

## QUICK REVIEW

# Quick Review: Stress, Strain, and Elasticity

Refresh the most important ideas, formulas, and problem-solving strategies for stress, strain, and elasticity in just a few minutes.

|                                                                                                                  |                                                                                                                         |                                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <br><b>TIME</b><br>5–10 minutes | <br><b>BEST FOR</b><br>A rapid refresh | <br><b>FINISH WITH</b><br>Key ideas refreshed |
|------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|

**After this quick review, you'll be able to...**

identify stress and strain, interpret elastic stiffness, and make a quick prediction about material deformation.

**HOW TO USE THIS GUIDE**

Work through the four stages in order. Write directly in the spaces provided, check your work in the Quick Answers 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 5–10 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:** MEC-U24  
**TOPIC:** Stress, Strain, and Elasticity  
**COURSE LEVEL:** Calculus-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 four stages to quickly refresh the essential ideas and confirm you're ready to continue.

4 stages • Approximately 5–10 minutes

|                                                                         |                                                                         |
|-------------------------------------------------------------------------|-------------------------------------------------------------------------|
| <b>1</b><br><b>Quick Recall</b><br>Refresh what you already know.       | <b>2</b><br><b>Essential Idea</b><br>Review the most important concept. |
| <b>3</b><br><b>Confidence Check</b><br>Confirm you're ready to move on. | <b>4</b><br><b>Next Step</b><br>Continue your learning.                 |

**PRINTING TIP**

For student copies, print double-sided and keep the Quick Answers section after the student activities so learners attempt each activity before checking their work.

FR-04 • STAGE 1 OF 4

## Quick Recall

Let's quickly refresh what you already know. This short recall activity will bring the most important ideas back to mind before you review them.

### QUICK RECALL

#### Recall Activity

Recall the local and global forms used for axial elastic deformation.

Write  $\sigma = F/A$ ,  $\varepsilon = \Delta L/L_0$ , and the differential extension  $d(\Delta L)$  for a small segment  $dx$  of a rod with area  $A(x)$ .

### Ready to refresh the essentials?

Great! Now review the most important idea you'll want to remember.

**Review the Essential Idea** →

## FR-05 • STAGE 2 OF 4

## Essential Idea

Take one last look at the most important concept from this topic. If you remember this idea, the rest will come back much more easily.

### ESSENTIAL IDEA

#### Elastic deformation can be accumulated from local strain

For linear axial elasticity,  $\epsilon = \sigma/Y$ . A small element  $dx$  extends by  $d(\Delta L) = \epsilon dx = F(x)dx/[Y A(x)]$ . For uniform  $F$ ,  $A$ , and  $Y$ , integration reduces to  $\Delta L = FL_0/(AY)$ .

$$\epsilon = du/dx \quad d(\Delta L) = F(x) dx / [Y A(x)]$$

EXAMPLE A tapered rod must be treated locally because  $A$  changes with position; the thinner sections contribute more extension.

SENSEI NOTE Do not use the uniform-rod formula when  $F$ ,  $A$ , or  $Y$  varies significantly along the length.

### Ready to check your memory?

You've refreshed the essential idea. Now see how much you remember before moving on.

**Start the Confidence Check** →

FR-06 • STAGE 3 OF 4

## Confidence Check

You've refreshed the essential idea. Now answer this quick confidence check to confirm you're ready to move on.

### CONFIDENCE CHECK

#### Where does most extension occur?

Reason from the integrand.

*A rod carries the same axial force everywhere but becomes gradually thinner. Which region contributes more extension per unit length?*

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### Ready for your next step?

Great work! You've refreshed the essential idea. Now choose the resource that best matches what you'd like to do next.

**Choose Your Next Step →**

## QUICK ANSWERS • CHECK AFTER ATTEMPTING

# Quick Answers and Explanations

Use these concise answers to check your recall and confidence—not only your final response.

**QUICK RECALL****Recall Activity**

$d(\Delta L) = F(x)dx/[Y A(x)]$  for linear axial elasticity.

WHY IT WORKS Local strain is  $\sigma/Y$  and stress is  $F/A$ , so extension accumulates by integrating strain over length.

**CONFIDENCE CHECK****CONFIDENCE CHECK****Where does most extension occur?**

The thinner region.

WHY IT WORKS With the same  $F$  and  $Y$ , the local extension rate is proportional to  $1/A(x)$ .

**READINESS GUIDE**

1 correct: You're ready to continue. • 0 correct: Revisit the Essential Idea or choose more practice.

FR-07 • STAGE 4 OF 4

## Next Step: Continue Learning

Great work! You've completed this quick review. Choose the next resource that best matches how confident you feel.

|                                                                                                                     |                                                                                                                                            |                                                                                                                    |
|---------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| <p><b>?</b></p> <p><b>I'm Still Unsure</b></p> <p>Review the essential idea again.</p> <p><b>Review Again →</b></p> | <p><b>🎯</b></p> <p><b>I Need More Practice</b></p> <p>Continue with additional practice for this topic.</p> <p><b>Go to Practice →</b></p> | <p><b>✓</b></p> <p><b>I'm Ready</b></p> <p>Continue to the next recommended resource.</p> <p><b>Continue →</b></p> |
|---------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|

### 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**