

10.3 Electric Fields

Name: _____ Class: _____ Date: _____

Total: 11 marks**KEY WORDS** electric field 电场 • field lines 电场线

Objective

Build the skills to answer exam questions on **electric fields**.**You must be able to:**

- define the **electric field** 电场 as force per unit positive charge, $\vec{E} = \vec{F}/q$
- draw and interpret **field lines** 电场线 (direction and density)
- calculate the field of a **point charge**, $E = k\frac{q}{r^2}$, and add fields as vectors
- describe the uniform field between parallel plates

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ The electric field

$\vec{E} = \frac{\vec{F}}{q}$, measured in N C^{-1} — the force a small positive test charge would feel per unit charge.

■ Field lines

Lines point **away** from positive and **toward** negative charge; where the lines are **denser**, the field is stronger.

■ Point charge and parallel plates

$E = k\frac{q}{r^2}$ for a point charge. Between parallel plates the field is **uniform**, running from the + plate to the – plate.

2 Practice

2.1 A charge of $2.0 \times 10^{-6} \text{ C}$ feels a force of 0.10 N. Find the electric field there. [2]

2.2 State the direction of the field around a positive point charge. [1]

2.3 Find the field 0.20 m from a $+4.0 \mu\text{C}$ charge ($k = 8.99 \times 10^9$). [2]

3 Exam-style questions

3.1 The electric field is defined as [1]

- A** force $\times$ charge
- B** force per unit charge
- C** charge per unit force
- D** charge $\times$ distance

3.2 Field lines around a negative point charge point [1]

- A** away from it
- B** toward it
- C** in circles around it
- D** there are none

3.3 A $+6.0 \mu\text{C}$ charge sits at the origin.

(a) Find the electric field 0.30 m from it. [3]

(b) State the direction of the field. [1]

Solutions

2.1 $E = \frac{F}{q} = \frac{0.10}{2.0 \times 10^{-6}} = 5.0 \times 10^4 \text{ N C}^{-1}.$

2.2 radially outward, away from the charge.

2.3 $E = k \frac{q}{r^2} = 8.99 \times 10^9 \times \frac{4.0 \times 10^{-6}}{(0.20)^2} = 9.0 \times 10^5 \text{ N C}^{-1}.$

3.1 B.

3.2 B.

3.3 (a) $E = 8.99 \times 10^9 \times \frac{6.0 \times 10^{-6}}{(0.30)^2} = 6.0 \times 10^5 \text{ N C}^{-1}.$ (b) away from the charge (radially outward).