

FOCUSED REVIEW

Focused Review — Acceleration and Constant-Acceleration Motion — 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-T02
TOPIC: Acceleration and Constant-Acceleration Motion
PARENT UNIT: MEC-U03 — Motion in One Dimension
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**

Connect the graph to the derivative.

What does the slope of a v -versus- t graph represent at a given time?

WARM-UP 2**Common Mistakes**

Distinguish an instantaneous value from a rate.

Can $v = 0$ while $a \neq 0$? Give a one-dimensional example.

FR-04 • WARM-UP CHECK CONTINUED

WARM-UP 3

Quick Application

Use an integral interpretation.

What does the signed area under an a -versus- t graph represent?

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

Differential Definition of Acceleration

Instantaneous acceleration is the derivative of velocity. Equivalently, it is the second derivative of position, so curvature in $x(t)$ is tied directly to acceleration.

$$a = dv/dt = d^2x/dt^2$$

EXAMPLE For $x(t) = 2 + 5t - t^2$, $v(t) = 5 - 2t$ and $a(t) = -2 \text{ m/s}^2$.

SENSEI NOTE A zero slope in $x(t)$ means $v = 0$, not necessarily $a = 0$.

KEY CONCEPT 2

Integrating Constant Acceleration

When a is constant, integrate acceleration over time to obtain velocity, then integrate velocity to obtain position. Initial conditions determine the integration constants.

$$v(t) = v_0 + at$$

EXAMPLE Integrating constant a from 0 to t gives $v - v_0 = at$.

SENSEI NOTE Initial conditions are essential; integration does not determine them automatically.

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**

Differentiate first, then evaluate.

A particle has $x(t) = 1 + 4t + 1.5t^2$ in SI units. Find $v(2 \text{ s})$ and a .

PRACTICE 2**Independent Check**

Use the constant-acceleration result with signed quantities.

A particle has $v_0 = -3 \text{ m/s}$ and constant $a = +2 \text{ m/s}^2$. Find the time when it reverses direction and the displacement up to that instant.

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**Second Derivative**

Differentiate twice.

For $x(t) = 6 - 2t + 4t^2$, what are $v(t)$ and $a(t)$?

CONFIDENCE CHECK 2**Area under Acceleration**

Use $\Delta v = \int a \, dt$ for constant a .

If $a = -5 \, \text{m/s}^2$ for $0.60 \, \text{s}$, what is the change in velocity?

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**Derivative View**

Acceleration is the local derivative dv/dt and also d^2x/dt^2 . Graph slopes encode these derivative relationships.

KEY TAKEAWAY 2**Integral View**

Integrating acceleration gives velocity change; integrating velocity gives displacement. Constant acceleration yields linear $v(t)$ and quadratic $x(t)$.

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.

WARM-UP • ACTIVITY 1

Key Ideas

Instantaneous acceleration.

WHY IT WORKS The derivative dv/dt is the slope of $v(t)$.

WARM-UP • ACTIVITY 2

Common Mistakes

Yes. At the top of a vertical throw, $v = 0$ momentarily while acceleration remains downward.

WHY IT WORKS Velocity can pass through zero while its derivative remains finite.

WARM-UP • ACTIVITY 3

Quick Application

The change in velocity, Δv .

WHY IT WORKS Integrating acceleration over time accumulates velocity change.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Guided Example

$v(t) = 4 + 3t$, so $v(2) = 10 \text{ m/s}$; $a = 3 \text{ m/s}^2$.

WHY IT WORKS Differentiation converts position to velocity and then to acceleration.

PRACTICE 2

Independent Check

Set $0 = -3 + 2t$, so $t = 1.5 \text{ s}$. Then $\Delta x = (-3)(1.5) + \frac{1}{2}(2)(1.5^2) = -2.25 \text{ m}$.

WHY IT WORKS The reversal occurs at $v = 0$; the signed displacement follows from the integrated constant-acceleration motion.

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE CHECK 1

Second Derivative

$$v(t) = -2 + 8t \text{ and } a(t) = +8 \text{ m/s}^2.$$

WHY IT WORKS The first derivative gives velocity; the second derivative gives acceleration.

CONFIDENCE CHECK 2

Area under Acceleration

$$\Delta v = (-5)(0.60) = -3.0 \text{ m/s}.$$

WHY IT WORKS For constant acceleration, the acceleration–time area is simply $a\Delta t$.

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