

FOCUSED REVIEW

Focused Review: Heat, Specific Heat, and Calorimetry

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-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 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**From Differential to Finite**

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

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

WARM-UP 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

WARM-UP 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 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

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

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.

$$\Sigma Q = 0$$

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 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**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.

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 .

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

Integral Setup

Answer before checking the solution.

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

CONFIDENCE CHECK 2

Weighted Equilibrium

Answer before checking the solution.

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

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**General relation**

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

KEY TAKEAWAY 2**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**

$$C_1(T_f - T_1) + C_2(T_f - T_2) = 0, \text{ so } T_f = (C_1T_1 + C_2T_2) / (C_1 + C_2).$$

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

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE 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.

CONFIDENCE CHECK 2

Weighted Equilibrium

T_1 , because $T_f = (C_1T_1 + C_2T_2)/(C_1 + C_2)$.

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

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