

FULL REVIEW

Full Review: Static Equilibrium and Stability

Review the essential ideas, relationships, and problem-solving tools for static equilibrium and stability.

 TIME 45–60 minutes	 BEST FOR A complete topic review	 FINISH WITH A readiness check
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After this full review, you'll be able to...

recall the equilibrium and stability framework, apply it to multi-step rigid-body problems, and evaluate readiness at the algebra-based level.

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-U23
TOPIC: Static Equilibrium and Stability
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

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**Key Equations**

Write the static-equilibrium equations for a planar rigid body.

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ACTIVITY 2**Torque Direction**

A downward force acts to the right of a pivot. Is its torque clockwise or counterclockwise?

A downward force acts to the right of a pivot. Is its torque clockwise or counterclockwise?

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Quick Application

A 50 N force is perpendicular to a 0.40 m lever arm. Find the torque magnitude.

A 50 N force is perpendicular to a 0.40 m lever arm. Find the torque magnitude.

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

Force Equilibrium

Resolve forces into components and require the sum in each independent direction to be zero. In two dimensions, this normally gives $\Sigma F_x = 0$ and $\Sigma F_y = 0$.

$$\Sigma F = 0 \quad \bullet \quad \Sigma \tau = 0 \quad \bullet \quad \tau = rF \sin \theta$$

EXAMPLE A hinge force may have both horizontal and vertical components.

SENSEI NOTE Draw the free-body diagram before writing equations.

KEY CONCEPT 2

Torque Equilibrium

Choose an origin and require $\Sigma \tau = 0$. Use $\tau = rF \sin \theta$, or use the perpendicular lever arm directly. A strategic origin can remove unknown forces from the torque equation.

$$\Sigma F = 0 \quad \bullet \quad \Sigma \tau = 0 \quad \bullet \quad \tau = rF \sin \theta$$

EXAMPLE Taking torques about a hinge eliminates both hinge-force components from that equation.

SENSEI NOTE Assign one rotational direction positive and keep the sign convention consistent.

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Stability and Tipping

For an object resting on a base, tipping begins when the line of action of the weight reaches a support edge. Before that point the normal-force distribution can adjust to maintain equilibrium; beyond it, the weight creates a net tipping torque.

$$\Sigma F = 0 \quad \bullet \quad \Sigma \tau = 0 \quad \bullet \quad \tau = rF \sin \theta$$

EXAMPLE A wider base increases the horizontal displacement required for the weight line to reach the edge.

SENSEI NOTE At the tipping threshold, treat the edge as the pivot.

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**

Solve the problem systematically and show the key equilibrium steps.

A 6.0 m uniform beam of weight 300 N is supported at both ends. A 600 N load is 2.0 m from the left support. Find the right support force.

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Guided Problem

Solve the problem systematically and show the key equilibrium steps.

For the previous beam, find the left support force.

PRACTICE 3

Independent Problem

Solve the problem systematically and show the key equilibrium steps.

A 2.0 m ladder-like beam of weight 120 N is horizontal, hinged at one end, and supported by a cable making 60° with the beam at the other end. Find the cable tension.

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**Cable Tension**

Solve using torque equilibrium.

A 4.0 m horizontal uniform beam weighs 200 N and is hinged at the left end. A vertical cable at the right end holds it. Find the cable tension.

QUICK CHECK 2**Angled Force Torque**

Calculate the torque magnitude.

A 80 N force acts at 30° to a 0.50 m lever arm. Find the torque magnitude.

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Support Reactions

Use force balance after finding one reaction.

A 5.0 m light beam supports a 500 N load 1.0 m from the left end and is supported at both ends. Find both support forces.

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**Use all equilibrium equations**

Static equilibrium requires component force balance and torque balance.

KEY TAKEAWAY 2**Choose the pivot strategically**

A good pivot choice can eliminate unknown forces and simplify the algebra.

KEY TAKEAWAY 3**Tipping is a torque problem**

At the tipping threshold, the support edge becomes the pivot and the normal force acts through that edge.

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. Focus on the method and the physical meaning of each result.

WARM-UP • ACTIVITY 1

Key Equations

$$\Sigma F_x = 0, \Sigma F_y = 0, \text{ and } \Sigma \tau = 0.$$

WHY IT WORKS The answer follows from the defining conditions for equilibrium and stability.

WARM-UP • ACTIVITY 2

Torque Direction

Clockwise.

WHY IT WORKS The answer follows from the defining conditions for equilibrium and stability.

WARM-UP • ACTIVITY 3

Quick Application

$$\tau = rF = (0.40 \text{ m})(50 \text{ N}) = 20 \text{ N}\cdot\text{m}.$$

WHY IT WORKS The answer follows from the defining conditions for equilibrium and stability.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Worked Example

Take torques about the left support: $R(6.0) - 300(3.0) - 600(2.0) = 0$. Thus $R = 350$ N.

WHY IT WORKS A correct solution satisfies both the force and torque requirements, or the stated stability criterion.

PRACTICE 2

Guided Problem

Vertical force balance gives $L + 350 - 300 - 600 = 0$, so $L = 550$ N.

WHY IT WORKS A correct solution satisfies both the force and torque requirements, or the stated stability criterion.

PRACTICE 3

Independent Problem

Torque balance about the hinge: $T(2.0)\sin 60^\circ - 120(1.0) = 0$. Thus $T \approx 69$ N.

WHY IT WORKS A correct solution satisfies both the force and torque requirements, or the stated stability criterion.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Cable Tension

$$T(4.0) - 200(2.0) = 0, \text{ so } T = 100 \text{ N.}$$

WHY IT WORKS The result follows from the equilibrium equations, torque geometry, or energy-stability test.

QUICK CHECK 2

Angled Force Torque

$$\tau = (0.50)(80)\sin 30^\circ = 20 \text{ N}\cdot\text{m.}$$

WHY IT WORKS The result follows from the equilibrium equations, torque geometry, or energy-stability test.

QUICK CHECK 3

Support Reactions

$$\text{Right: } R(5.0) = 500(1.0), \text{ so } R = 100 \text{ N. Left: } L = 400 \text{ N.}$$

WHY IT WORKS The result follows from the equilibrium equations, torque geometry, or energy-stability test.

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 Review the key ideas and examples again. Review Again →	 I Need More Practice Continue with additional practice for this topic. Go to Practice →	 I'm Ready Continue to the next recommended resource. Continue →
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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