FOCUSED REVIEW

Focused Review: Rotational Motion — Calculus-Based

15-minute calculus-based review of rotational motion, emphasizing calculus-based rotational kinematics, distributed inertia, torque, work, and angular momentum modeling.

◷	◎	✓
TIME	**BEST FOR**	**FINISH WITH**
15 minutes	Focused Review	Greater confidence

After this review, you'll be able to…

use derivatives and integrals with rotational kinematics, moment of inertia, torque, work, and angular momentum while maintaining consistent axis and sign conventions.

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 minutes

FR-02 • UNIT ALIGNMENT

Unit Alignment

This Physics Sensei Unit Review covers MEC-U08 — Rotational Motion using the Calculus-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: Calculus-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 focused stages in order. Each stage reinforces your understanding and prepares you for a final confidence check.

6 stages • Approximately 15 minutes

1 **Warm-Up Check — page 4** Refresh key ideas.	2 **Core Concepts — page 6** Reinforce the essentials.	3 **Guided Practice — page 7** Strengthen key skills.
4 **Confidence Check — page 8** Confirm your understanding.	5 **Summary — page 10** Remember the essentials.	6 **Next Step — page 14** 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

Instantaneous Rates

Differentiate θ(t).

For $\theta = 2t + t^3$, find $\omega(t)$ and $\alpha(t)$.

WARM-UP 2

Continuous Inertia

Recognize the mass-distribution integral.

Which expression defines moment of inertia for a continuous body?

WARM-UP 3

Angular Impulse

Connect torque and angular momentum.

What does ∫τext dt equal?

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 — page 6 →

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

Differential rotational kinematics

Use derivatives for instantaneous angular rates and integrals to recover angular displacement. Radius maps angular quantities to tangential quantities.

$$\omega = d\theta/dt;\ \alpha = d\omega/dt;\ \Delta\theta = \int \omega\, dt;\ v_t = r\omega.$$

SENSEI NOTE Differentiate and integrate signed quantities.

KEY CONCEPT 2

Distributed inertia, work, and angular momentum

Mass distribution enters through $I = \int r^2\, dm$. Variable torque performs rotational work through $W = \int \tau\, d\theta$. External torque changes angular momentum through dL/dt.

$$I = \int r^2 dm;\ W = \int \tau\, d\theta;\ P = \tau\omega;\ \Sigma\tau_{ext} = dL/dt.$$

SENSEI NOTE Use $\Sigma\tau = I\alpha$ only when fixed-axis rigid-body assumptions and constant I are appropriate.

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 — page 7 →

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

Integrate Angular Velocity

Work the problem and justify the model.

$\omega(t)=2+3t^2$ rad/s from $t=0$ to 2 s. Find $\Delta\theta$.

PRACTICE 2

Rod Inertia and Angular Acceleration

Work the problem and justify the model.

A uniform rod of mass M and length L rotates about one end. Use $I = \int r^2 dm$ to obtain I, then write α for applied torque τ.

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 — page 8 →

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

Variable Torque Work

Answer without notes and justify the reasoning.

If $\tau(\theta)=k\theta$, find the work from $\theta=0$ to $\theta=\Theta$.

CONFIDENCE CHECK 2

Angular Momentum Rate

Answer without notes and justify the reasoning.

If net external torque is zero over an interval, what does dL/dt imply?

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 — page 10 →

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

Calculus tracks rates and distributions

Differentiate motion; integrate mass distribution, torque, or angular velocity as the model requires.

KEY TAKEAWAY 2

External torque governs angular momentum

$\Sigma\tau_{ext} = dL/dt$ is the general rotational dynamics statement.

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 14 →

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 check both the setup and the physical interpretation.

WARM-UP • ACTIVITY 1

Instantaneous Rates

$\omega = 2 + 3t^2$; $\alpha = 6t$.

WHY IT WORKS $\omega = 2 + 3t^2$; $\alpha = 6t$.

WARM-UP • ACTIVITY 2

Continuous Inertia

$I = \int r^2\, dm$.

WHY IT WORKS $I = \int r^2\, dm$.

WARM-UP • ACTIVITY 3

Angular Impulse

The change in angular momentum, ΔL.

WHY IT WORKS The change in angular momentum, ΔL.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Integrate Angular Velocity

$\Delta\theta = \int_0^2 (2+3t^2)dt = 12$ rad.

WHY IT WORKS The result follows from the rotational model identified in the activity.

PRACTICE 2

Rod Inertia and Angular Acceleration

$I = (1/3)ML^2$; $\alpha = 3\tau/(ML^2)$.

WHY IT WORKS The result follows from the rotational model identified in the activity.

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE CHECK 1

Variable Torque Work

$W = \int_0^{\Theta} k\theta \, d\theta = \frac{1}{2}k\Theta^2$.

WHY IT WORKS This checks the core rotational decision rather than a memorized keyword.

CONFIDENCE CHECK 2

Angular Momentum Rate

$dL/dt = 0$, so total angular momentum about that origin or axis is constant.

WHY IT WORKS This checks the core rotational decision rather than a memorized keyword.

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