FULL REVIEW

Full Review: Motion in One Dimension

Review the essential ideas, relationships, graphs, and algebra-based problem-solving tools for motion in one dimension.

TIME	BEST FOR	FINISH WITH
45–60 minutes	A complete unit review	A readiness check

After this full review, you'll be able to…
interpret one-dimensional motion, apply algebra-based kinematics to representative problems, and determine what to study next.

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 • UNIT ALIGNMENT

Unit Alignment

This bundle is aligned to the approved Physics Sensei unit specification below. Use it to recover the unit structure, reinforce key decisions, and confirm readiness for the next study task.

ARCHITECTURE: Physics Sensei Independent Mechanics UNIT: MEC-U02 — Motion in One Dimension SCOPE: Unit Review PHYSICS LEVEL: Algebra-Based	BEST USED ✓ Before homework on one-dimensional kinematics ✓ Before a quiz or exam ✓ When signs, graphs, or constant-acceleration problems feel uncertain

Review Prerequisites →

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

Use displacement—not distance—to calculate average velocity.

A runner moves from $x = 5.0$ m to $x = -7.0$ m in 4.0 s. Find the runner's average velocity.

ACTIVITY 2

Recall Activity 2

Compare the change in velocity with the elapsed time and keep the sign.

A car traveling at +18 m/s brakes uniformly to +6.0 m/s in 3.0 s. Find its average acceleration.

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Recall Activity 3

Use the signed area under a velocity–time graph to find displacement.

Velocity increases linearly from +2.0 m/s to +8.0 m/s during a 3.0 s interval. Find the displacement during the interval.

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

Position, displacement, velocity, and signs

Choose a coordinate axis first. Position locates an object relative to the origin; displacement is the signed change in position. Average velocity uses displacement, not total distance. Speed is a magnitude and is never negative.

$$\Delta x = x_2 - x_1 \quad \bullet \quad v\_avg = \Delta x/\Delta t$$

EXAMPLE $\Delta x = x_2 - x_1$; average velocity = $\Delta x/\Delta t$. Example: from $x = +3$ m to $x = -9$ m in 4 s, $\Delta x = -12$ m and average velocity = -3 m/s.

SENSEI NOTE A negative velocity means motion in the negative coordinate direction. It does not automatically mean the object is slowing down.

KEY CONCEPT 2

Constant acceleration gives a compact kinematics toolkit

When acceleration is constant, velocity changes linearly with time and position changes quadratically. Select the equation that contains the known quantities and the single unknown you need.

$$v = v_0 + at \quad \bullet \quad \Delta x = v_0 t + \tfrac{1}{2}at^2$$

EXAMPLE $v = v_0 + at$; $\Delta x = v_0t + \tfrac{1}{2}at^2$; $v^2 = v_0^2 + 2a\Delta x$; $\Delta x = \tfrac{1}{2}(v_0 + v)t$. Example: $v_0 = 5$ m/s, $a = 2$ m/s², $t = 4$ s gives $v = 13$ m/s and $\Delta x = 36$ m.

SENSEI NOTE These shortcut equations require constant acceleration over the interval. If the motion changes stages, reset the initial conditions for each stage.

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Motion graphs and vertical free fall tell the same story

The slope of an x–t graph gives velocity. The slope of a v–t graph gives acceleration. Signed area under a v–t graph gives displacement. Near Earth, ideal vertical free fall is one-dimensional motion with constant downward acceleration.

slope(x–t) → v • slope(v–t) → a • area(v–t) → Δx

EXAMPLE slope(x–t) → v; slope(v–t) → a; area under v–t → Δx. If +y is upward, vertical acceleration is −g. A tossed ball has v = 0 momentarily at the top while a = −g.

SENSEI NOTE Zero velocity at an instant does not imply zero acceleration. Keep the chosen vertical sign convention from start to finish.

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

Separate the motion into two time intervals and carry the final velocity of the first interval into the second.

A car travels at 12.0 m/s for 5.0 s, then accelerates uniformly at 3.00 m/s² for 4.00 s. Find the total displacement and final speed.

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Guided Problem

Use the constant-acceleration equations once with the stopping condition $v = 0$.

A bicycle moving at 10.0 m/s brakes with constant acceleration −2.50 m/s². Find the stopping time and stopping distance.

