



**Test Papers
Hub.**

AP Physics C: Electricity & Magnetism Practice Paper 1

Full Exam Simulation — Calculus-Based Electricity & Magnetism

Section I: 35 multiple-choice (A–D) · Section II: 3 free-response questions (15 marks each) · 80 marks in all · 90 minutes

How to use this booklet

- Working time – 90 minutes (Section I: 45 minutes; Section II: 45 minutes). A scientific or graphing calculator is permitted throughout.
- Section I has 35 multiple-choice questions with four options (A–D). Section II has 3 free-response questions worth 15 marks each — show all work.
- An equation sheet is provided at the back of the question paper. Calculus (differentiation and integration) is expected.
- Worked solutions follow the paper: every question has step-by-step working, a key takeaway and (for multiple choice) a note on why each wrong option is wrong.

SECTION I — MULTIPLE CHOICE

35 marks · 45 minutes · Attempt Questions 1 – 35

Choose the best answer for each question. Each question is worth 1 mark; there is no penalty for incorrect answers. A calculator and the equation sheet at the back are permitted.

1. The electric flux through a closed surface is zero. Which of the following must be true?

- A There are no charges inside or outside the surface
- B The net charge enclosed by the surface is zero
- C The electric field is zero everywhere on the surface
- D The surface is inside a conductor

2. A charge of $+6.9 \times 10^{-6} \text{ C}$ is at $(-0.28 \text{ m}, 0)$ and a charge of $-3.0 \times 10^{-6} \text{ C}$ is at $(+0.28 \text{ m}, 0)$. Point P is at $(0, 0.48 \text{ m})$. What is the magnitude of the net electric field at P?

- A $1.75 \times 10^5 \text{ N C}^{-1}$
- B $4.02 \times 10^5 \text{ N C}^{-1}$
- C $2.88 \times 10^5 \text{ N C}^{-1}$
- D $1.45 \times 10^5 \text{ N C}^{-1}$

3. A $9.8 \times 10^{-5} \text{ F}$ capacitor charged to 9.0 V is discharged through a 66000Ω resistor starting at $t = 0$. What total energy is dissipated in the resistor during the whole discharge?

- A $7.94 \times 10^{-3} \text{ J}$
- B $6.14 \times 10^{-4} \text{ J}$
- C $4.41 \times 10^{-4} \text{ J}$
- D $3.97 \times 10^{-3} \text{ J}$

4. A aluminium wire of length 1.6 m and diameter $3.0 \times 10^{-4} \text{ m}$ (resistivity $2.8 \times 10^{-8} \Omega \text{ m}$) is connected across a 12 V battery. What is the resistance of the wire?

- A 0.634Ω
- B $1.24 \times 10^{-15} \Omega$
- C $1.49 \times 10^{-4} \Omega$
- D 0.158Ω

5. A long straight wire carries a current of 11 A. What is the magnitude of the magnetic field 0.040 m from the wire?

- A $1.38 \times 10^{-3} \text{ T}$
- B $5.50 \times 10^{-5} \text{ T}$
- C $3.46 \times 10^{-4} \text{ T}$
- D $1.73 \times 10^{-4} \text{ T}$

6. A $9.0 \times 10^{-6} \text{ F}$ capacitor charged to 12 V is connected across a 0.034 H inductor at $t = 0$, forming an ideal LC circuit. What is the maximum current in the inductor?

- A $6.64 \times 10^{-3} \text{ A}$
- B 738 A
- C 0.195 A
- D $3.18 \times 10^{-3} \text{ A}$

7. Which Maxwell equation states that a changing magnetic flux induces an electric field?

- A Gauss's law for electricity
- B Gauss's law for magnetism
- C Faraday's law
- D Ampère's law without Maxwell's correction

8. Consider the centripetal force on a mass moving in a circle ($F = mv^2/r$). The speed is multiplied by 5.0 and the radius is tripled, with everything else unchanged. By what factor does the quantity change?

- A $\times \frac{50}{3}$
- B $\times 2.89$
- C $\times 225$
- D $\times \frac{25}{3}$

9. An initially uncharged $6.6 \times 10^{-5} \text{ F}$ capacitor is connected in series with a 93000Ω resistor and a 12 V battery at $t = 0$. What charge is on the capacitor at $t = 8.0 \text{ s}$?

- A $5.76 \times 10^{-4} \text{ C}$
- B $7.92 \times 10^{-4} \text{ C}$
- C $2.16 \times 10^{-4} \text{ C}$
- D $6.91 \times 10^{-3} \text{ C}$

WORKED SOLUTIONS

Answers & worked solutions

Multiple-choice answer key

1	B	2	A	3	D	4	A	5	B	6	C
7	C	8	D	9	A	10	D	11	A	12	C
13	B	14	B	15	D	16	D	17	A	18	B
19	A	20	C	21	A	22	B	23	B	24	C
25	D	26	D	27	A	28	C	29	A	30	C
31	D	32	C	33	B	34	C	35	B		

SECTION I — MULTIPLE CHOICE

1. The electric flux through a closed surface is zero. Which of the following must be true? [Gauss's law]

Correct answer: B — The net charge enclosed by the surface is zero

- Gauss's law: $\Phi = Q_{\text{enc}}/\epsilon_0$.
- Zero flux means $Q_{\text{enc}} = 0$; the field itself need not be zero.
- Why the other options are wrong:
 - A (There are no charges inside or outside the surface): charges outside the surface may exist
 - C (The electric field is zero everywhere on the surface): the field may be non-zero with equal inward and outward flux
 - D (The surface is inside a conductor): this is only one possibility

LOS: Gauss's law

KEY TAKEAWAY

Gauss's law relates the TOTAL flux to the ENCLOSED charge only — a zero flux does not mean zero field.

2. A charge of $+6.9 \times 10^{-6} \text{ C}$ is at $(-0.28 \text{ m}, 0)$ and a charge of $-3.0 \times 10^{-6} \text{ C}$ is at $(+0.28 \text{ m}, 0)$. Point P is at $(0, 0.48 \text{ m})$. What is the magnitude of the net electric field at P? [Electric field and force]

Correct answer: A — $1.75 \times 10^5 \text{ N C}^{-1}$

- Distance from each charge to P: $r = \sqrt{(0.28^2 + 0.48^2)} = 0.556 \text{ m}$.
- Magnitudes: $E_1 = kq_1/r^2 = 2.01 \times 10^5 \text{ N/C}$ and $E_2 = k|q_2|/r^2 = 87300 \text{ N/C}$.
- Components (field of $+q_1$ points away from it, field of $-q_2$ points toward it): $E_x = (E_1 + E_2)(d/r) = 1.45 \times 10^5$, $E_y = (E_1 - E_2)(h/r) = 98100$.
- $|E| = \sqrt{E_x^2 + E_y^2} = 1.75 \times 10^5 \text{ N C}^{-1}$
- Why the other options are wrong: