

FOCUSED REVIEW

Focused Review: Rolling Motion

Review the most important ideas, reinforce the essential skills, and confirm you're ready to move on.

 TIME 15–20 minutes	 BEST FOR Focused review	 FINISH WITH Greater confidence
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After this focused review, you'll be able to...

recognize the key concepts, reinforce your problem-solving skills, and continue with greater confidence.

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 15–20 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:** Foundational

BEST USED

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

FR-03 • YOUR REVIEW PLAN

Your Review Plan

Complete these six focused stages in order. Each stage reinforces your understanding and prepares you for a final confidence check.

6 stages • Approximately 15–20 minutes

1 Warm-Up Check Refresh key ideas.	2 Core Concepts Reinforce the essentials.	3 Guided Practice Strengthen key skills.
4 Confidence Check Confirm your understanding.	5 Summary Remember the essentials.	6 Next Step Choose your next step.

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 minute to reactivate what you already know. This quick warm-up will help you focus on the most important ideas before moving on.

WARM-UP 1**Key Ideas**

State what rolling without slipping means and write the relation between center-of-mass speed and angular speed.

Write a short response: State what rolling without slipping means and write the relation between center-of-mass speed and angular speed.

WARM-UP 2**Common Mistakes**

Is static friction always opposite the direction the object is moving? Explain.

Write a short response: Is static friction always opposite the direction the object is moving? Explain.

FR-04 • WARM-UP CHECK CONTINUED

WARM-UP 3

Quick Application

A wheel rolls right without slipping. What is the instantaneous speed of the bottom contact point relative to the ground?

Write a short response: A wheel rolls right without slipping. What is the instantaneous speed of the bottom contact point relative to the ground?

Ready to strengthen your understanding?

You've refreshed the most important ideas. Now reinforce the concepts you'll use most often.

Continue to Core Concepts →

FR-05 • STAGE 2 OF 6

Core Concepts

Let's reinforce the most important concepts you'll need to solve problems with confidence. Focus on the ideas that appear most often in homework, quizzes, and exams.

KEY CONCEPT 1

Translation + Rotation

A rolling rigid body has center-of-mass motion and rotation at the same time. For pure rolling, the contact point is instantaneously at rest and $v_{cm} = \omega R$.

$$v_{cm} = \omega R$$

EXAMPLE At the top of a wheel, translation and rotation reinforce each other, giving a speed larger than v_{cm} .

SENSEI NOTE Do not picture the wheel as only spinning or only translating; both motions are present.

KEY CONCEPT 2

Energy and Mass Distribution

A rolling object has $K = \frac{1}{2} M v_{cm}^2 + \frac{1}{2} I \omega^2$. Objects with larger moment of inertia require more energy in rotation at the same v_{cm} .

$$K = \frac{1}{2} M v_{cm}^2 + \frac{1}{2} I \omega^2$$

EXAMPLE A hoop has more rotational energy than a solid disk at the same M , R , and v_{cm} .

SENSEI NOTE Shape matters through moment of inertia, not through mass alone.

Ready to apply these ideas?

You've reinforced the essential concepts. Now strengthen your problem-solving skills by working through a few guided examples.

[Continue to Guided Practice →](#)

FR-06 • STAGE 3 OF 6

Guided Practice

Now apply the key concepts you've just reviewed. Work through these focused practice activities to reinforce your problem-solving skills before the final confidence check.

PRACTICE 1**Guided Example**

Compare a solid cylinder and hoop released from the same height. Which is faster at the bottom?

Compare a solid cylinder and hoop released from the same height. Which is faster at the bottom?

PRACTICE 2**Independent Check**

A wheel of radius 0.40 m rolls without slipping with angular speed 5.0 rad/s. Find v_{cm} .

A wheel of radius 0.40 m rolls without slipping with angular speed 5.0 rad/s. Find v_{cm} .

Ready for a confidence check?

You've reinforced the essential skills through focused practice. Now confirm your understanding with two short questions.

Continue to Confidence Check →

FR-07 • STAGE 4 OF 6

Confidence Check

You've reinforced the key concepts and practiced the essential skills. Now confirm you're ready to move forward by completing these short confidence checks.

CONFIDENCE CHECK 1

Contact Point

Answer without looking back.

What is the instantaneous velocity of the point touching the ground during pure rolling?

CONFIDENCE CHECK 2

Energy

Answer without looking back.

Name the two terms in the kinetic energy of a rolling rigid body.

HOW DID IT GO?

I answered ____ of 2 questions correctly.

Use the Solutions section to check your reasoning, then take one final look at the essential ideas.

You've confirmed your understanding.

Take one final look at the essential ideas before choosing your next step.

Continue to Summary →

FR-08 • STAGE 5 OF 6

Summary

Before moving on, take one final look at the essential ideas you'll want to remember.

KEY TAKEAWAY 1**No Slip**

Pure rolling couples translation and rotation through $v_{\text{cm}} = \omega R$.

KEY TAKEAWAY 2**Energy Split**

Rolling kinetic energy contains both translational and rotational parts.

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 →

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

Key Ideas

Rolling combines translation and rotation; pure rolling has $v_{\text{cm}} = \omega R$.

WHY IT WORKS Rolling combines translation and rotation; pure rolling has $v_{\text{cm}} = \omega R$.

WARM-UP • ACTIVITY 2

Common Mistakes

No. Static friction acts to prevent relative slipping at the contact point, so its direction depends on the situation.

WHY IT WORKS No. Static friction acts to prevent relative slipping at the contact point, so its direction depends on the situation.

WARM-UP • ACTIVITY 3

Quick Application

Zero.

WHY IT WORKS Zero.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Guided Example

The solid cylinder. Its smaller rotational inertia means a larger fraction of the lost gravitational potential energy becomes center-of-mass kinetic energy.

WHY IT WORKS The solid cylinder. Its smaller rotational inertia means a larger fraction of the lost gravitational potential energy becomes center-of-mass kinetic energy.

PRACTICE 2

Independent Check

$$v_{\text{cm}} = \omega R = 5.0(0.40) = 2.0 \text{ m/s.}$$

WHY IT WORKS $v_{\text{cm}} = \omega R = 5.0(0.40) = 2.0 \text{ m/s.}$

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE CHECK 1

Contact Point

Zero relative to the ground.

WHY IT WORKS Zero relative to the ground.

CONFIDENCE CHECK 2

Energy

Translational center-of-mass kinetic energy and rotational kinetic energy about the center of mass.

WHY IT WORKS Translational center-of-mass kinetic energy and rotational kinetic energy about the center of mass.

READINESS GUIDE

2 correct: You're ready to continue. • 1 correct: Review the missed idea, then continue. • 0 correct: Revisit Core Concepts or choose more practice.

FR-09 • STAGE 6 OF 6

Next Step: Continue Learning

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

 I'm Still Unsure Review the focused review again to strengthen the essential concepts. Review Again →	 I Need More Practice Build confidence with additional practice problems. Go to Practice →	 I'm Ready Continue to the next topic or learning 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)