

## FULL REVIEW

# Full Review: Angular Momentum and Conservation

Review the essential ideas, relationships, and problem-solving tools for angular momentum and conservation.

|                                                                                                                   |                                                                                                                                 |                                                                                                                                |
|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| <br><b>TIME</b><br>45–60 minutes | <br><b>BEST FOR</b><br>A complete topic review | <br><b>FINISH WITH</b><br>A readiness check |
|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|

**After this full review, you'll be able to...**

**explain angular momentum, recognize the conservation condition, and apply algebra-based relationships with confidence.**

recall the essential ideas, apply them to representative problems, and determine what to study next.

## 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 45–60 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-U21  
**TOPIC:** Angular Momentum and Conservation  
**COURSE LEVEL:** Algebra-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 six stages in order. Each stage builds on the previous one and prepares you for the final readiness check.

6 stages • Approximately 45–60 minutes

|                                                                    |                                                                 |                                                               |
|--------------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------|
| <b>1</b><br><b>Warm-Up Check</b><br>Activate prior knowledge.      | <b>2</b><br><b>Core Concepts</b><br>Review the essential ideas. | <b>3</b><br><b>Guided Practice</b><br>Apply what you learned. |
| <b>4</b><br><b>Confidence Check</b><br>Confirm your understanding. | <b>5</b><br><b>Summary</b><br>Review the key ideas.             | <b>6</b><br><b>Next Step</b><br>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****Recall Definitions**

State the meaning or definition of angular momentum.

*Write a brief response in the space below.*

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**ACTIVITY 2****Recognize the Condition**

State the condition for conservation of total angular momentum.

*Write a brief response in the space below.*

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## FR-04 • WARM-UP CHECK CONTINUED

## ACTIVITY 3

**Quick Application**

Predict how angular speed changes when  $I$  decreases with negligible external torque.

*Write a brief response in the space below.*

**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 →**

## 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

### Particle and Rigid-Body Angular Momentum

For a particle,  $L = r \times p$  and  $|L| = rp \sin\theta$ . For fixed-axis rigid rotation,  $L = I\omega$ .

$$L = r \times p; |L| = rp \sin\theta; L = I\omega; \tau_{\text{ext}} \Delta t = \Delta L.$$

EXAMPLE For perpendicular  $r$  and  $p$ ,  $L = mvr$ .

SENSEI NOTE Use  $rp$  only when  $r$  is perpendicular to  $p$ .

## KEY CONCEPT 2

### Torque and Conservation

External torque changes angular momentum. For constant torque,  $\tau_{\text{ext}} \Delta t = \Delta L$ . If  $\tau_{\text{ext}} = 0$ , total  $L$  is conserved.

$$L = r \times p; |L| = rp \sin\theta; L = I\omega; \tau_{\text{ext}} \Delta t = \Delta L.$$

EXAMPLE For shape changes,  $I_{\text{initial}}\omega_{\text{initial}} = I_{\text{final}}\omega_{\text{final}}$ .

SENSEI NOTE Use the same axis for torque and angular momentum.

## FR-05 • CORE CONCEPTS CONTINUED

## KEY CONCEPT 3

**Angular Impulse**

Angular impulse equals the change in angular momentum.

$$\mathbf{L} = \mathbf{r} \times \mathbf{p}; |\mathbf{L}| = rp \sin\theta; \mathbf{L} = I\boldsymbol{\omega}; \tau_{\text{ext}} \Delta t = \Delta \mathbf{L}.$$

EXAMPLE A 3.0 N·m torque for 2.0 s gives  $\Delta L = 6.0 \text{ kg}\cdot\text{m}^2/\text{s}$ .

SENSEI NOTE Keep the sign convention consistent.

**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](#) →

## 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****Worked Example**

A 0.50 kg ball moves at 6.0 m/s perpendicular to  $r = 0.80$  m. Find  $|L|$ .

