

Storing charge and energy between two plates

AP Physics 2 (algebra-based) · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

This test covers capacitance, parallel plates, stored energy and dielectrics at AP Physics 2 level. Use $\epsilon_0 = 8.85 \times 10^{-12} \text{ F/m}$. A calculator is allowed. Show every step, give units with each result, and state clearly which quantity is held constant when a dielectric is inserted.

Level: AP Physics 2 (algebra-based) · **Curriculum:** AP P2 Unit 10

Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

Question 1 Capacitance (2 marks)

A capacitor stores 12 μC when connected to 3.0 V.

- Define capacitance. (1 mark)
- Calculate its capacitance. (1 mark)

Question 2 Parallel plates (3 marks)

A parallel-plate capacitor has plates of area 0.030 m^2 separated by 0.50 mm of air. Use $\epsilon_0 = 8.85 \times 10^{-12} \text{ F/m}$.

- Calculate its capacitance. (2 marks)
- State the effect on C of doubling the separation. (1 mark)

Question 3 Energy in a flash unit (3 marks)

A $220 \mu\text{F}$ capacitor is charged to 24 V. Calculate the charge stored and the energy stored. (3 marks)

Question 4 Battery stays connected (3 marks)

A $2.0 \mu\text{F}$ capacitor is connected to a 12 V battery. A dielectric with $\kappa = 3.0$ fills the gap with the battery still connected. Calculate the new capacitance and the charge before and after. (3 marks)

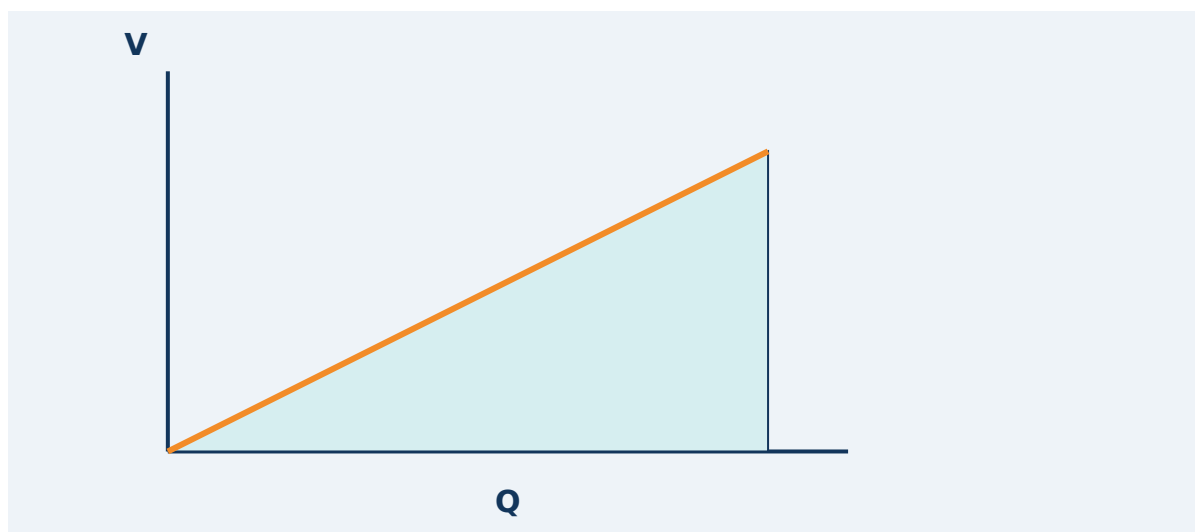
Question 5 Isolated capacitor (3 marks)

A charged capacitor is disconnected from its battery and then a dielectric is inserted. State

what happens to the charge, capacitance, voltage and stored energy, and explain the energy change. (3 marks)

Question 6 Voltage against charge (2 marks)

The graph shows voltage against charge for a capacitor.



A V against Q graph for a capacitor, with the area under the line shaded.

State what the gradient and the shaded area represent. (2 marks)

Question 7 Breakdown (2 marks)

Explain why every capacitor has a maximum safe voltage. (2 marks)

Question 8 Doubling the voltage (2 marks)

A capacitor is charged first to V and then to $2V$. State the effect on its capacitance and its stored energy. (2 marks)