FULL REVIEW

Full Review: Rotational Motion — Algebra-Based

60-minute algebra-based review of rotational motion, emphasizing algebraic rotational kinematics, torque, inertia, energy, and angular momentum problem solving.

◷ TIME	◎ BEST FOR	✓ FINISH WITH
60 minutes	Full Review	Greater confidence

After this review, you'll be able to…

calculate rotational kinematics, torque, moment of inertia, rotational energy, and angular momentum using algebraic models and consistent signs.

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 60 minutes

FR-02 • UNIT ALIGNMENT

Unit Alignment

This Physics Sensei Unit Review covers MEC-U08 — Rotational Motion using the Algebra-Based 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: Algebra-Based** **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

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

Angular Acceleration

Use signed angular quantities.

A wheel changes from 4.0 to 10.0 rad/s in 3.0 s. Find constant α.

ACTIVITY 2

Torque Magnitude

Use the perpendicular lever arm.

A 12 N force acts perpendicular to a 0.25 m radius. Find torque magnitude.

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Rotational Energy

Use Krot = ½Iω².

A rotor has I = 0.40 kg·m² and ω = 5.0 rad/s. Find Krot.

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 radius-dependent motion

Use signed angular variables and radians. Constant-α equations apply only when α is constant; tangential quantities follow from radius.

$$\omega_f = \omega_i + \alpha t;\ \Delta\theta = \omega_i t + \tfrac{1}{2}\alpha t^2;\ \omega_f^2 = \omega_i^2 + 2\alpha\Delta\theta;\ v_t = r\omega.$$

SENSEI NOTE Check signs of ω and α before describing speeding or slowing.

KEY CONCEPT 2

Moment of inertia, torque, and rotational energy

For particles, sum mr^2; for standard rigid bodies, use the formula for the stated axis. Compute torque with a perpendicular lever arm, then apply $\Sigma\tau = I\alpha$.

$$I = \Sigma mr^2;\ \tau = rF\sin\phi;\ \Sigma\tau = I\alpha;\ K_{rot} = \tfrac{1}{2}I\omega^2;\ P = \tau\omega.$$

SENSEI NOTE Torque has units N·m but is not an energy.

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Rolling and angular momentum conservation

No-slip rolling links center-of-mass speed and rotation. Angular momentum may be conserved when external torque about the chosen origin is negligible.

$$v_{CM} = R\omega;\ L = I\omega;\ I_i\omega_i = I_f\omega_f.$$

SENSEI NOTE Angular momentum conservation and energy conservation are separate tests.

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

Rotational Kinematics

Work through the setup before checking the solution.

A wheel starts at -12 rad/s with $\alpha = +3$ rad/s^2 for 2 s. Find ωf and $\Delta\theta$.

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Torque Dynamics

Work through the setup before checking the solution.

A disk with $I=0.80\ kg \cdot m^2$ has $+4.0\ N \cdot m$ and $-1.6\ N \cdot m$ torques. Find α.

PRACTICE 3

Angular Momentum Conservation

Work through the setup before checking the solution.

A rotating platform changes I from 6.0 to $4.0\ kg \cdot m^2$ with negligible external torque. If $\omega_i=2.0$ rad/s, find ω_f.

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

Tangential Speed

Answer without notes and justify the physical reasoning.

At $r=0.25$ m and $\omega=8$ rad/s, find v_t.

QUICK CHECK 2

Rotational Energy

Answer without notes and justify the physical reasoning.

For $I=0.50$ kg·m^2 and $\omega=6$ rad/s, find K_{rot}.

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Rolling Relation

Answer without notes and justify the physical reasoning.

A wheel rolls without slipping at 3.0 m/s with R=0.50 m. Find |ω|.

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

Use signs and radians consistently

Rotational kinematics is algebraically familiar but physically axis-dependent.

KEY TAKEAWAY 2

Compute torque and I about the same axis

That consistency is mandatory for $\Sigma\tau = I\alpha$.

KEY TAKEAWAY 3

Conservation conditions matter

No slip, negligible external torque, and energy conservation are distinct model assumptions.

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

Angular Acceleration

2.0 rad/s^2.

WHY IT WORKS 2.0 rad/s^2.

WARM-UP • ACTIVITY 2

Torque Magnitude

3.0 N·m.

WHY IT WORKS 3.0 N·m.

WARM-UP • ACTIVITY 3

Rotational Energy

5.0 J.

WHY IT WORKS 5.0 J.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Rotational Kinematics

ω_f=-6 rad/s; Δθ=-18 rad.

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

PRACTICE 2

Torque Dynamics

τ_{net}=2.4 N·m; α=3.0 rad/s^2.

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

PRACTICE 3

Angular Momentum Conservation

ω_f=3.0 rad/s.

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

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Tangential Speed

2.0 m/s.

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

QUICK CHECK 2

Rotational Energy

9.0 J.

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

QUICK CHECK 3

Rolling Relation

6.0 rad/s.

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