

FULL REVIEW

Full Review: Stress, Strain, and Elasticity

Review the essential ideas, relationships, and problem-solving tools for stress, strain, and elasticity.

 TIME 45–60 minutes	 BEST FOR A complete topic review	 FINISH WITH A readiness check
---	---	--

After this full review, you'll be able to...

explain the key elastic relationships, solve representative deformation problems, and interpret what the results mean physically.

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: MEC-U24
TOPIC: Stress, Strain, and Elasticity
COURSE LEVEL: Foundational

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**Key Ideas**

Identify the quantities in a stretching test.

A rod has original length L_0 , area A , pulling force F , and extension ΔL . Name the quantities used to describe loading and deformation.

ACTIVITY 2**Common Mistakes**

Decide whether each statement is true or false.

a) Stress is the same as force. b) Strain has no units. c) A stiffer material deforms less under comparable stress.

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Quick Application

Compare two samples qualitatively.

Two samples of the same material have equal length and carry the same force. One has twice the area. Which one experiences less stress?

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**Normal Stress and Strain**

For a straight sample pulled or compressed along its length, normal stress is $\sigma = F/A$. Longitudinal strain is $\epsilon = \Delta L/L_0$. Stress has units of pascals; strain is dimensionless.

$$\sigma = F/A \quad \epsilon = \Delta L/L_0$$

EXAMPLE A smaller area under the same force gives a larger stress.

SENSEI NOTE Always divide by the original cross-sectional area for this basic model.

KEY CONCEPT 2**Elasticity and Young's Modulus**

Within the linear elastic region, stress is proportional to strain: $\sigma = Y\epsilon$. Young's modulus Y measures stiffness. A larger Y means more stress is required to produce the same strain.

$$\sigma = Y\epsilon$$

EXAMPLE If two materials have the same strain, the one with larger Y carries the larger stress.

SENSEI NOTE Young's modulus is a material property, not a property of the sample dimensions.

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Elastic, Plastic, and Failure Behavior

A stress-strain curve shows different response regions. In the elastic region the material returns to its original shape. Beyond the elastic limit, permanent deformation can remain; sufficiently large loading can lead to failure.

Elastic → recoverable; plastic → permanent

EXAMPLE A rubber band, metal wire, and brittle plastic can have very different stress-strain behavior.

SENSEI NOTE “Elastic” does not mean “easy to stretch”; it means deformation is recoverable.

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**Guided Example**

Find stress and strain for a simple stretch.

A rod of area $2.0 \times 10^{-4} \text{ m}^2$ is pulled by 400 N and lengthens from 1.00 m to 1.002 m. Find σ and ϵ .

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Independent Check

Use Young's modulus.

A material has $Y = 2.0 \times 10^{11} \text{ Pa}$ and experiences strain 5.0×10^{-4} . Find the stress.

PRACTICE 3

Independent Problem

Combine stress, strain, and modulus.

A rod with $A = 1.5 \times 10^{-4} \text{ m}^2$ carries 3000 N. If $Y = 1.0 \times 10^{11} \text{ Pa}$ and $L_0 = 0.80 \text{ m}$, estimate its extension.

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**Area Effect**

Use $\sigma = F/A$.

If the same force is applied to a rod with twice the area, what happens to the stress?

QUICK CHECK 2**Stiffness**

Interpret Young's modulus.

Material A has a larger Young's modulus than Material B. Under the same stress, which has the smaller strain?

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Stress-Strain Curve

Interpret material behavior.

What does the initial slope of a stress-strain graph represent in the linear elastic region?

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**Stress and strain**

Stress measures load intensity; strain measures fractional deformation.

KEY TAKEAWAY 2**Elastic stiffness**

In the linear elastic region, $\sigma = Y\epsilon$; larger Y means greater stiffness.

KEY TAKEAWAY 3**Material response**

Elasticity describes recoverable deformation; beyond the elastic range, permanent deformation or failure can occur.

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.

WARM-UP • ACTIVITY 1**Key Ideas**

Stress uses F/A ; strain uses $\Delta L/L_0$.

WHY IT WORKS The quantities separate applied loading from deformation.

WARM-UP • ACTIVITY 2**Common Mistakes**

a) False. b) True. c) True.

WHY IT WORKS Force and stress differ; strain is a ratio; stiffness resists deformation.

WARM-UP • ACTIVITY 3**Quick Application**

The sample with twice the area has half the stress.

WHY IT WORKS For fixed F , σ is inversely proportional to A .

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1**Guided Example**

$$\sigma = 2.0 \times 10^6 \text{ Pa}; \varepsilon = 0.002.$$

WHY IT WORKS Compute F/A and $\Delta L/L_0$ using SI units.

PRACTICE 2**Independent Check**

$$\sigma = Y\varepsilon = 1.0 \times 10^8 \text{ Pa}.$$

WHY IT WORKS Linear elasticity connects stress and strain through Y .

PRACTICE 3**Independent Problem**

$$\sigma = 2.0 \times 10^7 \text{ Pa}; \varepsilon = 2.0 \times 10^{-4}; \Delta L = 1.6 \times 10^{-4} \text{ m}.$$

WHY IT WORKS Work in sequence: stress $\rightarrow$ strain $\rightarrow$ extension.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Area Effect

Stress is cut in half.

WHY IT WORKS Doubling A with fixed F halves F/A .

QUICK CHECK 2

Stiffness

Material A.

WHY IT WORKS For fixed σ , $\epsilon = \sigma/Y$, so larger Y gives smaller strain.

QUICK CHECK 3

Stress-Strain Curve

Young's modulus, Y .

WHY IT WORKS The slope $\Delta\sigma/\Delta\epsilon$ measures stiffness in the linear region.

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 →
---	--	--

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