

FULL REVIEW

Full Review: Heat, Specific Heat, and Calorimetry

Review the essential ideas, relationships, and problem-solving tools for heat, specific heat, and calorimetry.

 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-U03
TOPIC: Heat, Specific Heat, and Calorimetry
COURSE LEVEL: Calculus-Based College 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**From Differential to Finite**

Complete the activity, then check your reasoning in the Solutions section.

Integrate $dQ = mc \, dT$ for constant m and c .

ACTIVITY 2**Slope Meaning**

Complete the activity, then check your reasoning in the Solutions section.

What does dQ/dT represent for a fixed-mass sample?

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Variable c Setup

Complete the activity, then check your reasoning in the Solutions section.

For $c(T)=a+bT$, write Q from T_i to T_f .

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

Differential Heat Capacity

For an infinitesimal temperature change, $dQ = mc(T)dT$. If c is constant over the interval, integration gives $Q = mc\Delta T$. If c varies with temperature, retain $c(T)$ inside the integral.

$$dQ = mc(T)dT; Q = m\int c(T)dT$$

EXAMPLE $Q = m\int$ from T_i to T_f $c(T)dT$; constant c gives $mc(T_f - T_i)$.

SENSEI NOTE Do not pull c outside the integral unless treating it as constant over the interval.

KEY CONCEPT 2

Specific Heat and Heat Capacity

Specific heat c is heat capacity per unit mass, while total heat capacity is $C(T) = mc(T)$. The slope dQ/dT equals C when the path involves only sensible heating.

$$C(T) = mc(T) = dQ/dT$$

EXAMPLE A larger C means more energy is required for the same differential temperature rise.

SENSEI NOTE Distinguish the material property c from the object property C .

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Calorimetry as an Integral Energy Balance

For an isolated calorimeter, conservation of energy requires $\Sigma Q_i = 0$. Each object's heat-transfer term may be written as $m \int c(T) dT$ between that object's initial temperature and the common final temperature.

$$\Sigma m \int c(T) dT = 0$$

EXAMPLE With constant specific heats, the integral form reduces to the familiar algebraic calorimetry equation.

SENSEI NOTE The sign is automatic when the integration limits follow each object from T_i to T_f .

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. Show your setup before checking the solution.

A 0.200 kg sample has $c(T)=400+0.5T$ J/(kg·K), with T in °C for this empirical model. Find Q from 20 °C to 60 °C.

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Guided Problem

Solve the problem. Show your setup before checking the solution.

Two bodies with constant heat capacities C_1 and C_2 start at T_1 and T_2 in an isolated calorimeter. Derive T_f .

PRACTICE 3

Independent Problem

Solve the problem. Show your setup before checking the solution.

A body has heat capacity $C(T)=A+BT$. Write the heat absorbed from T_i to T_f and identify the constant- C limit.

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

Integral Setup

Answer before checking the solution.

When must $Q = m\int c(T)dT$ be used instead of $mc\Delta T$?

QUICK CHECK 2

Weighted Equilibrium

Answer before checking the solution.

If $C_1 = 2C_2$, which initial temperature has twice the weight in T_f ?

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Energy Conservation

Answer before checking the solution.

Write the isolated two-body balance in integral form.

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**General relation**

Use $dQ = mc(T)dT$ and integrate when specific heat varies with temperature.

KEY TAKEAWAY 2**Constant-c limit**

For constant c , the integral reduces to $Q = mc\Delta T$.

KEY TAKEAWAY 3**Calorimetry conservation**

For an isolated system, sum each object's finite heat transfer and set the total equal to zero.

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

From Differential to Finite

$$Q = \int mc \, dT = mc(T_f - T_i).$$

WHY IT WORKS The algebraic relation is the constant- c special case of the integral model.

WARM-UP • ACTIVITY 2

Slope Meaning

$$dQ/dT = mc(T) = C(T), \text{ the sample's heat capacity.}$$

WHY IT WORKS It measures energy required per unit temperature rise at that temperature.

WARM-UP • ACTIVITY 3

Variable c Setup

$$Q = m[a(T_f - T_i) + (b/2)(T_f^2 - T_i^2)].$$

WHY IT WORKS Integrate $c(T)$ before evaluating the limits.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Worked Example

$$Q = 0.200 \int_{20}^{60} (400 + 0.5T) dT = 0.200 [400(40) + 0.25(60^2 - 20^2)] = 3360 \text{ J.}$$

WHY IT WORKS Because c varies with T , using a single endpoint value would not be exact.

PRACTICE 2

Guided Problem

$$C_1(T_f - T_1) + C_2(T_f - T_2) = 0, \text{ so } T_f = (C_1 T_1 + C_2 T_2) / (C_1 + C_2).$$

WHY IT WORKS The result is a heat-capacity-weighted average of the initial temperatures.

PRACTICE 3

Independent Problem

$$Q = A(T_f - T_i) + (B/2)(T_f^2 - T_i^2). \text{ If } B=0, Q = A\Delta T.$$

WHY IT WORKS The finite energy transfer is the area under the C -versus- T curve.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Integral Setup

When c varies significantly with temperature over the interval and a variable- c model is supplied or required.

WHY IT WORKS Constant c is an approximation, not a mathematical identity for all materials and ranges.

QUICK CHECK 2

Weighted Equilibrium

T_1 , because $T_f = (C_1 T_1 + C_2 T_2) / (C_1 + C_2)$.

WHY IT WORKS Larger heat capacity makes the equilibrium temperature stay closer to that object's initial temperature.

QUICK CHECK 3

Energy Conservation

$m_1 \int_{T_1}^{T_f} c_1(T) dT + m_2 \int_{T_2}^{T_f} c_2(T) dT = 0$.

WHY IT WORKS Using each object's own limits automatically captures heating versus cooling signs.

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