*Show your setup and reasoning in the space below.*

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## FR-06 • GUIDED PRACTICE CONTINUED

## PRACTICE 2

**Guided Problem**

$I$  changes from  $3.0 \text{ kg}\cdot\text{m}^2$  at  $4.0 \text{ rad/s}$  to  $2.0 \text{ kg}\cdot\text{m}^2$ . Find  $\omega_{\text{final}}$ .

*Show your setup and reasoning in the space below.*

## PRACTICE 3

**Independent Problem**

A constant  $4.0 \text{ N}\cdot\text{m}$  torque acts for  $1.5 \text{ s}$ . Find  $\Delta L$ .

*Show your setup and reasoning in the space below.*

**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 →**

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

#### Particle Angular Momentum

Solve or explain.

*A 2.0 kg object moves at 5.0 m/s perpendicular to  $r = 0.30$  m. Find  $L$ .*

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### QUICK CHECK 2

#### Conservation

Solve or explain.

*$I$  drops from 5.0 to 2.0  $\text{kg}\cdot\text{m}^2$  while  $\omega_{\text{initial}} = 1.6$  rad/s. Find  $\omega_{\text{final}}$ .*

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## FR-07 • CONFIDENCE CHECK CONTINUED

## QUICK CHECK 3

**Angular Impulse**

Solve or explain.

*A 2.5 N·m torque acts for 4.0 s. Find  $\Delta L$ .*

## 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 →**

## 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****Angular Momentum**

For a particle,  $L = r \times p$  and  $|L| = rp \sin\theta$ . For fixed-axis rigid rotation,  $L = I\omega$ .

**KEY TAKEAWAY 2****Torque and Conservation**

External torque changes angular momentum. For constant torque,  $\tau_{\text{ext}} \Delta t = \Delta L$ . If  $\tau_{\text{ext}} = 0$ , total  $L$  is conserved.

**KEY TAKEAWAY 3****Angular Impulse**

Angular impulse equals the change in angular momentum.

**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****Recall Activity 1**

Angular momentum describes rotational motion about a chosen origin or axis.

WHY IT WORKS This checks the central definition or conservation condition.

**WARM-UP • ACTIVITY 2****Recall Activity 2**

Total angular momentum is conserved when net external torque is zero or negligible.

WHY IT WORKS This checks the central definition or conservation condition.

**WARM-UP • ACTIVITY 3****Recall Activity 3**

Angular speed increases.

WHY IT WORKS This checks the central definition or conservation condition.

## SOLUTIONS • GUIDED PRACTICE

**PRACTICE 1****Worked Example**

$$L = mvr = 2.4 \text{ kg}\cdot\text{m}^2/\text{s}.$$

WHY IT WORKS Use the relation appropriate to the system and chosen axis.

**PRACTICE 2****Guided Problem**

$$\omega_{\text{final}} = 6.0 \text{ rad/s}.$$

WHY IT WORKS Use the relation appropriate to the system and chosen axis.

**PRACTICE 3****Independent Problem**

$$\Delta L = 6.0 \text{ kg}\cdot\text{m}^2/\text{s}.$$

WHY IT WORKS Use the relation appropriate to the system and chosen axis.

## SOLUTIONS • CONFIDENCE CHECK

## QUICK CHECK 1

**Particle Angular Momentum**

3.0 kg·m<sup>2</sup>/s.

WHY IT WORKS Apply the definition, torque theorem, or conservation condition directly.

## QUICK CHECK 2

**Conservation**

4.0 rad/s.

WHY IT WORKS Apply the definition, torque theorem, or conservation condition directly.

## QUICK CHECK 3

**Angular Impulse**

10 kg·m<sup>2</sup>/s.

WHY IT WORKS Apply the definition, torque theorem, or conservation condition directly.

## 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.

|                                                                                                                                                                                            |                                                                                                                                                                                                           |                                                                                                                                                                                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <br><b>I'm Still Unsure</b><br>Review the key ideas and examples again.<br><a href="#">Review Again →</a> | <br><b>I Need More Practice</b><br>Continue with additional practice for this topic.<br><a href="#">Go to Practice →</a> | <br><b>I'm Ready</b><br>Continue to the next recommended resource.<br><a href="#">Continue →</a> |
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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**