

FOCUSED REVIEW

Focused Review — Work and the Work–Energy Theorem — Calculus-Based

Review the most important ideas, reinforce the essential skills, and confirm you're ready to move on.

 TIME 15–20 minutes	 BEST FOR Focused review	 FINISH WITH Greater confidence
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After this focused review, you'll be able to...

recognize the key concepts, reinforce your problem-solving skills, and continue with greater confidence.

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 15–20 minutes

FR-02 • COURSE ALIGNMENT

Course Alignment

This Physics Sensei Topic Review is an independent learning resource. Use it to reinforce key concepts, prepare for homework, or review before a quiz or exam.

Related Unit Review: If you need to review the complete unit material, review [Work, Energy, and Power here →](#)

RESOURCE: Physics Sensei Topic Review TOPIC ID: MEC-U06-T01 TOPIC: Work and the Work–Energy Theorem PARENT UNIT: MEC-U06 — Work, Energy, and Power COURSE LEVEL: Calculus-Based	BEST USED ✓ After learning the topic ✓ Before starting homework ✓ Before a quiz or exam
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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 15–20 minutes

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

Answer before revealing the response.

Write the general line-integral expression for work.

WARM-UP 2**Common Mistakes**

Answer before revealing the response.

In one-dimensional motion, what does the signed area under an F-versus-x graph represent?

FR-04 • WARM-UP CHECK CONTINUED

WARM-UP 3

Quick Application

Answer before revealing the response.

For $F(x) = 4x \text{ N}$ from $x = 0$ to 3 m , set up the work integral.

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 →](#)

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

Work as a Line Integral

For a variable force, differential work is the dot product of force with an infinitesimal displacement. Integrating along the path gives the total work. In one dimension, this becomes the definite integral of $F(x)$ with respect to x .

$$W = \int F \cdot dr$$

EXAMPLE If $F(x) = 2x$ N from 0 to 3 m, the work is the integral of $2x$ dx, giving 9 J.

SENSEI NOTE Use limits that match the actual initial and final positions.

KEY CONCEPT 2

The Work–Energy Theorem

The net work by all forces equals the change in kinetic energy. The theorem remains valid for variable forces, so the integral of net force along the path determines the kinetic-energy change.

$$W_{net} = \Delta K$$

EXAMPLE If the net-work integral gives +12 J, kinetic energy increases by 12 J.

SENSEI NOTE Integrate the net force or sum the work contributions before applying the theorem.

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 →](#)

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**Guided Example**

Evaluate a one-dimensional work integral.

A force $F(x) = 5x^2 \text{ N}$ acts from $x = 0$ to $x = 2 \text{ m}$. Find the work done.

PRACTICE 2**Independent Check**

Combine a work integral with the work–energy theorem.

A 2.0 kg particle starts at 2.0 m/s . The net force is $F(x) = 3x \text{ N}$ from $x = 0$ to $x = 2 \text{ m}$. Find the final kinetic energy and final speed.

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 →

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-Force Work**

Solve independently before checking the solution.

Evaluate the work done by $F(x) = 6x$ N from $x = 1$ m to $x = 3$ m.

CONFIDENCE CHECK 2**Work–Energy with an Integral**

Solve independently before checking the solution.

A particle begins with 10 J of kinetic energy. The net-work integral over the motion is -4 J. What is its final kinetic energy?

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 →](#)

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**Integrate Along the Motion**

For variable force, integrate the force component along the displacement to obtain total work.

KEY TAKEAWAY 2**The Theorem Works for Variable Forces**

Once the net work is known, it equals the kinetic-energy change regardless of whether the force was constant or variable.

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

Key Ideas

W is the line integral of force dotted with displacement.

WHY IT WORKS The dot product selects the force component along the path before integration.

WARM-UP • ACTIVITY 2

Common Mistakes

It is the work done by the force over that interval.

WHY IT WORKS A definite integral of force versus position is signed area and therefore work.

WARM-UP • ACTIVITY 3

Quick Application

Integrate $4x \, dx$ from 0 to 3.

WHY IT WORKS The limits match the stated positions.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1**Guided Example**

$40/3$ J, about 13.3 J.

WHY IT WORKS Integrating $5x^2$ gives $(5/3)x^3$ over the interval.

PRACTICE 2**Independent Check**

Initial kinetic energy is 4 J. The work is 6 J, so final kinetic energy is 10 J and final speed is about 3.16 m/s.

WHY IT WORKS The net-force integral gives the work, which then updates kinetic energy.

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE CHECK 1

Variable-Force Work

24 J.

WHY IT WORKS The antiderivative of $6x$ is $3x^2$; evaluate at 3 and 1.

CONFIDENCE CHECK 2

Work–Energy with an Integral

6 J.

WHY IT WORKS Negative net work reduces kinetic energy by 4 J.

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