

FOCUSED REVIEW

Focused Review: Gauss's Law — Calculus-Based

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: EME-U03
TOPIC: Gauss's Law
COURSE LEVEL: Calculus-Based University 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**Key Ideas**

Electric flux, Gaussian surface, enclosed charge, and symmetry are the central ideas.

Match: flux $\rightarrow$ field through a surface; Gaussian surface $\rightarrow$ imaginary closed surface; Q_{enc} $\rightarrow$ net charge inside.

WARM-UP 2**Common Mistakes**

Decide whether each statement is true or false.

A charge outside the Gaussian surface contributes to Q_{enc} . (False) Zero net flux always means $E = 0$ everywhere. (False)

FR-04 • WARM-UP CHECK CONTINUED

WARM-UP 3

Quick Application

Use Gauss's law conceptually before calculating.

A closed surface encloses $+4\ \mu\text{C}$ and $-1\ \mu\text{C}$. Identify Q_{enc} and the sign of the net flux.

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

Electric Flux and Enclosed Charge

Flux describes how the electric field crosses a surface. For a flat area in a uniform field, $\Phi_E = \int \mathbf{E} \cdot d\mathbf{A}$. For a closed surface, Gauss's law relates the total flux to the net charge inside: $\oint \mathbf{E} \cdot d\mathbf{A} = Q_{\text{enc}} / \epsilon_0$.

$$\oint \mathbf{E} \cdot d\mathbf{A} = Q_{\text{enc}} / \epsilon_0$$

EXAMPLE If Q_{enc} doubles, the net flux doubles. Changing the shape of the closed surface does not change the total flux as long as the same net charge remains enclosed.

SENSEI NOTE Count only net enclosed charge; outside charges are not part of Q_{enc} .

KEY CONCEPT 2

Choosing a Gaussian Surface

Choose a closed surface that matches the symmetry of the charge distribution. Spherical, cylindrical, and planar symmetry are the standard cases. The goal is to make the magnitude of E constant on useful portions of the surface and make E parallel or perpendicular to the area vector.

$$\text{Spherical symmetry: } E(4\pi r^2) = Q_{\text{enc}} / \epsilon_0$$

EXAMPLE Spherical symmetry gives $E = (1 / 4\pi\epsilon_0)(Q_{\text{enc}} / r^2)$. Cylindrical symmetry can give $E = \lambda / (2\pi\epsilon_0 r)$.

SENSEI NOTE Do not choose a Gaussian surface merely because it is easy to draw; it must exploit the actual symmetry.

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

Guided Example

Find the electric field a distance r from a point charge Q using a spherical Gaussian surface.

1. Choose a sphere centered on Q .
 2. E is radial and constant on the sphere.
 3. Flux = $E(4\pi r^2)$.
 4. Set $E(4\pi r^2) = Q/\epsilon_0$.
 5. Therefore $E = (1 / 4\pi\epsilon_0)(Q_{\text{enc}} / r^2)$.
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PRACTICE 2

Independent Check

Apply the same strategy to a new case.

An infinitely long line has linear charge density λ . Use a cylindrical Gaussian surface of radius r and length L to derive $E(r)$.

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

Flux versus Field

Answer in one or two sentences.

A closed surface has zero net enclosed charge. Must the electric field be zero at every point on the surface? Explain.

CONFIDENCE CHECK 2

Symmetry Check

Answer in one or two sentences.

Why can E be taken outside the flux integral for a spherical Gaussian surface centered on a spherically symmetric charge distribution?

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**Gauss's Law**

Net electric flux through a closed surface is determined by net enclosed charge: $\oint \mathbf{E} \cdot d\mathbf{A} = Q_{\text{enc}} / \epsilon_0$.

KEY TAKEAWAY 2**Symmetry Is the Solver**

Gauss's law is always valid, but symmetry is what lets you turn the flux relation into a simple equation for E .

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. Use each explanation to compare your reasoning with the representative solution.

WARM-UP • ACTIVITY 1

Key Ideas

Electric flux measures field through a surface; a Gaussian surface is imaginary and closed; Q_{enc} is net charge inside.

WHY IT WORKS These definitions identify the quantities that appear in Gauss's law.

WARM-UP • ACTIVITY 2

Common Mistakes

Both statements are false.

WHY IT WORKS Outside charge is excluded from Q_{enc} , and zero net flux does not require zero local field.

WARM-UP • ACTIVITY 3

Quick Application

$Q_{\text{enc}} = +3 \mu\text{C}$, so the net flux is positive.

WHY IT WORKS Net enclosed charge determines the sign and magnitude of total closed-surface flux.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1**Guided Example**

$$E = (1 / 4\pi\epsilon_0)(Q_{\text{enc}} / r^2).$$

WHY IT WORKS Spherical symmetry makes E constant and radial on the sphere.

PRACTICE 2**Independent Check**

$$E = \lambda / (2\pi\epsilon_0 r).$$

WHY IT WORKS Only the curved side contributes flux; $E(2\pi rL) = \lambda L / \epsilon_0$.

SOLUTIONS • CONFIDENCE CHECK

CONFIDENCE CHECK 1

Flux versus Field

No. E can be nonzero while positive and negative flux contributions cancel.

WHY IT WORKS Gauss's law constrains net flux, not the field at each point.

CONFIDENCE CHECK 2

Symmetry Check

Because symmetry makes E have the same magnitude everywhere on the sphere and parallel to dA .

WHY IT WORKS Then $\oint E \cdot dA$ becomes $E \oint dA = E(4\pi r^2)$.

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