

FULL REVIEW

Full Review: Phase Changes and Latent Heat

Review the essential ideas, relationships, and problem-solving tools for phase changes and latent heat.

 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-U04
TOPIC: Phase Changes and Latent Heat
COURSE LEVEL: Algebra-based introductory physics

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 phase-change vocabulary and energy sign.

Classify melting, freezing, vaporization, condensation, sublimation, and deposition as energy absorbed or released by the sample.

ACTIVITY 2**Recall Activity 2**

Select the correct thermal relationship.

Choose $Q = mc\Delta T$ or $Q = mL$ for each: warming liquid water; melting ice at 0°C ; boiling water at 100°C .

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Recall Activity 3

Interpret a heating curve quantitatively.

A heating curve has a flat segment at the melting point. What physical quantity is changing even though temperature is not?

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

Latent Heat and Phase-Change Energy

At a phase boundary, the energy transferred to a mass m is proportional to the mass and the appropriate latent heat. For melting/freezing use L_f ; for vaporization/condensation use L_v . The sign of Q depends on whether the sample gains or loses energy.

$$Q = mL; \text{ melting/vaporization: } Q > 0 \text{ for the sample; freezing/condensation: } Q < 0$$

EXAMPLE Melting 0.250 kg of ice: $Q = (0.250 \text{ kg})(334 \text{ kJ/kg}) = 83.5 \text{ kJ}$.

SENSEI NOTE Separate the magnitude mL from the sign convention used in the problem.

KEY CONCEPT 2

Heating Curves and Piecewise Energy

A heating curve is naturally piecewise. Sloped segments use $Q = mc\Delta T$; phase-change plateaus use $Q = mL$. A process that crosses several regions requires one energy calculation per region.

$$Q_{\text{total}} = \Sigma(mc\Delta T) + \Sigma(mL)$$

EXAMPLE Ice below 0°C $\rightarrow$ ice at 0°C $\rightarrow$ liquid at 0°C requires warming the solid, then melting it.

SENSEI NOTE Do not combine ΔT across a phase-change plateau as though one heat capacity applied everywhere.

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Phase Diagrams and Transition Conditions

A phase diagram maps the stable phase as a function of temperature and pressure. Crossing a phase boundary changes the stable phase; the transition temperature depends on pressure. Triple and critical points identify special boundaries of phase behavior.

Phase boundary: coexistence of two phases at the specified T and P

EXAMPLE Lowering pressure can shift the boiling temperature because the liquid–vapor boundary is pressure dependent.

SENSEI NOTE Use a heating curve for energy versus temperature at a fixed path; use a phase diagram to determine which phase is stable at T and P.

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**

Compute one latent-heat stage and label the energy direction.

How much energy is needed to vaporize 0.030 kg of water at its boiling point if $L_v = 2260 \text{ kJ/kg}$?

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Guided Problem

Build a two-stage energy calculation.

A 0.150 kg ice sample at 0 °C melts and then the resulting water warms by 20 °C. Use $L_f = 334 \text{ kJ/kg}$ and $c_{\text{water}} = 4.18 \text{ kJ/(kg}\cdot\text{°C)}$. Find each stage and the total.

PRACTICE 3

Independent Problem

Solve independently and report the total energy.

A 0.040 kg water-vapor sample condenses at the boiling point. Using $L_v = 2260 \text{ kJ/kg}$, find Q for the sample if energy leaving the sample is negative.

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**Model Selection**

Name the equation and latent heat.

A solid melts at its melting point. Which equation is used for the transition?

QUICK CHECK 2**Two-Stage Calculation**

Calculate the total energy.

A 0.100 kg sample melts with $L_f = 200 \text{ kJ/kg}$, then the liquid warms by 10°C with $c = 2.0 \text{ kJ/(kg}\cdot^\circ\text{C)}$. Find Q_{total} .

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Heating-Curve Interpretation

Explain the flat segment.

Why can a heating curve be horizontal while energy is still entering the sample?

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

Choose the equation from the physical stage

Use $Q = mc\Delta T$ inside one phase and $Q = mL$ during a phase change.

KEY TAKEAWAY 2

Latent heat is mass proportional

For a given transition, doubling the mass doubles the required or released phase-change energy.

KEY TAKEAWAY 3

Treat heating curves piecewise

Calculate each slope or plateau separately and sum the energy contributions.

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

Absorbed: melting, vaporization, sublimation. Released: freezing, condensation, deposition.

WHY IT WORKS The direction toward a less bound phase requires energy input.

WARM-UP • ACTIVITY 2

Recall Activity 2

Warming liquid: $Q = mc\Delta T$. Melting: $Q = mL_f$. Boiling: $Q = mL_v$.

WHY IT WORKS Match the equation to the physical stage, not just to the word “heat.”

WARM-UP • ACTIVITY 3

Recall Activity 3

The phase fraction and intermolecular potential energy change while temperature remains approximately constant.

WHY IT WORKS Latent heat changes phase without increasing average kinetic energy during the plateau.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Worked Example

$$Q = mL_v = (0.030)(2260) = 67.8 \text{ kJ absorbed.}$$

WHY IT WORKS Vaporization is a liquid→gas phase change, so use L_v .

PRACTICE 2

Guided Problem

Melting: $Q_1 = (0.150)(334) = 50.1 \text{ kJ}$. Warming: $Q_2 = (0.150)(4.18)(20) = 12.54 \text{ kJ}$. Total = 62.64 kJ absorbed.

WHY IT WORKS The path crosses a phase change and then a temperature-change region, so it must be split.

PRACTICE 3

Independent Problem

$$Q = -mL_v = -(0.040)(2260) = -90.4 \text{ kJ.}$$

WHY IT WORKS Condensation releases energy from the sample, so Q is negative under the stated convention.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Model Selection

$$Q = mL_f.$$

WHY IT WORKS Solid↔liquid uses the latent heat of fusion.

QUICK CHECK 2

Two-Stage Calculation

Melting: 20 kJ. Warming: 2 kJ. Total: 22 kJ absorbed.

WHY IT WORKS Add the phase-change and temperature-change stage energies.

QUICK CHECK 3

Heating-Curve Interpretation

The incoming energy is latent heat used to change phase and intermolecular potential energy, so temperature remains approximately constant.

WHY IT WORKS A horizontal segment represents coexistence of phases during the transition.

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