

FOCUSED REVIEW

Focused Review — Unit Conversions and Dimensional Analysis — Calculus-Based

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

 TIME 15–20 minutes	 BEST FOR Focused review	 FINISH WITH Greater confidence
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After this focused review, you'll be able to...

recognize the key concepts, reinforce your problem-solving skills, and continue with greater confidence.

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 Topic Review is an independent learning resource. Use it to reinforce key concepts, prepare for homework, or review before a quiz or exam.

Related Unit Review: If you need to review the complete unit material, review [Units and Measurements here →](#)

RESOURCE: Physics Sensei Topic Review
TOPIC ID: MEC-U01-T01
TOPIC: Unit Conversions and Dimensional Analysis
PARENT UNIT: MEC-U01 — Units and Measurements
COURSE LEVEL: Calculus-Based

BEST USED

- ✓ After learning the topic
- ✓ Before starting homework
- ✓ Before a quiz or exam

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

1 Warm-Up Check Refresh key ideas.	2 Core Concepts Reinforce the essentials.	3 Guided Practice Strengthen key skills.
4 Confidence Check Confirm your understanding.	5 Summary Remember the essentials.	6 Next Step Choose your next step.

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**

Give the dimensions of velocity, acceleration, momentum, and force.

WARM-UP 2**Common Mistakes**

What dimensions does dQ/dt have? What about $\int Q dt$?

FR-04 • WARM-UP CHECK CONTINUED

WARM-UP 3

Quick Application

Check whether $\sin(vt)$ can be valid when v is velocity and t is time.

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 →

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

Dimensions of Derivatives and Integrals

A derivative divides the dependent quantity's dimensions by the independent variable's dimensions. An integral multiplies by the integration variable's dimensions.

$$[dQ/dt] = [Q]/[T] \quad \text{and} \quad [\int Q dt] = [Q][T]$$

EXAMPLE dp/dt has $[ML/T^2]$, matching force.

SENSEI NOTE Do not treat d/dt or dt as dimensionless symbols.

KEY CONCEPT 2

Dimensionless Function Arguments

Arguments of $\exp$, $\ln$, $\sin$, $\cos$, and related functions must be dimensionless. This often determines the dimensions of parameters such as angular frequency or decay constants.

$$[\text{argument of sin, cos, exp, ln}] = 1$$

$$[\omega t] = 1 \Rightarrow [\omega] = T^{-1}$$

EXAMPLE $e^{(-t/\tau)}$ is valid only when τ has dimension $[T]$.

SENSEI NOTE A dimensioned exponent is physically meaningless.

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 →](#)

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

Determine the dimensions of impulse $J = \int F \, dt$.

$[F][T] = [ML/T^2][T] = [ML/T]$, the same as momentum.

PRACTICE 2

Independent Check

For $x(t) = A \cos(\omega t)$, determine the dimensions of A and ω .

Use the dimensions of x and the requirement that ωt be dimensionless.

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 →](#)

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

Derivative Dimension

Answer without looking back.

If energy E has $[ML^2/T^2]$, what are the dimensions of dE/dt ?

CONFIDENCE CHECK 2

Exponential Argument

Use units or dimensions to justify your answer.

For $e^{(-kt)}$, what dimensions must k have?

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 →

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**Calculus Carries Dimensions**

Derivatives divide by the independent-variable dimension; integrals multiply by it.

KEY TAKEAWAY 2**Function Arguments Are Dimensionless**

Use this rule to infer the dimensions of frequencies, rate constants, and characteristic times.

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 →

ANSWER KEY • CHECK AFTER ATTEMPTING

Solutions and Explanations

Use these solutions to check your reasoning—not only your final answer. Replace each placeholder with a concise answer and the essential explanation.

WARM-UP • ACTIVITY 1

Key Ideas

$[L/T]$, $[L/T^2]$, $[ML/T]$, $[ML/T^2]$.

WHY IT WORKS These are the standard factors or dimensions needed for the topic.

WARM-UP • ACTIVITY 2

Common Mistakes

$[Q]/[T]$ and $[Q][T]$.

WHY IT WORKS Unit cancellation or dimensional compatibility reveals the correct choice.

WARM-UP • ACTIVITY 3

Quick Application

No. vt has dimension $[L]$, so the sine argument is not dimensionless.

WHY IT WORKS The conversion factors cancel the original units and leave the requested units.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Guided Example

$[F][T] = [ML/T^2][T] = [ML/T]$, the same as momentum.

WHY IT WORKS Writing every factor makes the unit logic visible and checkable.

PRACTICE 2

Independent Check

Use the dimensions of x and the requirement that ωt be dimensionless.

WHY IT WORKS The same factor-label logic applies; the final unit and dimension provide a check.

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE CHECK 1

Derivative Dimension

$[ML^2/T^3]$, the dimensions of power.

WHY IT WORKS The setup is correct when the unwanted unit cancels and the requested unit remains.

CONFIDENCE CHECK 2

Exponential Argument

$[T^{-1}]$.

WHY IT WORKS Dimensional consistency is a fast physical reasonableness test.

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 Review the focused review again to strengthen the essential concepts. Review Again →	🎯 I Need More Practice Build confidence with additional practice problems. Go to Practice →	✓ I'm Ready Continue to the next topic or learning resource. Continue →
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RECOMMENDED LINKS

[Review this topic again →](#)

[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