FULL REVIEW

Full Review: Torque and Rotational Dynamics — Foundational

Review the essential foundational ideas, relationships, and problem-solving tools for Torque and Rotational Dynamics.

◷ TIME	◎ BEST FOR	✓ FINISH WITH
60 minutes	A complete topic review	A readiness check

After this full review, you'll be able to…

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 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-U20** **TOPIC: Torque and Rotational Dynamics** **COURSE LEVEL: Foundational / conceptual**	**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

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

Torque Vocabulary

Define pivot/axis, line of action, lever arm, torque direction, and net torque in your own words.

Write your response in the space below.

ACTIVITY 2

Classify the Situation

For each case—push through the pivot, perpendicular push far from pivot, two equal opposite torques—classify the torque as zero, large/nonzero, or balanced.

Write your response in the space below.

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Predict Before Calculating

A rigid object initially at rest has a nonzero clockwise net torque. Predict what happens to its rotation.

Write your 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

Torque as a Turning Effect

Torque describes how strongly a force tends to rotate an object about a selected axis. Both the point of application and the force direction matter. The physically useful lever arm is the perpendicular distance from the axis to the force’s line of action.

Torque depends on force, lever arm, and direction.

EXAMPLE A longer wrench makes the same hand force more effective at turning a bolt.

SENSEI NOTE Do not use the straight-line distance to the force point unless the force is perpendicular to the lever arm.

KEY CONCEPT 2

Adding Torques

When several forces act, determine the rotational sense caused by each force and add torques with a consistent sign convention. Opposing torques can partially or completely cancel.

Torque depends on force, lever arm, and direction.

EXAMPLE A seesaw can have zero net torque even when both riders exert large forces.

SENSEI NOTE Write your clockwise/counterclockwise sign convention before combining torques.

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Rotational Inertia and Angular Acceleration

Objects resist changes in rotation. That resistance depends not only on total mass but on how mass is distributed relative to the axis. For the same net torque, an object with greater rotational inertia has less angular acceleration.

Torque depends on force, lever arm, and direction.

EXAMPLE A mass concentrated farther from the axis is harder to spin up than the same mass concentrated close to the axis.

SENSEI NOTE Rotational inertia belongs to a specific axis; changing the axis can change it.

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 door is pushed perpendicular to its surface at two different distances from the hinges. Compare the resulting torques and predict which push gives the larger angular acceleration.

Show your setup and reasoning in the space below.

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Guided Problem

A bar has a clockwise torque from one force and a larger counterclockwise torque from another. Determine the direction of the net torque and angular acceleration.

Show your setup and reasoning in the space below.

PRACTICE 3

Independent Problem

Two objects have the same mass and radius, but one has more of its mass near the rim. The same torque acts on both. Which develops the smaller angular acceleration? Explain.

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

Lever-Arm Reasoning

Solve or explain without looking back.

Can a large force produce zero torque? Give a condition.

QUICK CHECK 2

Torque Balance

Solve or explain without looking back.

If clockwise and counterclockwise torques are equal in magnitude, what is the net torque?

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Rotational Inertia

Solve or explain without looking back.

For the same net torque, which object has the larger angular acceleration: smaller or larger rotational inertia?

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

Torque Is Geometric

Force magnitude, lever arm, and direction together determine the rotational effectiveness of a force.

KEY TAKEAWAY 2

Use Net Torque

Combine all torque contributions with a consistent sign convention to predict rotational change.

KEY TAKEAWAY 3

Mass Distribution Matters

Rotational inertia depends on how mass is distributed about the axis and controls the angular response to torque.

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

Torque Vocabulary

Pivot/axis is the reference for rotation; line of action is the infinite line along the force; lever arm is the perpendicular distance from axis to that line; torque direction indicates clockwise/counterclockwise tendency; net torque is the signed total.

WHY IT WORKS This restores a prerequisite idea used later in the review.

WARM-UP • ACTIVITY 2

Classify the Situation

Through pivot: zero. Perpendicular and far from pivot: comparatively large. Equal opposite torques: balanced, so net torque is zero.

WHY IT WORKS This restores a prerequisite idea used later in the review.

WARM-UP • ACTIVITY 3

Predict Before Calculating

It develops clockwise angular acceleration, so its angular velocity begins changing in the clockwise sense.

WHY IT WORKS This restores a prerequisite idea used later in the review.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Worked Example

Because the force is perpendicular in both cases, torque grows with the lever arm. The farther push gives the larger torque; for the same door and axis, it also gives the larger angular acceleration.

WHY IT WORKS The solution follows the Unit 20 rotational-dynamics model and a consistent axis/sign convention.

PRACTICE 2

Guided Problem

The larger counterclockwise contribution dominates, so the net torque is counterclockwise. The angular acceleration is therefore counterclockwise.

WHY IT WORKS The solution follows the Unit 20 rotational-dynamics model and a consistent axis/sign convention.

PRACTICE 3

Independent Problem

The object with more mass near the rim has the greater rotational inertia, so the same torque produces a smaller angular acceleration.

WHY IT WORKS The solution follows the Unit 20 rotational-dynamics model and a consistent axis/sign convention.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Lever-Arm Reasoning

Yes. If its line of action passes through the chosen axis, the perpendicular lever arm is zero.

WHY IT WORKS Torque depends on turning geometry as well as force magnitude.

QUICK CHECK 2

Torque Balance

Zero.

WHY IT WORKS Opposite-sense torque contributions cancel in the signed sum.

QUICK CHECK 3

Rotational Inertia

The object with smaller rotational inertia.

WHY IT WORKS Greater rotational inertia means greater resistance to angular acceleration.

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 →	**Go to Practice →**	**Continue →**

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