FULL REVIEW

Full Review: Motion in Two Dimensions

Review planar motion through vectors, components, trajectories, and qualitative reasoning before relying on heavy calculation.

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

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

explain what position, velocity, acceleration, and motion graphs mean physically and use those ideas to predict two-dimensional motion.

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 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-U03 — Motion in Two Dimensions SCOPE: Unit Review PHYSICS LEVEL: Foundational	BEST USED ✓ Before work with vectors or projectile motion ✓ When components or trajectories feel confusing ✓ When you want to understand the physics before calculating

Review Prerequisites →

Physics Sensei is an independent educational resource. This review is independently authored and organized under the approved Physics Sensei mechanics architecture.

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 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

Separate a path from the net displacement vector.

A student walks 6 m east and then 8 m north. What are the displacement magnitude and total distance traveled?

ACTIVITY 2

Recall Activity 2

Identify perpendicular velocity components.

A drone moves east while also climbing. Which velocity components are positive if +x is east and +y is up?

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Recall Activity 3

Recognize independent component motion.

In ideal projectile motion, which velocity component stays constant and which changes?

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

Vectors describe position and displacement in a plane

A position vector locates an object relative to an origin. Displacement is the vector from initial to final position; distance is the total path length.

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

EXAMPLE $\Delta\vec{r} = \langle \Delta x, \Delta y \rangle$. A displacement $\langle 6, 8 \rangle$ m has magnitude 10 m and points 53° above +x.

SENSEI NOTE Define both axes before interpreting component signs.

KEY CONCEPT 2

Velocity and acceleration are vectors with components

Velocity is tangent to the path; acceleration describes how the velocity vector changes. Analyze x and y components independently, then recombine them.

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

EXAMPLE A velocity $\langle 3,4 \rangle$ m/s has speed 5 m/s. If acceleration is $\langle 0,-9.8 \rangle$ m/s², only the vertical velocity component changes.

SENSEI NOTE A negative component indicates axis direction; a vector magnitude is never negative.

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Projectile motion combines two simple component motions

For an ideal projectile, horizontal velocity is constant while vertical velocity changes uniformly under gravity. Both components share the same time.

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

EXAMPLE A horizontal launch has v_x constant, $v_y = -gt$, $x = v_x t$, and $y = y_0 - \frac{1}{2}gt^2$.

SENSEI NOTE At the top of a projectile path, $v_y = 0$ but v_x and downward acceleration remain.

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

Combine perpendicular displacements as vectors.

A student walks 6 m east and 8 m north. Find the displacement magnitude and direction.

PRACTICE 2

Guided Problem

Distinguish vertical from horizontal motion at the top.

At the top of an ideal projectile path, describe v_x, v_y, and acceleration.

PRACTICE 3

Independent Problem

Use relative velocity to describe motion seen from shore.

A boat moves north relative to the water while the current flows east. In what general direction does it move relative to shore?

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

Identify a constant component

Use the acceleration direction.

For ideal projectile motion, which velocity component remains constant?

QUICK CHECK 2

Combine vector components

Use the Pythagorean theorem.

A velocity has components 6 m/s east and 8 m/s north. What is its speed?

QUICK CHECK 3

Use a shared flight time

Apply the same time to both components.

Why must the horizontal and vertical projectile equations use the same time?

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

Components describe direction

Define perpendicular axes; component signs then describe vector direction.

KEY TAKEAWAY 2

Treat component motions independently

The x and y equations are linked by a common time, not by forces between the components.

KEY TAKEAWAY 3

Vectors recombine the component story

Use magnitude and direction to recombine components into a physical vector.

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

10 m displacement; 14 m distance.

WHY IT WORKS The displacement magnitude is $\sqrt{(6^2+8^2)}=10$ m. Distance follows the path: 6+8=14 m.

WARM-UP • ACTIVITY 2

Recall Activity 2

$v_x > 0$ and $v_y > 0$.

WHY IT WORKS East is +x and upward is +y, so both stated velocity components are positive.

WARM-UP • ACTIVITY 3

Recall Activity 3

v_x stays constant; v_y changes because of gravity.

WHY IT WORKS Ideal projectile motion has $a_x=0$ and $a_y=-g$.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Worked Example

10 m at 53° north of east.

WHY IT WORKS Combine ⟨6,8⟩ m: magnitude 10 m and direction $\tan^{-1}(8/6)=53°$.

PRACTICE 2

Guided Problem

$v_y=0$ momentarily; v_x remains nonzero; $\vec{a}$ points downward.

WHY IT WORKS Gravity changes vertical velocity but not horizontal velocity.

PRACTICE 3

Independent Problem

Northeast relative to shore.

WHY IT WORKS The northward boat velocity and eastward current add as perpendicular vectors.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Identify a constant component

The horizontal component v_x.

WHY IT WORKS With $a_x=0$, horizontal velocity does not change.

QUICK CHECK 2

Combine vector components

10 m/s.

WHY IT WORKS $\sqrt{(6^2+8^2)}=10$ m/s.

QUICK CHECK 3

Use a shared flight time

Because one physical motion has one elapsed time.

WHY IT WORKS The component equations describe the same object during the same interval.

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