

FULL REVIEW

Full Review: Entropy and the Second Law — Algebra-Based

Review the essential ideas, relationships, and problem-solving tools for entropy and the second law.

 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 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 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: THM-U11
TOPIC: Entropy and the Second Law
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**Recall Activity 1**

Recall the entropy-change relation for reversible heat transfer at constant absolute temperature.

Write the key relationship and explain its physical meaning.

ACTIVITY 2**Recall Activity 2**

Identify the SI unit of entropy and explain why temperature must be in kelvins.

Write the key relationship and explain its physical meaning.

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Recall Activity 3

For two reservoirs exchanging heat Q , write the entropy changes of the hot and cold reservoirs and predict the sign of their sum.

Write the key relationship and explain its physical meaning.

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

Entropy change from reversible heat transfer

For reversible heat transfer at constant absolute temperature T , the entropy change is $\Delta S = Q_{\text{rev}}/T$. Use the sign of Q for the system being analyzed.

$$\Delta S = Q_{\text{rev}}/T \text{ (constant } T\text{)}$$

If 600 J enters a system reversibly at 300 K, $\Delta S = +2.00 \text{ J/K}$.

Always use kelvins and keep the heat sign consistent with the chosen system.

KEY CONCEPT 2

Second-law entropy balance

For an isolated system, $\Delta S_{\text{total}} \geq 0$. Equality describes a reversible idealization; a positive value indicates irreversibility.

$$\Delta S_{\text{total}} = -Q/T_h + Q/T_c \geq 0$$

Heat Q transferred from T_h to T_c gives $\Delta S_{\text{total}} = -Q/T_h + Q/T_c$, which is positive when $T_h > T_c$.

Do not apply $\Delta S = Q/T$ blindly when temperature changes during the process.

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Entropy in cycles and devices

Entropy is a state function, so a system completing a cycle has $\Delta S_{\text{system}} = 0$. The surroundings can still gain entropy, and real cycles generate entropy.

$$\text{For a cycle: } \Delta S_{\text{system}} = 0; \Delta S_{\text{universe}} \geq 0$$

A cyclic heat engine returns to its starting state each cycle while transferring entropy between reservoirs. Zero entropy change of the working substance over a cycle does not mean the entire process is reversible.

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 and justify the entropy relation used.

A system absorbs 900 J reversibly from a 300 K reservoir. Calculate its entropy change.

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Guided Problem

Solve the problem and justify the entropy relation used.

500 J of heat flows from a 400 K reservoir to a 300 K reservoir. Calculate ΔS_{hot} , ΔS_{cold} , and ΔS_{total} .

PRACTICE 3

Independent Problem

Solve the problem and justify the entropy relation used.

A cyclic device has $\Delta S_{\text{system}} = 0$ but produces 0.80 J/K of entropy per cycle. What must be true about the net entropy change of the surroundings?

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

Entropy Check

Solve or explain briefly.

A system releases 240 J reversibly at 300 K. Find ΔS_{system} .

QUICK CHECK 2

Entropy Check

Solve or explain briefly.

For $Q = 1000 \text{ J}$ transferred from 500 K to 250 K, find ΔS_{total} .

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Entropy Check

Solve or explain briefly.

A complete cycle has $\Delta S_{\text{system}} = 0$. Does that prove the cycle is reversible? Explain quantitatively in terms of ΔS_{total} .

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 $\Delta S = Q_{\text{rev}}/T$ correctly**

For reversible heat transfer at constant absolute temperature T , the entropy change is $\Delta S = Q_{\text{rev}}/T$.

KEY TAKEAWAY 2**Check $\Delta S_{\text{total}} \geq 0$**

For an isolated system, $\Delta S_{\text{total}} \geq 0$.

KEY TAKEAWAY 3**State function vs entropy generation**

Entropy is a state function, so a system completing a cycle has $\Delta S_{\text{system}} = 0$.

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**Recall Activity 1**

For constant-temperature reversible heat transfer, $\Delta S = Q_{\text{rev}}/T$. Entropy is measured in J/K.

This is the governing entropy principle for the activity.

WARM-UP • ACTIVITY 2**Recall Activity 2**

Entropy is a state function; the total entropy of an isolated system satisfies $\Delta S_{\text{total}} \geq 0$.

This is the governing entropy principle for the activity.

WARM-UP • ACTIVITY 3**Recall Activity 3**

For heat Q from hot to cold: $\Delta S_{\text{hot}} = -Q/T_h$ and $\Delta S_{\text{cold}} = +Q/T_c$; their sum is positive when $T_h > T_c$.

This is the governing entropy principle for the activity.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1**Worked Example**

$$\Delta S = 900 \text{ J} / 300 \text{ K} = +3.00 \text{ J/K}.$$

Verify the integral/sign convention and interpret the result physically.

PRACTICE 2**Guided Problem**

$\Delta S_{\text{hot}} = -500/400 = -1.25 \text{ J/K}$; $\Delta S_{\text{cold}} = +500/300 = +1.67 \text{ J/K}$; $\Delta S_{\text{total}} = +0.417 \text{ J/K}$, so the transfer is irreversible.

Verify the integral/sign convention and interpret the result physically.

PRACTICE 3**Independent Problem**

Because the device returns to its initial state, its entropy change is zero. The surroundings must gain $+0.80 \text{ J/K}$ per cycle so the total entropy generation is $+0.80 \text{ J/K}$.

Verify the integral/sign convention and interpret the result physically.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Entropy Check

$$\Delta S = 900 \text{ J} / 300 \text{ K} = +3.00 \text{ J/K}.$$

A correct result must also satisfy the second-law entropy balance.

QUICK CHECK 2

Entropy Check

$\Delta S_{\text{hot}} = -500/400 = -1.25 \text{ J/K}$; $\Delta S_{\text{cold}} = +500/300 = +1.67 \text{ J/K}$; $\Delta S_{\text{total}} = +0.417 \text{ J/K}$, so the transfer is irreversible.

A correct result must also satisfy the second-law entropy balance.

QUICK CHECK 3

Entropy Check

Because the device returns to its initial state, its entropy change is zero. The surroundings must gain $+0.80 \text{ J/K}$ per cycle so the total entropy generation is $+0.80 \text{ J/K}$.

A correct result must also satisfy the second-law entropy balance.

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](https://www.physicssensei.com)