

18.1 Electric fields and field lines

Name: _____ Class: _____ Date: _____

Total: 9 marks

Objective

Build the skills to answer exam questions on the **electric field** —its definition and field lines.

You must be able to:

- define **electric field strength** as force per unit positive charge
- use $F = qE$
- represent an electric field with **field lines**

1 Worked examples

Study these first. Each one shows the method for a question type used later —follow the steps and you can do the Practice and Exam-style questions yourself.

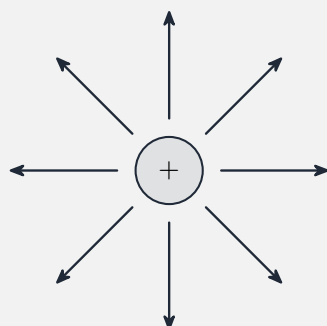
■ Field strength

The **electric field strength** is the force per unit **positive** charge:

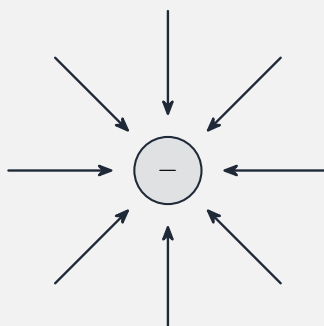
$$E = \frac{F}{q} \quad (\text{N C}^{-1} = \text{V m}^{-1}), \quad F = qE.$$

■ Field lines

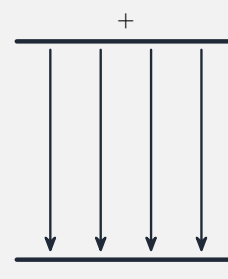
Field lines point the way the force acts on a **positive** charge:



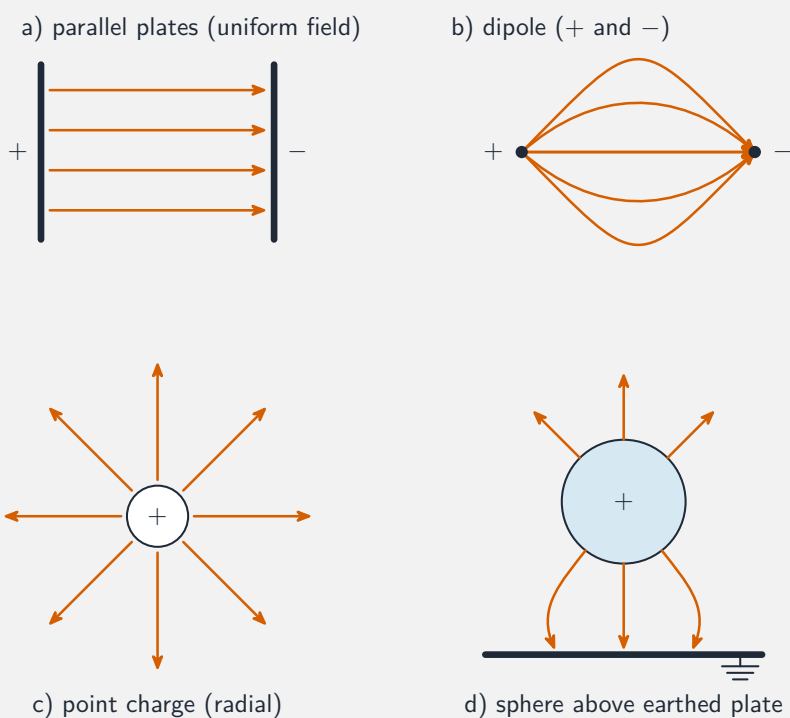
(a) + charge



(b) - charge



(c) uniform



Electric field line patterns

Outward from +, inward to -, and uniform between charged plates. Closer lines $\rightarrow$ stronger field.

2 Practice

Now apply the methods above.

2.1 Define **electric field strength**. [1]

2.2 State the unit of electric field strength. [1]

2.3 Write the equation for the **force** on a charge q in a field E . [1]

2.4 State the **direction** of the field lines around a **positive** point charge. [1]

3 Exam-style questions

3.1 Electric field strength is the force per unit: [1]

- **A** mass
 - **B** positive charge
 - **C** area
 - **D** length
-

3.2 A charge of 2.0×10^{-6} C experiences a force of 0.10 N in a field. Find the **field strength**. [2]

3.3 Sketch the field lines around (a) a positive and (b) a negative point charge. [2]

4 Go further

You are now ready for the real exam questions on this subtopic. Open the **18.1 Electric field** past-paper sheet in the Library, or try this in **Practice mode**:

- 9702/42 N25 —Q6 (define electric field; draw field lines; field strength)

Electric field strength also runs through the **18.2 Uniform electric fields** and **18.4 Electric field of a point charge** sheets, so practise those too.

Solutions

2.1 The **force per unit positive charge** on a small test charge ($E = F/q$).

2.2 N C^{-1} (or V m^{-1}).

2.3 $F = qE$.

2.4 Outward (away from the charge).

3.1 B —positive charge.

3.2 $E = F/q = 0.10/(2.0 \times 10^{-6}) = 5.0 \times 10^4 \text{ N C}^{-1}$.

3.3 (a) radial lines pointing **outward** from the positive charge; (b) radial lines pointing **inward** to the negative charge.