

QUICK REVIEW

Quick Review: Center of Mass and Systems of Particles

Refresh the essential center-of-mass formulas and system-motion relationships in just a few minutes.

 TIME 5 minutes	 BEST FOR A rapid refresh	 FINISH WITH Key ideas refreshed
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After this quick review, you'll be able to...

calculate a discrete center of mass and remember the links $P = M V_{CM}$ and net external force = $M \Delta V_{CM}$.

HOW TO USE THIS GUIDE

Work through the four stages in order. Write directly in the spaces provided, check your work in the Quick Answers 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 5 minutes

FR-02 • PHYSICS SENSEI UNIT REVIEW

Physics Sensei Unit Review

Use this Physics Sensei Unit Review to reinforce key concepts, prepare for homework, and review before a quiz or exam.

UNIT: MEC-U19**TOPIC FAMILY: Mechanics****TOPIC: Center of Mass and Systems of Particles****COURSE LEVEL: Algebra-based introductory college physics****BEST USED**

- ✓ **To reinforce key concepts**
- ✓ Before starting homework
- ✓ Before a quiz or exam

Continue with Physics Sensei →

Physics Sensei is an independent educational resource organized around core college-physics ideas, problem-solving models, and study workflows.

FR-03 • YOUR REVIEW PLAN

Your Review Plan

Complete these four stages to quickly refresh the essential ideas and confirm you're ready to continue.

4 stages • Approximately 5 minutes

1 Quick Recall — page 4 Refresh what you already know.	2 Essential Idea — page 5 Review the most important concept.
3 Confidence Check — page 6 Confirm you're ready to move on.	4 Next Step — page 8 Continue your learning.

PRINTING TIP

For student copies, print double-sided and keep the Quick Answers section after the student activities so learners attempt each activity before checking their work.

FR-04 • STAGE 1 OF 4

Quick Recall

Let's quickly refresh what you already know. This short recall activity will bring the most important ideas back to mind before you review them.

QUICK RECALL

Recall Activity

Complete the three statements from memory before revealing the answer.

1) $x_{CM} = \Sigma(mi x_i) / \underline{\hspace{1cm}}$. 2) Total momentum satisfies $P = M \underline{\hspace{1cm}}$. 3) Center-of-mass acceleration satisfies net external force = $M \underline{\hspace{1cm}}$.

Ready to refresh the essentials?

Great! Now review the most important idea you'll want to remember.

Continue to Essential Idea — page 5 →

FR-05 • STAGE 2 OF 4

Essential Idea

Take one last look at the most important concept from this topic. If you remember this idea, the rest will come back much more easily.

ESSENTIAL IDEA

Weighted Position → Momentum → External Force

For discrete particles, the center of mass is a mass-weighted average of position. Once the system is defined, total momentum connects to center-of-mass velocity through $\mathbf{P} = M \mathbf{V}_{\text{CM}}$, and net external force connects to center-of-mass acceleration through net external force = $M \mathbf{A}_{\text{CM}}$.

$$x_{\text{CM}} = \frac{\sum_i m_i x_i}{M} \quad \mathbf{P} = M \mathbf{V}_{\text{CM}} \quad \sum \mathbf{F}_{\text{ext}} = M \mathbf{A}_{\text{CM}}$$

EXAMPLE For 2.0 kg at $x = 1.0$ m and 3.0 kg at $x = 5.0$ m, $x_{\text{CM}} = 3.4$ m.

SENSEI NOTE Define the system first. Internal forces redistribute momentum inside the system; net external force determines $\mathbf{A}_{\text{CM}}$.

Ready to check your memory?

You've refreshed the essential idea. Now see how much you remember before moving on.

[Continue to Confidence Check — page 6 →](#)

FR-06 • STAGE 3 OF 4

Confidence Check

You've refreshed the essential idea. Now answer this quick confidence check to confirm you're ready to move on.

CONFIDENCE CHECK

Five-Minute Readiness Check

Answer all three without notes.

A 2.0 kg mass is at $x = 0$ and a 3.0 kg mass is at $x = 5.0$ m. Find x_{CM} . Then state the equations linking total momentum to VCM and net external force to ACM.

Ready for your next step?

Great work! You've refreshed the essential idea. Now choose the resource that best matches what you'd like to do next.

Continue to Next Step — page 8 →

QUICK ANSWERS • CHECK AFTER ATTEMPTING

Quick Answers and Explanations

Use these concise answers to check your recall and confidence—not only your final response.

QUICK RECALL

Recall Activity

1) M; 2) VCM; 3) ACM.

WHY IT WORKS These three relations are the core algebra-based system tools: mass-weighted position gives x_{CM} , total momentum gives VCM through $P = M V_{CM}$, and net external force gives ACM through $\text{net external force} = M \text{ ACM}$.

CONFIDENCE CHECK

CONFIDENCE CHECK

Five-Minute Readiness Check

$x_{CM} = [2(0) + 3(5)]/5 = 3.0 \text{ m}$. The system relations are $P = M V_{CM}$ and $\text{net external force} = M \text{ ACM}$.

WHY IT WORKS The mass-weighted average gives $x_{CM} = 3.0 \text{ m}$. The other two equations connect the entire system's momentum and net external force to the motion of its center of mass.

READINESS GUIDE

3 correct: You're ready to continue. • 2 correct: Review the missed idea. • 0–1 correct: Revisit the Essential Idea or choose more practice.

FR-07 • STAGE 4 OF 4

Next Step: Continue Learning

Great work! You've completed this quick review. Choose the next resource that best matches how confident you feel.

 I'm Still Unsure Review the essential idea again. Review again: return to Essential Idea on page 5.	 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 Essential Idea on page 5.

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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