

8.3 Electric Fields

Name: _____ Class: _____ Date: _____

Total: 11 marks

KEY WORDS electric field 电场 • test charge 检验电荷 • point charges 点电荷
• superposition 叠加

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 charge, $\vec{E} = \frac{\vec{F}}{q}$
- calculate the field of a **point charge**, $E = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2}$
- use **superposition** for several point charges
- find the force $\vec{F} = q\vec{E}$ on a charge in a field

1 Worked examples

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

■ The electric field

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

■ Point charge

$E = k\frac{q}{r^2}$, pointing away from a positive charge and toward a negative one; add fields as vectors (superposition).

■ Force on a charge

$\vec{F} = q\vec{E}$. A positive charge feels a force **along** $\vec{E}$; a negative charge feels one **opposite** to $\vec{E}$.

2 Practice

2.1 Find the electric field 0.20 m from a $+5.0 \mu\text{C}$ charge ($k = 8.99 \times 10^9$). [2]

2.2 A $+2.0 \mu\text{C}$ charge sits in a field of 3000 N C^{-1} . Find the force on it. [2]

2.3 State the direction of the field around a negative point charge. [1]

3 Exam-style questions

3.1 The electric field is defined as [1]

- | | |
|---|--------|
| A | qF |
| B | F/q |
| C | q/F |
| D | qr^2 |

3.2 The force on a charge q in a field E is [1]

- | | |
|---|--------|
| A | q/E |
| B | qE |
| C | E/q |
| D | qE^2 |

3.3 A $+4.0 \mu\text{C}$ charge is at the origin.

(a) Find the electric field 0.30 m from it. [2]

(b) Find the force on a $-1.0 \mu\text{C}$ charge placed there, with direction. [2]