

FULL REVIEW

Full Review: Gravitation — Foundational

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

 TIME 45–60 minutes	 BEST FOR A complete topic review	 FINISH WITH A readiness check
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After this full review, you'll be able to...

recall the essential ideas, apply them 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 • TOPIC ALIGNMENT

Topic Alignment

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

TEXTBOOK: Independent Physics Sensei Unit Review CHAPTER: Mechanics • MEC-U13 TOPIC: Gravitation COURSE LEVEL: Foundational	BEST USED ✓ After reading the chapter ✓ Before starting homework ✓ Before a quiz or exam
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Review Prerequisites →

Physics Sensei is an independent educational resource designed to complement independently authored Physics Sensei materials. Physics Sensei content is independently authored and organized under the approved topic 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 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**

Predict without calculating.

A satellite moves from distance r to $2r$ from a planet's center. How do the field strength and force on the satellite change?

ACTIVITY 2**Recall Activity 2**

Choose the correct distance.

A spacecraft is altitude h above a spherical planet of radius R . What distance belongs in GM/r^2 ?

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Recall Activity 3

Identify the real force.

What keeps an unpowered satellite moving around Earth, and why do astronauts feel weightless?

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

Force, field, direction, and superposition

Every mass attracts every other mass. Force acts along the line joining centers. A field describes what a source mass does to the space around it; a test mass placed there experiences force.

$$\mathbf{F} \propto m_1 m_2 / r^2; \mathbf{g} \propto M / r^2.$$

EXAMPLE Doubling distance makes force and field one-fourth; tripling source mass makes field three times larger.

SENSEI NOTE Lock the model before calculating: identify the source, test object, center-to-center distance, and direction of every contribution.

KEY CONCEPT 2

Potential, potential energy, work, and binding

Zero gravitational potential energy is chosen at infinite separation. A bound pair has negative potential energy. Moving masses farther apart increases U toward zero.

Farther apart → U increases toward 0; closer → U becomes more negative.

EXAMPLE A satellite lifted to a higher orbit has greater (less negative) potential energy.

SENSEI NOTE Negative U is not “negative energy motion.” K remains nonnegative; the sign of total E classifies whether an ideal two-body orbit is bound.

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Circular orbits, escape, and Kepler relationships

An orbit is continuous free fall. Closer circular orbits are faster and have shorter periods. Escape means reaching infinite separation with no remaining speed in the minimum-energy case.

Closer circular orbit → larger speed, shorter period; $v_{\text{escape}} = \sqrt{2} v_{\text{circular}}$ at the same r .

EXAMPLE If circular-orbit radius becomes four times larger, speed halves and period becomes eight times larger.

SENSEI NOTE Never use altitude in an orbital formula until you convert it to radius from the center. Never add a separate “centripetal force” to gravity.

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**

Model the interaction, show direction, and calculate or justify the result.

Two identical source masses lie symmetrically left and right of a point. Predict the net field at the point.

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Guided Problem

Choose an energy reference and solve without using constant- g kinematics.

A spacecraft coasts outward after its engine stops. Describe the changes in K , U , and total E .

PRACTICE 3

Independent Problem

Select the orbital relationship, state assumptions, and check scale.

Two circular satellites orbit the same planet at radii r and $9r$. Compare speeds and periods.

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**Force or field?**

Answer and justify in one sentence.

If the test mass doubles, what happens to the field at its location and to the force on it?

QUICK CHECK 2**Energy sign and motion**

Classify the claim.

"Negative gravitational potential energy means the satellite cannot move." Correct or incorrect?

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Orbit model check

Choose the valid relationship.

Which satellite has the shorter period: smaller or larger circular radius?

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

Choose the gravitational quantity

Force depends on source and test masses; field and potential describe the source at a location. Preserve vector direction for force and field.

KEY TAKEAWAY 2

Use the general energy model

With zero at infinity, $U = -GMm/r$. Use mgh only for small height changes in an approximately uniform field.

KEY TAKEAWAY 3

Orbit means gravity-driven free fall

For a circular orbit, gravity is the net inward force. Radius is measured from the center; escape and general bound orbits are best analyzed with energy.

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. Replace each placeholder with a concise answer and the essential explanation.

WARM-UP • ACTIVITY 1

Recall Activity 1

Both become one-fourth as large.

WHY IT WORKS Gravity follows an inverse-square distance rule.

WARM-UP • ACTIVITY 2

Recall Activity 2

$r = R+h$, measured from the planet's center.

WHY IT WORKS Point-mass and spherical-source models use center-to-center separation.

WARM-UP • ACTIVITY 3

Recall Activity 3

Gravity supplies the inward acceleration; astronaut and spacecraft share the same free fall.

WHY IT WORKS Apparent weightlessness is negligible support force, not absence of gravity.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Worked Example

Zero. Equal field vectors point in opposite directions.

WHY IT WORKS Symmetry cancels the vectors; neither field is absent.

PRACTICE 2

Guided Problem

K decreases, U increases toward zero, and total E stays constant in the ideal isolated model.

WHY IT WORKS Gravity does negative work during outward motion.

PRACTICE 3

Independent Problem

At $9r$, speed is one-third and period is 27 times larger.

WHY IT WORKS Use $v \propto r^{-1/2}$ and $T \propto r^{3/2}$.

SOLUTIONS • CONFIDENCE CHECK**QUICK CHECK 1****Force or field?**

Field is unchanged; force doubles.

WHY IT WORKS The field is created by the source; force also depends on the test mass.

QUICK CHECK 2**Energy sign and motion**

Incorrect.

WHY IT WORKS The zero of U is conventional; kinetic energy remains nonnegative.

QUICK CHECK 3**Orbit model check**

Smaller radius.

WHY IT WORKS $T \propto r^{3/2}$.

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 Review the key ideas and examples again. Review again: return to Warm-Up Check on page 4.	🕒 I Need More Practice Continue with additional practice for this topic. Go to Practice →	✓ I'm Ready Continue to the next recommended resource. Continue →
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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