FOCUSED REVIEW

Focused Review: Work, Energy, and Power

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

◷	◎	✓
TIME 15–20 minutes	**BEST FOR** Focused review	**FINISH WITH** Greater confidence

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 • TOPIC ALIGNMENT

Topic Alignment

This bundle is aligned to the approved Physics Sensei topic specification below. Use it to recover the topic structure, reinforce key decisions, and confirm readiness for the next study task.

ARCHITECTURE: Physics Sensei Independent Mechanics UNIT: MEC-U06 — Work, Energy, and Power TOPIC: Unit Review — Work, Energy, and Power PROFILE: Calculus-Based	BEST USED ✓ Before calculus-based energy homework ✓ Before a quiz or exam ✓ When variable forces or potential curves are involved

Review Prerequisites →

Physics Sensei is an independent educational resource designed to complement independently authored Physics Sensei materials. Physics Sensei content is independently authored and organized under the approved topic architecture.

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 — 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

Variable-force work

Integrate the force-position function.

For $F_x = 3x^2$, find the work from $x = 0$ to $x = 2.0$ m.

WARM-UP 2

Force from potential

Differentiate the potential-energy function.

If $U(x) = 2x^2$, what is $F_x(x)$?

FR-04 • WARM-UP CHECK CONTINUED

WARM-UP 3

Instantaneous power

Use the dot product.

A 10 N force is parallel to a 3.0 m/s velocity. What is the instantaneous power?

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

Variable-force work is a line integral

For one-dimensional motion, $W = \int F_x\,dx$. Graphically, work is the signed area under the force-position curve.

$$W = \int F_x\,dx \quad \bullet \quad W_{net} = \Delta K$$

EXAMPLE If $F_x = 6x + 2$ from 0 to 3.0 m, then $W = [3x^2 + 2x]_0^3 = 33$ J.

SENSEI NOTE A negative region below the x-axis contributes negative work.

KEY CONCEPT 2

Potential-energy curves encode force and stability

For a conservative force, $F_x = -dU/dx$. Equilibrium occurs where $dU/dx = 0$; a local minimum of U is stable and a local maximum is unstable.

$$F_x = -dU/dx \quad \bullet \quad P = F \cdot v$$

EXAMPLE $U = 5x^2 - 20x$ has equilibrium at $x = 2.0$ m, and $d^2U/dx^2 = 10 > 0$, so the equilibrium is stable.

SENSEI NOTE Potential-energy graphs let you infer force direction without solving the motion explicitly.

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 a variable force

Compute the exact work from a force-position function.

A force is $F_x = 6x + 2$ N. Find the work from $x = 0$ to $x = 3.0$ m.

PRACTICE 2

Equilibrium from U(x)

Find and classify equilibrium.

For $U(x) = 5x^2 - 20x$ J, find the equilibrium position and determine whether it is stable.

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

Force from a potential function

Differentiate and apply the minus sign.

If $U(x) = 4x^3$ J, what is F_x at $x = 2.0$ m?

CONFIDENCE CHECK 2

Instantaneous power

Use $P = F \cdot v$.

A 10 N force is parallel to a 3.0 m/s velocity. What is the instantaneous power?

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

Integrate force to obtain work

$W = \int F \cdot dr$ accumulates energy transfer along the path; in one dimension it becomes the signed area under $F_x(x)$.

KEY TAKEAWAY 2

Differentiate potential to obtain force

For conservative one-dimensional systems, $F_x = -dU/dx$, and the shape of $U(x)$ reveals equilibrium and stability.

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. Replace each placeholder with a concise answer and the essential explanation.

WARM-UP • ACTIVITY 1

Variable-force work

8.0 J.

WHY IT WORKS $W = \int_0^2 3x^2\,dx = [x^3]_0^2 = 8.0$ J.

WARM-UP • ACTIVITY 2

Force from potential

$F_x = -4x$.

WHY IT WORKS For a conservative one-dimensional force, $F_x = -dU/dx$.

WARM-UP • ACTIVITY 3

Instantaneous power

30 W.

WHY IT WORKS $P = F \cdot v = Fv$ when force and velocity are parallel.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Integrate a variable force

33 J.

WHY IT WORKS $W = \int_0^3 (6x + 2)dx = [3x^2 + 2x]_0^3 = 33$ J.

PRACTICE 2

Equilibrium from U(x)

x = 2.0 m, stable.

WHY IT WORKS $F_x = -dU/dx = -(10x - 20)$. Setting $F_x = 0$ gives x = 2.0 m; $d^2U/dx^2 = 10 > 0$, so U has a local minimum.

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE CHECK 1

Force from a potential function

–48 N.

WHY IT WORKS $F_x = -dU/dx = -12x^2$; at $x = 2.0$ m, $F_x = -48$ N.

CONFIDENCE CHECK 2

Instantaneous power

30 W.

WHY IT WORKS $P = F \cdot v = (10)(3.0) = 30$ W.

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