

FOCUSED REVIEW

Focused Review: Thermal Expansion

Review the most important thermal-expansion ideas, reinforce the essential calculations, and confirm you are 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...

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connect temperature change to length, area, and volume changes and solve representative thermal-expansion problems.

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-U02
TOPIC: Thermal Expansion
COURSE LEVEL: Algebra-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**Equation match**

Match $\Delta L = \alpha L_0 \Delta T$, $\Delta A = 2\alpha A_0 \Delta T$, and $\Delta V = \beta V_0 \Delta T$ to length, area, and volume expansion.

WARM-UP 2**Units and signs**

State the units of α and the sign of ΔL when $\Delta T < 0$ for an ordinary material with $\alpha > 0$.

FR-04 • WARM-UP CHECK CONTINUED

WARM-UP 3

Coefficient relation

For an isotropic solid, express β in terms of α .

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

Linear Expansion Model

For a uniform isotropic material over a moderate temperature range, $\Delta L = \alpha L_0 \Delta T$ and $L = L_0(1 + \alpha \Delta T)$. The units of α are inverse temperature, such as $^{\circ}\text{C}^{-1}$ or K^{-1} .

$$\Delta L = \alpha L_0 \Delta T; \quad L = L_0(1 + \alpha \Delta T)$$

EXAMPLE A steel rail of length 20.0 m heated by 25°C with $\alpha = 12 \times 10^{-6}/^{\circ}\text{C}$ expands 6.0 mm.

SENSEI NOTE Keep the sign of ΔT through the calculation.

KEY CONCEPT 2

Area and Volume Expansion

For small fractional changes, $\Delta A = 2\alpha A_0 \Delta T$ and $\Delta V = \beta V_0 \Delta T$. For isotropic solids, $\beta \approx 3\alpha$. Use initial area or volume in these linear approximations.

$$\Delta A = 2\alpha A_0 \Delta T; \quad \Delta V = \beta V_0 \Delta T; \quad \beta \approx 3\alpha$$

EXAMPLE A 0.100 m^3 solid with $\alpha = 20 \times 10^{-6}/^{\circ}\text{C}$ heated by 50°C gains about $3.00 \times 10^{-4} \text{ m}^3$.

SENSEI NOTE Do not use α directly in the volume equation unless you first replace β with 3α .

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**Aluminum rail**

An aluminum rail is 18.0 m long at 10°C. If $\alpha = 23 \times 10^{-6}/^\circ\text{C}$, find its length at 45°C.

PRACTICE 2**Expansion gap**

Steel bridge sections are 30.0 m long. For a 55°C temperature rise and $\alpha = 12 \times 10^{-6}/^\circ\text{C}$, find the minimum gap needed per section.

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**Solve for coefficient**

A 1.50 m rod lengthens by 0.810 mm for $\Delta T = 30^\circ\text{C}$. Find α .

CONFIDENCE CHECK 2**Area expansion**

A metal sheet has $A_0 = 0.800 \text{ m}^2$, $\alpha = 15 \times 10^{-6}/^\circ\text{C}$, and $\Delta T = 40^\circ\text{C}$. Find ΔA .

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

Linear Expansion Model

For a uniform isotropic material over a moderate temperature range, $\Delta L = \alpha L_0 \Delta T$ and $L = L_0(1 + \alpha \Delta T)$. The units of α are inverse temperature, such as $^{\circ}\text{C}^{-1}$ or K^{-1} .

KEY TAKEAWAY 2

Area and Volume Expansion

For small fractional changes, $\Delta A = 2\alpha A_0 \Delta T$ and $\Delta V = \beta V_0 \Delta T$. For isotropic solids, $\beta \approx 3\alpha$. Use initial area or volume in these linear approximations.

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

Equation match

Use the definitions and sign conventions from the review.

WHY IT WORKS Thermal expansion begins with identifying ΔT , the relevant dimension, and the correct coefficient.

WARM-UP • ACTIVITY 2

Units and signs

Use the definitions and sign conventions from the review.

WHY IT WORKS Thermal expansion begins with identifying ΔT , the relevant dimension, and the correct coefficient.

WARM-UP • ACTIVITY 3

Coefficient relation

Use the definitions and sign conventions from the review.

WHY IT WORKS Thermal expansion begins with identifying ΔT , the relevant dimension, and the correct coefficient.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1**Aluminum rail**

$$\Delta T = 35^\circ\text{C}. \Delta L = (23 \times 10^{-6})(18.0)(35) = 0.01449 \text{ m, so } L = 18.0145 \text{ m.}$$

WHY IT WORKS Substitute signed quantities into the matching expansion equation and check units.

PRACTICE 2**Expansion gap**

$$\Delta L = (12 \times 10^{-6})(30.0)(55) = 0.0198 \text{ m} = 1.98 \text{ cm.}$$

WHY IT WORKS Substitute signed quantities into the matching expansion equation and check units.

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE CHECK 1

Solve for coefficient

$$\alpha = \Delta L / (L_0 \Delta T) = 0.000810 / (1.50 \times 30) = 1.80 \times 10^{-5} / ^\circ\text{C}.$$

WHY IT WORKS The result follows from proportionality and the correct geometric factor.

CONFIDENCE CHECK 2

Area expansion

$$\Delta A = 2\alpha A_0 \Delta T = 2(15 \times 10^{-6})(0.800)(40) = 9.60 \times 10^{-4} \text{ m}^2.$$

WHY IT WORKS The result follows from proportionality and the correct geometric factor.

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