

FULL REVIEW

Full Review: Capacitance and Dielectrics — Foundational

Review the essential ideas, relationships, and problem-solving tools for Capacitance and Dielectrics.

 TIME 45–60 minutes	 BEST FOR A complete topic review	 FINISH WITH A readiness check
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After this full review, you'll be able to...

recall the essential ideas, apply them to representative problems, and determine what to study next.

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: EME-U05
TOPIC: Capacitance and Dielectrics
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**

In one phrase each, define capacitor, capacitance, and dielectric. Then identify whether each describes charge separation, storage ability, or material response.

Complete the activity in the space below.

ACTIVITY 2**Common Mistakes**

Decide whether each statement is true or false: “A capacitor creates net charge,” “More plate area increases capacitance,” and “A dielectric usually increases capacitance.”

Complete the activity in the space below.

FR-04 • WARM-UP CHECK CONTINUED

ACTIVITY 3

Quick Application

A capacitor is redesigned with larger plates but the same spacing and material. Predict how its capacitance changes and explain why.

Complete the activity in the space below.

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**What a capacitor does**

A capacitor consists of two conductors separated by an insulating region. Moving charge from one conductor to the other creates equal and opposite plate charges and an electric field. Capacitance measures how much charge separation corresponds to a given potential difference.

C compares charge separation with potential difference

EXAMPLE Think of larger capacitance as "more charge separation for the same voltage."

SENSEI NOTE Do not confuse capacitance with the actual charge currently on the plates.

KEY CONCEPT 2**Geometry, combinations, and dielectrics**

For parallel plates, larger area increases capacitance while larger separation decreases it. Parallel connections increase total capacitance; a series connection makes the equivalent capacitance smaller than either individual capacitor. A dielectric polarizes and increases capacitance.

larger A → larger C • larger d → smaller C

EXAMPLE A dielectric-filled capacitor can store more separated charge at the same battery voltage.

SENSEI NOTE Always identify whether the battery remains connected before predicting changes in charge, voltage, or energy.

FR-05 • CORE CONCEPTS CONTINUED

KEY CONCEPT 3

Energy and the battery condition

Charging a capacitor requires work, so energy is stored in the electric field. When a dielectric is added, capacitance increases. If the battery stays connected, voltage is fixed and more charge flows onto the plates; if disconnected, charge stays fixed and voltage falls.

battery connected: ΔV fixed • isolated: Q fixed

EXAMPLE Compare the same capacitor before and after inserting a dielectric under both battery conditions.

SENSEI NOTE Never predict the energy change until you know whether Q or voltage is fixed.

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**

Two identical $4\ \mu\text{F}$ capacitors are connected in parallel. Find the equivalent capacitance and explain the result conceptually.

Show the governing relation, substitution or reasoning, and final conclusion.

FR-06 • GUIDED PRACTICE CONTINUED

PRACTICE 2

Independent Check

Two capacitors are connected in series. Is the equivalent capacitance greater than, equal to, or less than the smaller capacitor? Explain without calculation.

Show the governing relation, substitution or reasoning, and final conclusion.

PRACTICE 3

Independent Problem

A $6\ \mu\text{F}$ capacitor is charged and then disconnected. A dielectric doubles its capacitance. Without detailed calculation, compare the new voltage and stored energy with the old values.

Show the governing relation, substitution or reasoning, and final conclusion.

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**Geometry Check**

Work independently, then check the solution.

If the plate separation doubles while area and material stay unchanged, what happens to capacitance?

QUICK CHECK 2**Dielectric Check**

Work independently, then check the solution.

A dielectric is inserted while the capacitor remains connected to a battery. What happens to capacitance and stored charge?

FR-07 • CONFIDENCE CHECK CONTINUED

QUICK CHECK 3

Network Check

Work independently, then check the solution.

Two identical capacitors are connected first in parallel and then in series. Which arrangement has the larger equivalent capacitance?

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**What capacitance means**

Capacitance describes how much separated charge a capacitor can store for a given potential difference.

KEY TAKEAWAY 2**Geometry and connections matter**

Larger plate area and dielectric material increase capacitance; wider plate spacing decreases it. Parallel capacitors add directly, while series combinations have a smaller equivalent capacitance.

KEY TAKEAWAY 3**Dielectrics change the electric response**

A dielectric polarizes in the electric field and increases capacitance. Whether stored energy rises or falls depends on whether the battery remains connected.

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. Focus on the governing idea and the essential explanation.

WARM-UP • ACTIVITY 1

Key Ideas

A capacitor separates equal and opposite charge on two conductors; capacitance measures charge separation per potential difference; a dielectric is an insulating material whose polarization changes the electric response.

WHY IT WORKS These three ideas describe different roles: the capacitor is the device, capacitance is the storage-response property, and the dielectric is the material response between conductors.

WARM-UP • ACTIVITY 2

Common Mistakes

False; true; true.

WHY IT WORKS Charging transfers charge between conductors rather than creating net charge. For parallel plates, larger area increases capacitance, and inserting a dielectric increases capacitance.

WARM-UP • ACTIVITY 3

Quick Application

Capacitance increases. If the plate area is multiplied by a factor, capacitance increases by the same factor when spacing and material stay unchanged.

WHY IT WORKS For the same spacing and dielectric, a larger plate area gives the electric field more effective area over which to store separated charge for a given voltage.

SOLUTIONS • GUIDED PRACTICE

PRACTICE 1**Guided Example**

Parallel capacitors act like a larger effective plate area, so their capacitances add: $8\ \mu\text{F}$.

WHY IT WORKS Parallel capacitors share the same voltage and act like increased effective plate area, so their capacitances add.

PRACTICE 2**Independent Check**

Less than the smaller capacitor, because series connection increases the effective separation for storing charge.

WHY IT WORKS A series connection effectively increases the separation associated with storing charge, so the equivalent capacitance is smaller than either individual capacitance.

PRACTICE 3**Independent Problem**

Charge remains fixed. Doubling C halves the voltage, and with fixed Q the stored energy also halves.

WHY IT WORKS For an isolated capacitor Q is fixed. If C doubles, $V = Q/C$ is halved and $U = Q^2/(2C)$ is also halved.

SOLUTIONS • CONFIDENCE CHECK

QUICK CHECK 1

Geometry Check

It decreases by a factor of 2.

WHY IT WORKS For parallel plates, capacitance varies inversely with separation when area and dielectric are unchanged.

QUICK CHECK 2

Dielectric Check

Capacitance increases, and the battery supplies additional charge so Q increases.

WHY IT WORKS The dielectric increases C ; with the battery attached, ΔV stays fixed, so $Q = C\Delta V$ increases.

QUICK CHECK 3

Network Check

Parallel; two identical capacitors give $2C$ in parallel and $C/2$ in series.

WHY IT WORKS For identical capacitors, parallel addition gives $2C$ while the series reciprocal rule gives $C/2$.

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 →
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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)