FULL REVIEW

Full Review: Units and Measurements — Foundational

Review the essential ideas, relationships, and problem-solving tools for units, measurement, dimensional reasoning, precision, and estimation.

◷ TIME	◎ BEST FOR	✓ FINISH WITH
45–60 minutes	A complete topic review	A readiness check

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

interpret physical measurements, convert units reliably, use dimensional reasoning, communicate precision, and evaluate estimates.

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

RESOURCE: Physics Sensei Unit Review **UNIT ID: MEC-U01** **TOPIC: Units and Measurements** **COURSE LEVEL: Foundational introductory physics**	**BEST USED** ✓ After learning the unit ✓ Before starting homework ✓ Before a quiz or exam

Start the Unit Review Online →

Physics Sensei organizes this material as an independent learning unit rather than following an external textbook chapter sequence.

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 quantity, value, and unit.

A desk length is reported as 1.42 m. Identify the physical quantity, numerical value, and unit.

ACTIVITY 2

Recall Activity 2

Use a conversion factor equal to one.

Convert 5.25 km to meters and 420 ms to seconds.

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Recall Activity 3

Judge a result by scale and precision.

A student reports a classroom width as 8.173942 m. What should you question about this result?

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

Physical Quantities, SI Units, and Prefixes

A measurement combines a physical quantity, a numerical value, a unit, and an implied precision. SI base units provide a common system, while derived units combine base units. Metric prefixes represent powers of ten and allow the same quantity to be written on a convenient scale.

$$1\ \text{km} = 10^{3}\ \text{m};\ 1\ \text{cm} = 10^{-2}\ \text{m};\ 1\ \mu\text{m} = 10^{-6}\ \text{m}.$$

EXAMPLE 2.50 mm = 2.50×10^{-3} m. The numerical value changes because the unit scale changes; the physical length does not.

SENSEI NOTE A bare number is usually incomplete in physics. Ask what quantity the number represents and which unit defines its scale.

KEY CONCEPT 2

Conversion Factors and Dimensional Reasoning

A valid conversion factor is a ratio of equivalent quantities and therefore equals one. Arrange factors so unwanted units cancel. Dimensional reasoning checks whether quantities being added or equated have compatible physical dimensions.

$$90.0\ \text{km/h} \times (1000\ \text{m} / 1\ \text{km}) \times (1\ \text{h} / 3600\ \text{s}) = 25.0\ \text{m/s}.$$

EXAMPLE 90.0 km/h x (1000 m/1 km) x (1 h/3600 s) = 25.0 m/s.

SENSEI NOTE Dimensional consistency is necessary but not sufficient. An equation can have correct dimensions and still contain incorrect physics.

KEY CONCEPT 3

Precision, Uncertainty, and Estimation

Measured values have limited precision. Accuracy describes closeness to an accepted value; precision describes resolution or repeatability. Significant figures communicate justified digits, uncertainty quantifies a plausible range, and order-of-magnitude estimates provide a reasonableness check.

$$\text{percent uncertainty} = (\Delta x / x) \times 100\%;\ [v] = L\,T^{-1};\ [a] = L\,T^{-2}.$$

EXAMPLE For L = 25.0 ± 0.2 cm, the percent uncertainty is (0.2/25.0) × 100% = 0.8%.

SENSEI NOTE Keep extra digits during intermediate work, then round the final result to a precision supported by

the input measurements.

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

Convert area by applying the linear conversion to both dimensions.

Convert 2.75 m^2 to cm^2.

PRACTICE 2

Guided Problem

Use density units to organize the calculation.

A sample has mass 125 g and volume 48.0 cm^3. Find its density in g/cm^3 and kg/m^3.

PRACTICE 3

Independent Problem

Estimate using transparent assumptions.

Estimate the number of heartbeats in 80 years using 70 beats/min as a representative rate.

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

Scientific Notation

Preserve significant figures.

Write 0.0004820 m in scientific notation and state its number of significant figures.

QUICK CHECK 2

Dimensional Consistency

Compare dimensions on both sides.

Could the equation distance = speed + time be dimensionally valid? Explain.

QUICK CHECK 3

Uncertainty and Precision

Separate calculator output from measured precision.

A calculated result is 9.846273 using inputs known to three significant figures. How should the final result normally be reported?

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

Units Are Algebraic Information

Carry units through every conversion and calculation; correct cancellation is a built-in error check.

KEY TAKEAWAY 2

Dimensions Test Structure

Quantities that are added or equated must have compatible dimensions.

KEY TAKEAWAY 3

Precision and Estimation Check Meaning

Report only justified digits and compare the final magnitude with a reasonable physical estimate.

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

Quantity: length; numerical value: 1.42; unit: meter (m).

WHY IT WORKS The number and unit are the representation of the measured physical quantity.

WARM-UP • ACTIVITY 2

Recall Activity 2

5.25 km = 5.25×10^3 m; 420 ms = 0.420 s.

WHY IT WORKS kilo = 10^3 and milli = 10^{-3}. The factors change the unit scale without changing the physical quantity.

WARM-UP • ACTIVITY 3

Recall Activity 3

The precision is suspiciously high for an ordinary classroom measurement.

WHY IT WORKS Many reported decimal places can imply measurement resolution that the instrument did not provide.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Worked Example

$2.75\ m^2 = 2.75 \times 10^4\ cm^2$.

WHY IT WORKS Since 1 m = 100 cm, square the entire conversion factor: $(100\ cm/1\ m)^2$.

PRACTICE 2

Guided Problem

Density = 125/48.0 = 2.60 g/cm^3 = 2.60 × 10^3 kg/m^3.

WHY IT WORKS 1 g/cm^3 = 1000 kg/m^3, so the numerical value increases by 10^3 in SI density units.

PRACTICE 3

Independent Problem

About 2.9 × 10^9 heartbeats.

WHY IT WORKS 80 yr x 365 day/yr x 24 h/day x 60 min/h x 70 beats/min is approximately 2.9 billion beats.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Scientific Notation

4.820 × 10^{-4} m; four significant figures.

WHY IT WORKS Leading zeros locate the decimal point and are not significant; the trailing zero after the decimal is significant.

QUICK CHECK 2

Dimensional Consistency

No.

WHY IT WORKS Speed has dimensions L/T and time has dimension T, so they cannot be added to produce a length.

QUICK CHECK 3

Uncertainty and Precision

Normally report 9.85.

WHY IT WORKS The final result should not claim more significant figures than the limiting measured inputs justify.

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