PRACTICE 3

Independent Problem

Choose +y upward, use $a = -g$, and solve the upward part of the motion.

A ball is launched straight upward from ground level at 19.6 m/s. Ignore air resistance. Find the time to maximum height and the maximum height.

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

Choose the equation that removes time

Identify the equation containing v, v_0, a, and Δx but not t.

An object has $v_0 = 4.0$ m/s, $a = 3.0$ m/s², and $\Delta x = 10$ m. Which constant-acceleration equation finds the final velocity without first finding time?

QUICK CHECK 2

Use area on a velocity–time graph

Treat the triangular region under the graph as signed displacement.

A velocity–time graph rises linearly from 0 at $t = 0$ to +12 m/s at $t = 6.0$ s. Find the displacement during the interval.

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Apply the free-fall sign convention

Take +y upward, so the acceleration is negative.

A rock is dropped from rest and falls for 2.0 s. With +y upward and $g = 9.80\ m/s^2$, find its velocity and displacement.

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

Define the axis before the algebra

Signs come from the coordinate choice. Distinguish displacement from distance and velocity from speed before substituting numbers.

KEY TAKEAWAY 2

Match the equation to the model

The standard kinematics equations are powerful because acceleration is constant. Use known quantities to choose the most direct equation.

KEY TAKEAWAY 3

Use graphs and physical checks

Slope and signed area connect x, v, and a. Check units, signs, graph behavior, and whether the final result makes physical sense.

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. Compare your setup, signs, units, and interpretation with the explanations below.

WARM-UP • ACTIVITY 1

Recall Activity 1

–3.0 m/s.

WHY IT WORKS $\Delta x = -7.0\ \text{m} - 5.0\ \text{m} = -12.0\ \text{m}$. Average velocity $= \Delta x/\Delta t = -12.0/4.0 = -3.0$ m/s.

WARM-UP • ACTIVITY 2

Recall Activity 2

–4.0 m/s².

WHY IT WORKS Average acceleration $= (6.0 - 18)/3.0 = -4.0\ \text{m/s}^2$. The negative sign is consistent with the positive velocity decreasing.

WARM-UP • ACTIVITY 3

Recall Activity 3

15 m.

WHY IT WORKS The signed area is a trapezoid: average velocity is $\frac{1}{2}(2.0 + 8.0) = 5.0$ m/s, so $\Delta x = (5.0)(3.0) = 15$ m.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Worked Example

Total displacement = 132 m; final speed = 24.0 m/s.

WHY IT WORKS First interval: $\Delta x_1 = (12.0)(5.0) = 60.0$ m. Second interval: $\Delta x_2 = (12.0)(4.0) + \frac{1}{2}(3.00)(4.00^2) = 72.0$ m. Total = 132 m. Final speed is $v = 12.0 + (3.00)(4.00) = 24.0$ m/s.

PRACTICE 2

Guided Problem

Stopping time = 4.00 s; stopping distance = 20.0 m.

WHY IT WORKS Use $0 = 10.0 - 2.50t$ to obtain $t = 4.00$ s. Then $0 = (10.0)^2 + 2(-2.50)\Delta x$ gives $\Delta x = 20.0$ m.

PRACTICE 3

Independent Problem

Time to maximum height = 2.00 s; maximum height = 19.6 m.

WHY IT WORKS At the top, $v = 0$. With $+y$ upward, $0 = 19.6 - 9.80t$ gives $t = 2.00$ s. Then $\Delta y = 19.6(2.00) - \frac{1}{2}(9.80)(2.00^2) = 19.6$ m.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Choose the equation that removes time

$v^2 = v_0^2 + 2a\Delta x$.

WHY IT WORKS It contains the desired final velocity and the given v_0, a, and Δx, but no time.

QUICK CHECK 2

Use area on a velocity–time graph

36 m.

WHY IT WORKS The displacement is the triangular area under v(t): ½(6.0 s)(12 m/s) = 36 m.

QUICK CHECK 3

Apply the free-fall sign convention

v = –19.6 m/s; Δy = –19.6 m.

WHY IT WORKS With $v_0 = 0$ and $a = -9.80\ \text{m/s}^2$, $v = at = -19.6$ m/s and $\Delta y = \frac{1}{2}at^2 = -19.6$ m.

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 unit.	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