

QUICK REVIEW

Quick Review: Rolling Motion

Refresh the most important ideas, formulas, and problem-solving strategies for rolling motion in just a few minutes.

 TIME 5–10 minutes	 BEST FOR A rapid refresh	 FINISH WITH Key ideas refreshed
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After this quick review, you'll be able to...

quickly recall the essential concepts, formulas, and problem-solving strategies needed to move forward with confidence.

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 5–10 minutes

FR-02 • COURSE ALIGNMENT

Course Alignment

This Physics Sensei Unit Review is an independent learning resource. Use it to reinforce key concepts, prepare for homework, or review before a quiz or exam.

RESOURCE: Physics Sensei Unit Review **UNIT ID:** MEC-U22
TOPIC: Rolling Motion **COURSE LEVEL:** Calculus-Based

BEST USED

- ✓ After learning the unit
- ✓ Before starting homework
- ✓ Before a quiz or exam

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 5–10 minutes

1 Quick Recall Refresh what you already know.	2 Essential Idea Review the most important concept.
3 Confidence Check Confirm you're ready to move on.	4 Next Step 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

Recall the instantaneous kinematics of a rigid body rolling without slipping.

*For any point P : $\mathbf{v}[P] = \mathbf{v}_{CM} + \boldsymbol{\omega} \times \mathbf{r}[P/CM]$. At the contact point in pure rolling: $\mathbf{v}_{contact} = 0$. Therefore $|\mathbf{v}_{CM}| = \omega R$.
Tangentially, $a_{CM} = \alpha R$.*

Ready to refresh the essentials?

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

[Review the Essential Idea →](#)

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

Pure Rolling Is an Instantaneous Velocity Constraint

Rigid-body kinematics gives the velocity of any point as the center-of-mass velocity plus the rotational contribution. At the point of contact with a stationary surface, pure rolling requires those contributions to cancel instantaneously. That condition produces $v_{CM} = \omega R$ and, for tangential changes, $a_{CM} = \alpha R$.

$$\mathbf{v}_P = \mathbf{v}_{CM} + \boldsymbol{\omega} \times \mathbf{r}_{P/CM} \quad ; \quad \mathbf{v}_{\text{contact}} = \mathbf{0}$$

EXAMPLE At the top of a wheel rolling right at speed v_{CM} , the rotational contribution points right with the same magnitude, so the top point has speed $2v_{CM}$.

SENSEI NOTE The contact point can have zero instantaneous velocity and still have nonzero acceleration. Do not treat it as a permanently fixed point.

Ready to check your memory?

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

[Start the Confidence Check →](#)

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

Top-Point Speed

Use rigid-body velocity addition.

A wheel rolls right without slipping with center-of-mass speed v . What is the instantaneous speed of the point at the top of the wheel?

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.

Choose Your Next Step →

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

$v[P] = v_{CM} + \omega \times r[P/CM]$. At the contact point, pure rolling gives $v_{\text{contact}} = 0$, which implies $v_{CM} = \omega R$.

WHY IT WORKS The contact condition is a vector cancellation at one instant, not a statement that the contact point has zero acceleration.

CONFIDENCE CHECK

CONFIDENCE CHECK

Top-Point Speed

$2v$.

WHY IT WORKS At the top point, the translational and rotational velocity contributions point in the same direction and each has magnitude v .

READINESS GUIDE

1 correct: You're ready to continue. • 0 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 →	 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 this topic again →](#)[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](https://www.PhysicsSensei.com)