a tall narrow peak; Curve Y has a lower broader peak. Which system is more strongly damped?

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

Steady-State Frequency

State the frequency that survives.

A system with natural frequency 3 Hz is driven continuously at 5 Hz. Long after startup, what frequency dominates its motion?

CONFIDENCE CHECK 2

Critical vs Overdamped

Choose the faster nonoscillatory return.

Which returns to equilibrium faster without oscillation: critical damping or overdamping?

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

Damping Controls How Motion Dies Away

Damping determines whether free motion oscillates while decaying or returns without oscillation.

KEY TAKEAWAY 2

Driving Controls the Long-Time Response

The driver fixes the steady-state frequency; resonance and damping determine how large that response becomes.

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

It decreases because dissipative forces transfer mechanical energy to thermal/internal energy.

WHY IT WORKS Damping removes mechanical energy from the oscillator.

WARM-UP • ACTIVITY 2

Common Mistakes

At the driver's frequency.

WHY IT WORKS The external periodic force sets the frequency of the steady-state motion.

WARM-UP • ACTIVITY 3

Quick Application

The less strongly damped oscillator.

WHY IT WORKS Weaker energy loss allows more amplitude buildup and greater frequency selectivity.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Guided Example

A is underdamped; B is critically damped.

WHY IT WORKS Underdamping retains oscillation; critical damping is the fastest return without overshoot.

PRACTICE 2

Independent Check

Curve Y.

WHY IT WORKS Stronger damping dissipates more energy each cycle, reducing amplitude buildup and widening the response.

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE CHECK 1

Steady-State Frequency

5 Hz.

WHY IT WORKS The persistent forcing determines the steady-state frequency.

CONFIDENCE CHECK 2

Critical vs Overdamped

Critical damping.

WHY IT WORKS Critical damping is the boundary case optimized for the fastest nonoscillatory settling.

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