

FOCUSED REVIEW

Focused Review — Position, Displacement, and Velocity — 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 [Motion in One Dimension here →](#)

RESOURCE: Physics Sensei Topic Review
TOPIC ID: MEC-U03-T01
TOPIC: Position, Displacement, and Velocity
PARENT UNIT: MEC-U03 — Motion in One Dimension
COURSE LEVEL: Calculus-Based introductory physics

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**

Differentiate position.

If $x(t) = t^2 + 2t$, what is $v(t)$?

WARM-UP 2**Common Mistakes**

Compare average and instantaneous values.

What geometric objects on an x - t graph represent average velocity and instantaneous velocity?

FR-04 • WARM-UP CHECK CONTINUED

WARM-UP 3

Quick Application

Read a turning instant.

If $v(t_0) = 0$, what does the x - t graph look like at t_0 ?

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

Finite changes give average velocity

For a time interval, displacement is $x(t_2) - x(t_1)$. Dividing by $t_2 - t_1$ gives the average velocity, the secant slope of the position function over that interval.

$$\bar{v} = [x(t_2) - x(t_1)] / (t_2 - t_1)$$

EXAMPLE For $x(t) = t^2$, from 1 s to 3 s: $\bar{v} = (9 - 1)/(3 - 1) = 4$ m/s.

SENSEI NOTE Keep the interval endpoints distinct; average velocity is not generally equal to v at either endpoint.

KEY CONCEPT 2

The derivative gives instantaneous velocity

Taking the limit of secant slopes as the interval shrinks gives the derivative of position. This local slope is the instantaneous velocity.

$$v(t) = dx/dt$$

EXAMPLE For $x(t) = 2t^2 - 3t$, $v(t) = 4t - 3$.

SENSEI NOTE A zero derivative identifies a horizontal tangent, but additional reasoning is needed to decide whether direction reverses.

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**

Compare secant and tangent slopes.

For $x(t) = t^2 - 2t$, find the average velocity from $t = 1$ s to $t = 4$ s and the instantaneous velocity at $t = 4$ s.

PRACTICE 2**Independent Check**

Locate zero velocity.

For $x(t) = t^3 - 3t^2$, find the times when $v = 0$.

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

Average velocity

Use the position function at both endpoints.

For $x(t) = 2t^2 + 1$, find $\bar{v}$ from $t = 1$ s to $t = 3$ s.

CONFIDENCE CHECK 2

Instantaneous velocity

Differentiate first.

For $x(t) = 4t^3 - t$, find v at $t = 1$ s.

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**Average velocity is a secant slope**

Use endpoint displacement divided by elapsed time for a finite interval.

KEY TAKEAWAY 2**Instantaneous velocity is dx/dt**

Differentiate $x(t)$ to obtain the local rate and direction of position change.

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

WARM-UP • ACTIVITY 1

Key Ideas

$$v(t) = 2t + 2.$$

WHY IT WORKS Instantaneous velocity is dx/dt .

WARM-UP • ACTIVITY 2

Common Mistakes

Average velocity: secant slope. Instantaneous velocity: tangent slope.

WHY IT WORKS Both are rates of change of position, but over different time scales.

WARM-UP • ACTIVITY 3

Quick Application

It has a horizontal tangent at t_0 .

WHY IT WORKS Zero derivative means zero instantaneous slope; direction may or may not change there.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Guided Example

$x(1) = -1$ m, $x(4) = 8$ m, so $\bar{v} = 3$ m/s. $v(t) = 2t - 2$, so $v(4) = 6$ m/s.

WHY IT WORKS The interval slope and the endpoint tangent slope answer different questions.

PRACTICE 2

Independent Check

$v(t) = 3t^2 - 6t = 3t(t - 2)$, so $v = 0$ at $t = 0$ s and $t = 2$ s.

WHY IT WORKS Set the derivative of position equal to zero to find horizontal tangents.

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE CHECK 1

Average velocity

$$\bar{v} = (19 \text{ m} - 3 \text{ m}) / (2 \text{ s}) = 8 \text{ m/s.}$$

WHY IT WORKS Average velocity is the secant slope over the specified interval.

CONFIDENCE CHECK 2

Instantaneous velocity

$$v(t) = 12t^2 - 1, \text{ so } v(1) = 11 \text{ m/s.}$$

WHY IT WORKS The derivative gives the tangent slope at the requested time.

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