FULL REVIEW

Full Review: Rotational Motion — Foundational

60-minute foundational review of rotational motion, emphasizing concept-first reasoning about angular motion, torque, rotational energy, and angular momentum.

TIME	BEST FOR	FINISH WITH
60 minutes	Full Review	Greater confidence

After this review, you'll be able to…

explain angular motion, connect radius to tangential motion, reason about torque and rotational inertia, and recognize when angular momentum is conserved.

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 optional • Approximately 60 minutes

FR-02 • UNIT ALIGNMENT

Unit Alignment

This Physics Sensei Unit Review covers MEC-U08 — Rotational Motion using the Foundational treatment. Use it to reinforce the unit, prepare for homework, or review before a quiz or exam.

UNIT ID: MEC-U08 **UNIT: Rotational Motion** **TREATMENT: Foundational** **RESOURCE: Unit Review**	**BEST USED** ✓ After reading the chapter ✓ Before starting homework ✓ Before a quiz or exam

Explore Rotational Motion Online →

Physics Sensei Unit Reviews use independent organization, wording, examples, and explanations.

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 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

Radius and Tangential Speed

Compare two points on the same rotating disk.

Point B is twice as far from the axis as point A. If the disk rotates rigidly, compare angular speeds and tangential speeds.

ACTIVITY 2

Torque Direction

Use the force line of action.

A force is applied directly through the rotation axis. What rotational effect does it have about that axis?

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Rotational Inertia

Reason about mass distribution.

Two wheels have the same mass and radius. More of wheel 2's mass is near the rim. Which is harder to angularly accelerate?

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

Rotational kinematics and rigid-body geometry

Angular position describes orientation; angular velocity and acceleration describe how orientation changes. Points on the same rigid body share angular quantities but have radius-dependent tangential motion.

$$\theta = s/r;\ v_t = r\omega;\ a_t = r\alpha;\ a_r = r\omega^2.$$

SENSEI NOTE Use radians in angular-linear relationships.

KEY CONCEPT 2

Torque, moment of inertia, and rotational energy

Torque depends on force and lever arm. Moment of inertia depends on mass distribution around the chosen axis. Rotational kinetic energy grows with I and ω^2.

$$\tau = r_\perp F;\ \Sigma\tau = I\alpha;\ K_{rot} = \tfrac{1}{2}I\omega^2.$$

SENSEI NOTE A larger I means less angular acceleration for the same net torque.

KEY CONCEPT 3

Rolling and angular momentum

For rolling without slipping, translation and rotation are linked. Angular momentum belongs to a chosen origin or axis and is conserved when net external torque is negligible.

$$v_{CM} = R\omega;\ L = I\omega \text{ for fixed-axis rigid-body rotation.}$$

SENSEI NOTE Angular momentum conservation does not automatically conserve rotational kinetic energy.

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

Rigid Disk Speeds

Work through the setup before checking the solution.

A disk rotates at 6 rad/s. Compare speeds at r=0.10 m and 0.30 m.

PRACTICE 2

Torque and Inertia Reasoning

Work through the setup before checking the solution.

The same torque acts on two flywheels; one has three times the moment of inertia. Compare α.

PRACTICE 3

Skater Conservation

Work through the setup before checking the solution.

A skater pulls mass inward while external torque is negligible. Describe what happens to I, ω, and L.

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

Direction and Speeding

Answer without notes and justify the physical reasoning.

If ω is clockwise and α is counterclockwise, what initially happens to angular speed?

QUICK CHECK 2

Lever Arm

Answer without notes and justify the physical reasoning.

What torque is produced by a force whose line of action crosses the axis?

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Rolling Boundary

Answer without notes and justify the physical reasoning.

When may vCM = Rω be used?

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

Rigid-body angular quantities are shared

Every point shares θ, ω, and α; tangential quantities vary with radius.

KEY TAKEAWAY 2

Axis-first reasoning prevents errors

Torque, inertia, angular momentum, and signs all depend on the chosen axis or origin.

KEY TAKEAWAY 3

Choose the conservation law that fits

Energy and angular momentum each require their own physical conditions.

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

Radius and Tangential Speed

Same angular speed; B has twice the tangential speed.

WHY IT WORKS Same angular speed; B has twice the tangential speed.

WARM-UP • ACTIVITY 2

Torque Direction

Zero torque about that axis.

WHY IT WORKS Zero torque about that axis.

WARM-UP • ACTIVITY 3

Rotational Inertia

Wheel 2; it has larger rotational inertia.

WHY IT WORKS Wheel 2; it has larger rotational inertia.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Rigid Disk Speeds

0.60 m/s and 1.8 m/s.

WHY IT WORKS The selected rotational relationship matches the stated assumptions and axis.

PRACTICE 2

Torque and Inertia Reasoning

The larger-I flywheel has one-third the angular acceleration.

WHY IT WORKS The selected rotational relationship matches the stated assumptions and axis.

PRACTICE 3

Skater Conservation

I decreases, ω increases, and L remains constant.

WHY IT WORKS The selected rotational relationship matches the stated assumptions and axis.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Direction and Speeding

It decreases because ω and α have opposite signs.

WHY IT WORKS The reasoning uses the correct sign, axis, conservation condition, or calculus relationship.

QUICK CHECK 2

Lever Arm

Zero.

WHY IT WORKS The reasoning uses the correct sign, axis, conservation condition, or calculus relationship.

QUICK CHECK 3

Rolling Boundary

Only when rolling without slipping is established.

WHY IT WORKS The reasoning uses the correct sign, axis, conservation condition, or calculus relationship.

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.

PhysicsSensei.com