AP PHYSICS 2 • EXERCISE SHEET

10.3 Electric Fields

Name: _____ Class: _____ Date: _____ **Total: 11 marks**

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**, $E = k\dfrac{q}{r^2}$, 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

$\vec{E} = \dfrac{\vec{F}}{q}$, 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

$E = k\dfrac{q}{r^2}$ 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 2.0×10^{-6} 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 μC charge ($k = 8.99 \times 10^9$). [2]

3 Exam-style questions

3.1 The electric field is defined as [1]

- **A** force × charge
- **B** force per unit charge
- **C** charge per unit force
- **D** charge × 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 μC charge sits at the origin.

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

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

4 Go further

- work through the **10.3 Electric Fields** lesson on the **Learn** page;

- read the **Electric Force, Field, and Potential** section of the AP Physics 2 handout on the **Know** page.

Solutions

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

2.2 radially outward, away from the charge.

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

3.1 B.

3.2 B.

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