FULL REVIEW

Full Review: Projectile Motion — Foundational

Review the essential ideas, relationships, and problem-solving tools for projectile motion.

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

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

analyze vector motion, solve representative projectile and relative-motion problems, and interpret circular acceleration.

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 bundle is designed to complement the chapter listed below. Use it to reinforce key concepts, prepare for homework, or review before a quiz or exam.

TEXTBOOK: Independent Physics Sensei Unit Review **CHAPTER: MEC-U15** **TOPIC: MEC-U15 — Projectile Motion** **COURSE LEVEL: Foundational introductory physics**	**BEST USED** ✓ After reading the chapter ✓ Before starting homework ✓ Before a quiz or exam

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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 the motion diagram, not a formula, to identify which parts of the motion change.

A ball is launched horizontally from a table. Neglect air resistance. As it travels, what happens to its horizontal velocity, vertical velocity, and downward acceleration?

ACTIVITY 2

Recall Activity 2

Think about the top of the path as a turning point in only one direction.

At the highest point of an angled projectile, is the projectile momentarily at rest? State the horizontal and vertical velocity components and the acceleration direction.

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Recall Activity 3

Compare two objects that have identical vertical starting conditions.

Two balls leave the same height at the same instant. One is dropped and one is launched horizontally. Which reaches the floor first if air resistance is negligible?

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

The Ideal Projectile Model

Projectile motion is two perpendicular motions happening at once. With air resistance neglected, gravity is the only acceleration: horizontal motion is uniform while vertical motion is uniformly accelerated downward. The two components are physically independent but occur during the same elapsed time.

Horizontal: $a_x = 0$ and v_x = constant. Vertical: $a_y = -g$. Both use the same time t.

EXAMPLE A ball rolls off a level table. Equal time marks along its path are equally spaced horizontally but farther apart vertically, showing constant horizontal velocity and increasing downward vertical speed.

SENSEI NOTE Do not imagine a forward force "carrying" the projectile. After release, ideal horizontal motion needs no horizontal force to continue.

KEY CONCEPT 2

Trajectory, Time, Range, and Height

The curved path comes from combining constant horizontal motion with accelerated vertical motion. Time is the bridge between the axes. For a horizontal launch, the vertical drop determines how long the projectile is airborne; for an angled launch, the vertical component determines when it rises, reaches the top, and lands.

Conceptual workflow: resolve the launch → solve the vertical motion for time → use the same time to locate the projectile horizontally.

EXAMPLE A horizontally launched ball and a dropped ball from the same height land together, but the launched ball lands farther away because it also moves horizontally during the shared fall time.

SENSEI NOTE A longer horizontal distance does not mean a longer fall time when the two objects have the same vertical starting conditions.

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Velocity Along the Path and Model Limits

Velocity is tangent to the trajectory. The horizontal component remains constant, while the vertical component changes continuously because of gravity. The projectile speeds up while descending because its downward velocity grows. Real projectiles deviate from this model when air drag, lift, wind, or large altitude changes matter.

Direction comes from combining v_x and v_y. At the apex $v_y = 0$, but $a_y = -g$.

EXAMPLE On the descending side of a trajectory, the velocity arrow points forward and downward while the acceleration arrow still points straight downward.

SENSEI NOTE Acceleration is not required to point in the direction of motion. For a projectile, velocity is tangent to the path while acceleration is vertical downward.

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

Use component reasoning to compare the two motions.

A marble rolls horizontally off a 1.2 m high bench while an identical marble is released from rest at the same instant. Which marble has the greater downward speed just before impact?

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Guided Problem

Track which component changes before, at, and after the top of the trajectory.

A soccer ball is kicked upward and forward. Describe the directions of its velocity and acceleration while rising, at the highest point, and while falling.

PRACTICE 3

Independent Problem

Decide whether the ideal projectile model is appropriate.

For each case, state whether the ideal projectile model is a reasonable first approximation: a tossed classroom ball, a feather released outdoors, and a long-range golf drive in strong wind.

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

Horizontal–Vertical Independence

Choose the statement that matches the ideal model.

If the horizontal launch speed of a ball from a fixed-height table is doubled, does the time to hit the floor double, halve, or stay the same?

QUICK CHECK 2

Apex Check

Identify what is zero and what is not.

At the top of an ideal angled projectile path, which of these are zero: total velocity, vertical velocity, horizontal velocity, acceleration?

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Read the Arrows

Use the physical directions, not memorized wording.

A projectile is moving down and to the right. Which way do its velocity and acceleration vectors point?

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

Separate the Motions

Treat horizontal and vertical motion independently, but remember that both components describe the same object at the same time.

KEY TAKEAWAY 2

The Apex Does Not Turn Gravity Off

At the highest point only vertical velocity is momentarily zero; horizontal velocity remains and acceleration is still downward.

KEY TAKEAWAY 3

Use the Model Deliberately

Ideal projectile motion is an approximation that neglects air effects and assumes nearly constant gravitational acceleration.

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

Horizontal velocity stays constant; the downward vertical velocity grows in magnitude; acceleration stays constant and downward at g.

WHY IT WORKS Gravity changes only the vertical component in the ideal model. The horizontal component has no acceleration, while the vertical component becomes increasingly downward.

WARM-UP • ACTIVITY 2

Recall Activity 2

No. The vertical velocity is zero momentarily, the horizontal velocity is still nonzero, and acceleration is downward.

WHY IT WORKS The projectile stops rising for an instant, but it continues moving horizontally. Gravity does not switch off at the top.

WARM-UP • ACTIVITY 3

Recall Activity 3

They reach the floor at the same time.

WHY IT WORKS Their vertical motions are identical: same starting vertical velocity, same vertical displacement, and the same downward acceleration. Horizontal motion does not change the fall time.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Worked Example

They have the same downward speed just before impact.

WHY IT WORKS The two marbles have identical vertical initial conditions and identical downward acceleration through the same vertical displacement, so their vertical velocities match at every instant.

PRACTICE 2

Guided Problem

Rising: velocity forward/up, acceleration down. Apex: velocity forward only, acceleration down. Falling: velocity forward/down, acceleration down.

WHY IT WORKS Gravity continuously changes only the vertical velocity. The horizontal velocity persists in the ideal model, so the projectile never stops completely at the apex.

PRACTICE 3

Independent Problem

Classroom ball: usually yes. Feather outdoors: usually no. Long golf drive in strong wind: only a rough approximation.

WHY IT WORKS The ideal model is strongest when air forces are small compared with gravity and the motion occurs over ordinary near-Earth distances.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Horizontal–Vertical Independence

It stays the same.

WHY IT WORKS The vertical motion is unchanged, so the fall time is unchanged. The ball simply travels farther horizontally during that same time.

QUICK CHECK 2

Apex Check

Only the vertical velocity is zero. Horizontal velocity and downward acceleration are nonzero, so total velocity is nonzero.

WHY IT WORKS The apex is a turning point for vertical motion only.

QUICK CHECK 3

Read the Arrows

Velocity points down and to the right, tangent to the path; acceleration points straight downward.

WHY IT WORKS Velocity describes the current direction of motion. Gravity determines the acceleration direction.

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.

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