QUICK REVIEW

Quick Review: Damping, Driving, and Resonance — Calculus-Based

Refresh the most important ideas about damping, driving, and resonance from the Calculus-Based perspective in just a few minutes.

◷ TIME	◎ BEST FOR	✓ FINISH WITH
5–10 minutes	A rapid refresh	Key ideas refreshed

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

analyze damped and driven oscillator equations, connect transient and steady-state solutions, and interpret amplitude and phase response.

HOW TO USE THIS GUIDE

Work through the four stages in order. Write directly in the spaces provided, check your work in the Quick Answers 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 5–10 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: Calculus-Based** **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 four stages to quickly refresh the essential ideas and confirm you're ready to continue.

4 stages • Approximately 5–10 minutes

1 **Quick Recall — page 4** Refresh what you already know.	2 **Essential Idea — page 5** Review the most important concept.
3 **Confidence Check — page 6** Confirm you're ready to move on.	4 **Next Step — page 8** Continue your learning.

PRINTING TIP

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

FR-04 • STAGE 1 OF 4

Quick Recall

Let’s quickly refresh what you already know. This short recall activity will bring the most important ideas back to mind before you review them.

QUICK RECALL

Recall Activity

Complete the three statements from memory before revealing the answer.

1) Free damped motion satisfies $mx'' + bx' + kx =$ ____. 2) Driven motion adds $F_0 \cos(\omega t)$ on the ____. 3) The steady-state response oscillates at angular frequency ____.

Ready to refresh the essentials?

Great! Now review the most important idea you’ll want to remember.

Continue to Essential Idea — page 5 →

FR-05 • STAGE 2 OF 4

Essential Idea

Take one last look at the most important concept from this topic. If you remember this idea, the rest will come back much more easily.

ESSENTIAL IDEA

The Motion Is Homogeneous Transient Plus Forced Steady State

The damped driven oscillator obeys $mx'' + bx' + kx = F_0 \cos(\omega t)$. The homogeneous solution contains the transient determined by initial conditions and damping. The particular solution is the long-time sinusoidal response at the driving frequency, with amplitude and phase set by m, b, k, and ω.

$v = dr/dt$; $a = dv/dt$; projectile: $a_x = 0$ and $a_y = -g$; circular: $a_{rad} = v^2/r$; relative: $v_{A/C} = v_{A/B} + v_{B/C}$.

EXAMPLE For weak damping the transient decays approximately like e^(-bt/2m), leaving x_ss = A cos(ωt - ϕ). Near resonance, A becomes large and the phase changes rapidly with frequency.

SENSEI NOTE Do not confuse the natural frequency appearing in the homogeneous dynamics with the driving frequency of the surviving steady-state motion.

Ready to check your memory?

You've refreshed the essential idea. Now see how much you remember before moving on.

Continue to Confidence Check — page 6 →

FR-06 • STAGE 3 OF 4

Confidence Check

You've refreshed the essential idea. Now answer this quick confidence check to confirm you're ready to move on.

CONFIDENCE CHECK

Five-Minute Readiness Check

Answer all three without notes.

In $mx'' + bx' + kx = F_0 \cos(\omega t)$, what happens to the homogeneous part as t becomes large when $b > 0$, and what frequency remains?

Ready for your next step?

Great work! You've refreshed the essential idea. Now choose the resource that best matches what you'd like to do next.

Continue to Next Step — page 8 →

QUICK ANSWERS • CHECK AFTER ATTEMPTING

Quick Answers and Explanations

Use these concise answers to check your recall and confidence—not only your final response.

QUICK RECALL

Recall Activity

1) 0; 2) right-hand side; 3) ω, the driving frequency.

WHY IT WORKS The homogeneous equation describes the transient/free response. The forcing term generates a particular steady-state solution at the driver's frequency.

CONFIDENCE CHECK

CONFIDENCE CHECK

Five-Minute Readiness Check

The homogeneous transient decays. The remaining steady-state motion is at the driving angular frequency ω.

WHY IT WORKS Positive damping gives decaying homogeneous modes, while the persistent forcing continuously sustains the particular solution.

READINESS GUIDE

3 correct: You're ready to continue. • 2 correct: Review the missed idea. • 0–1 correct: Revisit the Essential Idea or choose more practice.

FR-07 • STAGE 4 OF 4

Next Step: Continue Learning

Great work! You've completed this quick 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 essential idea again.	Continue with additional practice for this topic.	Continue to the next recommended resource.
Review again: return to Essential Idea on page 5.	**Go to Practice →**	**Continue →**

RECOMMENDED LINKS

Review again: return to Essential Idea on page 5.

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.

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