

Flux, Gauss's law and continuous charge

AP Physics C (Mechanics and E&M, calculus-based) · Test

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

This test covers flux, Gauss's law and fields of continuous charge distributions in the style of AP Physics C: Electricity and Magnetism. Show every step, name the Gaussian surface where you use one, and give units. Take $k = 8.99 \times 10^9 \text{ N m}^2/\text{C}^2$ and $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/(\text{N m}^2)$. The total is 20 marks.

Level: AP Physics C (Mechanics and E&M, calculus-based) · **Curriculum:** AP PC:E&M Unit 8

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

Question 1 Flux through a tilted area (2 marks)

A uniform field of 800 N/C passes through a flat surface of area 0.30 m². The normal makes 30° with the field. Calculate the flux.

Question 2 Net flux (3 marks)

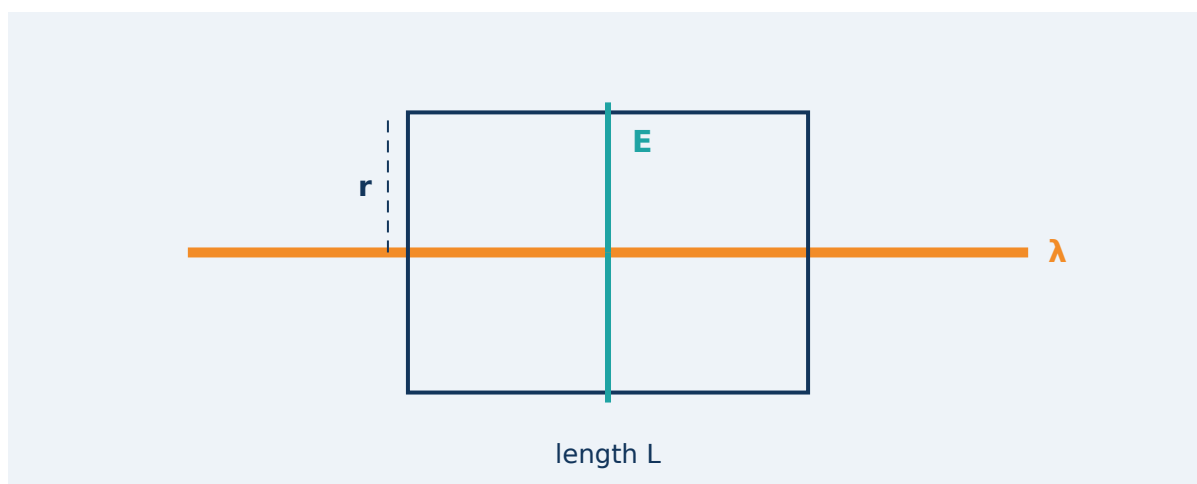
A closed surface encloses +5.0 nC and −2.0 nC.

- Calculate the net flux through it. (2 marks)
- State the effect on the net flux of adding a +4.0 nC charge outside the surface. (1 mark)

Question 3 Inside a conductor (2 marks)

Explain why the electric field inside a conductor in electrostatic equilibrium is zero and where any net charge is found.

Question 4 Line of charge (3 marks)



Question 4: Gaussian cylinder around a line charge.

Use Gauss's law and the cylinder in the figure to derive the field at distance r from a very long line of charge with linear density λ .

Question 5 Insulating sphere (3 marks)

A solid insulating sphere of radius 0.060 m carries a uniform +9.0 nC. Calculate the field at $r = 0.030$ m and at $r = 0.12$ m.

Question 6 Charged ring (3 marks)

A thin ring of radius 0.40 m carries +6.0 nC. Calculate the field on its axis 0.30 m from the centre and explain why the perpendicular components cancel.

Question 7 Large sheet (2 marks)

A large flat sheet carries a uniform charge density of +6.0 nC/m². Calculate the field on either side of it.

Question 8 Limits of Gauss's law (2 marks)

Explain why Gauss's law cannot be used directly to find the field at a point near a short charged rod.