FULL REVIEW

Full Review: Springs and Elastic Potential Energy

Review the essential ideas, relationships, and problem-solving tools for springs and elastic potential energy using the Algebra-Based treatment.

◷ TIME	◎ BEST FOR	✓ FINISH WITH
45–60 minutes	A complete topic review	A readiness check

After this full review, you'll be able to…
calculate spring force, elastic potential energy, spring work, speed, and maximum deformation using Hooke's law and conservation of mechanical energy.

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

Use this independent Physics Sensei Unit Review to reinforce key concepts, prepare for homework, or review before a quiz or exam.

RESOURCE: Physics Sensei Unit Review **UNIT: MEC-U18** **TOPIC: Springs and Elastic Potential Energy** **COURSE LEVEL: College introductory physics • Algebra-Based**	**BEST USED** ✓ **After learning the topic** ✓ Before starting homework ✓ Before a quiz or exam

Explore Physics Sensei Reviews →

Physics Sensei is an independent educational resource. This Unit Review uses Physics Sensei-owned organization, examples, explanations, and practice.

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

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

Hooke's Law

Use $F_s = -kx$ with units and direction.

A 300 N/m spring is stretched 0.040 m. Find the spring-force magnitude.

ACTIVITY 2

Elastic Potential Energy

Use $U_s = ½kx^2$.

A 160 N/m spring is compressed 0.20 m. Find the stored elastic potential energy.

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Energy Conversion

Use initial and final states.

A 0.80 kg block is released from a 0.10 m compression of a 320 N/m spring. Find its speed at equilibrium.

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 — page 6 →

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

Hooke's Law and Force Graphs

For an ideal spring, force varies linearly with displacement. The slope of an F-versus-x graph is -k. Use signs for direction and magnitudes when only the size of the force is requested.

Fs = -kx; |Fs| = k|x|; k = |Fs|/|x|.

EXAMPLE A 250 N/m spring stretched 0.080 m exerts a 20 N restoring force.

SENSEI NOTE Do not drop the restoring direction when interpreting a signed coordinate problem.

KEY CONCEPT 2

Elastic Energy and Spring Work

Elastic potential energy is $U_s = \frac{1}{2}kx^2$. The work done by the spring equals the decrease in its potential energy.

Us = (1/2)kx^2; Ws = (1/2)kxi^2 - (1/2)kxf^2 = -Delta Us.

EXAMPLE For k = 200 N/m, moving from x = 0.15 m to 0.05 m gives W_s = 2.00 J.

SENSEI NOTE Do not use a single endpoint force in W = Fd because spring force changes with position.

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Conservation of Mechanical Energy

For conservative spring systems, write the energy present in the chosen initial and final states, eliminate zero terms, and solve. Include gravitational potential energy when height changes.

(1/2)mvi^2 + (1/2)kxi^2 = (1/2)mvf^2 + (1/2)kxf^2; v = sqrt[(k/m)(A^2 - x^2)].

EXAMPLE A block released from maximum displacement A has $v = \sqrt{[(k/m)(A^2-x^2)]}$.

SENSEI NOTE At turning points $v = 0$; at equilibrium $x = 0$. Use those conditions to simplify equations.

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 — page 8 →

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

Calculate stored spring energy.

A 300 N/m spring is compressed 0.080 m. Find U_s.

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Guided Problem

Use energy to find speed.

A 0.50 kg block is released from rest at x = 0.10 m on a 200 N/m spring. Find its speed at equilibrium.

PRACTICE 3

Independent Problem

Find maximum compression.

A 1.0 kg block moving at 3.0 m/s compresses a 450 N/m spring on a frictionless surface. Find maximum compression.

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 — page 10 →

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

Spring Force

Calculate magnitude and direction.

A 240 N/m spring is stretched 0.050 m to the right. Find the spring force.

QUICK CHECK 2

Energy Scaling

Compare deformation.

If a spring compression doubles, by what factor does U_s *change?*

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Spring Work

Use the change in spring energy.

For $k = 250$ N/m, the spring moves from $x_i = 0.12$ m to $x_f = 0.04$ m. Find W_s.

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 — page 12 →

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

Use Signed Hooke's Law

$F_s = -kx$; the negative sign encodes restoring direction.

KEY TAKEAWAY 2

Spring Energy Is Quadratic

$U_s = \frac{1}{2}kx^2$ and $W_s = -\Delta U_s$.

KEY TAKEAWAY 3

Solve Spring Motion with Energy States

Choose initial/final states, identify K, U_s, and U_g, remove zero terms, and solve.

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 — page 16 →

ANSWER KEY • CHECK AFTER ATTEMPTING

Solutions and Explanations

Use these solutions to check your reasoning—not only your final answer. Use each answer and explanation to identify the step that supports the result.

WARM-UP • ACTIVITY 1

Recall Activity 1

12 N, directed toward equilibrium.

WHY IT WORKS $|F_s| = k|x| = (300)(0.040) = 12$ N.

WARM-UP • ACTIVITY 2

Recall Activity 2

3.2 J.

WHY IT WORKS $U_s = ½(160)(0.20)^2 = 3.2$ J.

WARM-UP • ACTIVITY 3

Recall Activity 3

2.0 m/s.

WHY IT WORKS $½kx^2 = ½mv^2$, so $v = x\sqrt{(k/m)} = 2.0$ m/s.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1

Worked Example

0.96 J.

WHY IT WORKS $U_s = ½(300)(0.080)^2 = 0.96$ J.

PRACTICE 2

Guided Problem

2.0 m/s.

WHY IT WORKS $½kx^2 = ½mv^2$ gives $v = 0.10\sqrt{(200/0.50)} = 2.0$ m/s.

PRACTICE 3

Independent Problem

0.141 m (about 0.14 m).

WHY IT WORKS $½mv^2 = ½kx^2$, so $x = v\sqrt{(m/k)} = 3.0\sqrt{(1/450)} = 0.141$ m.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Spring Work

12 N to the left.

WHY IT WORKS $F_s = -kx$; magnitude = 12 N and direction is toward equilibrium.

QUICK CHECK 2

Check Spring Energy Reasoning

A factor of 4.

WHY IT WORKS $U_s \propto x^2$.

QUICK CHECK 3

Spring Work

1.60 J.

WHY IT WORKS $W_s = ½k(x_i^2\text{-x\_f}^2) = 125(0.0144-0.0016) = 1.60$ J.

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	◎ I Need More Practice	✓ I'm Ready
Review the key ideas and examples again.	Continue with additional practice for this topic.	Continue to the next recommended resource.
Review again: return to Warm-Up Check on page 4.	Go to Practice →	Continue →

RECOMMENDED LINKS

Review again: return to Warm-Up Check on page 4.

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