

FOCUSED REVIEW

Focused Review: First Law of Thermodynamics — Algebra-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 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: THM-U08
TOPIC: First Law of Thermodynamics
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 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**

Apply the sign convention

For W defined as work done by the system, assign signs when a gas absorbs 420 J and is compressed with 160 J of work done on it.

WARM-UP 2**Common Mistakes**

Rearrange the first law

Rearrange $\Delta U = Q - W$ to solve for Q .

FR-04 • WARM-UP CHECK CONTINUED

WARM-UP 3

Quick Application

PV work units

Show that $\text{Pa}\cdot\text{m}^3$ has units of joules.

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**First-Law Energy Balance**

Use $\Delta U = Q - W$ with W as work done by the system. $Q > 0$ for heat absorbed, $Q < 0$ for heat released, $W > 0$ for expansion work, and $W < 0$ when work is done on the system.

$$\Delta U = Q - W$$

EXAMPLE If $Q = 900 \text{ J}$ and $W = 350 \text{ J}$, $\Delta U = 550 \text{ J}$.

SENSEI NOTE Write the signs before inserting numbers.

KEY CONCEPT 2**State Function vs. Path Transfers**

Internal energy U is a state function: ΔU depends only on initial and final states. Q and W depend on the process path, even though $Q - W$ must equal the same ΔU between fixed endpoints.

$$\Delta U = U_2 - U_1 \quad (\text{path independent})$$

EXAMPLE Two paths can have different Q and W but the same ΔU .

SENSEI NOTE Do not treat Q or W as properties of a state.

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**

A gas absorbs 1.20 kJ and does 450 J of work. Calculate ΔU .

Convert 1.20 kJ to 1200 J and apply $\Delta U = Q - W$.

PRACTICE 2**Independent Check**

A gas is compressed at constant pressure 1.8×10^5 Pa from 6.0 L to 3.5 L while 220 J of heat leaves the gas. Find ΔU .

Compute $\Delta V = -2.5 \text{ L} = -2.5 \times 10^{-3} \text{ m}^3$, then $W = P \Delta V$.

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

Compression balance

Solve using the first law and the stated sign convention.

$Q = -100 \text{ J}$ and $W = -350 \text{ J}$. Find ΔU .

CONFIDENCE CHECK 2

Solve for work

Solve using the first law and the stated sign convention.

$Q = 700 \text{ J}$ and $\Delta U = 480 \text{ J}$. Find W .

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**First-law equation**

$\Delta U = Q - W$ with W defined as work done by the system.

KEY TAKEAWAY 2**State and path**

ΔU is state-dependent only; Q and W depend on the process.

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

$Q = +420 \text{ J}$ and $W = -160 \text{ J}$.

WHY IT WORKS Work done on the system corresponds to negative work done by the system.

WARM-UP • ACTIVITY 2

Common Mistakes

$Q = \Delta U + W$.

WHY IT WORKS Move $-W$ to the other side.

WARM-UP • ACTIVITY 3

Quick Application

$\text{Pa} \cdot \text{m}^3 = (\text{N}/\text{m}^2)\text{m}^3 = \text{N} \cdot \text{m} = \text{J}$.

WHY IT WORKS Pressure-volume work is an energy.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Guided Example

$$\Delta U = 1200 \text{ J} - 450 \text{ J} = 750 \text{ J}.$$

WHY IT WORKS Keep all energy quantities in the same unit.

PRACTICE 2

Independent Check

$$W = -450 \text{ J}; Q = -220 \text{ J}; \Delta U = -220 - (-450) = 230 \text{ J}.$$

WHY IT WORKS Compression makes W negative in the work-by-system convention.

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE CHECK 1

Compression balance

$$\Delta U = 250 \text{ J.}$$

WHY IT WORKS $\Delta U = -100 - (-350).$

CONFIDENCE CHECK 2

Solve for work

$$W = 220 \text{ J.}$$

WHY IT WORKS $W = Q - \Delta U.$

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