

10.5 Electric Potential

Name: _____ Class: _____ Date: _____

Total: 11 marks**KEY WORDS** electric potential 电势 • potential difference 电势差 • electric field 电场

Objective

Build the skills to answer exam questions on **electric potential**.

You must be able to:

- define **electric potential** 电势 (voltage) as potential energy per unit charge, $V = U/q$
- calculate the potential due to point charges, $V = k\frac{q}{r}$
- relate the **potential difference** 电势差 to the work needed to move a charge
- connect the field to the potential (the field points toward decreasing potential)

1 Worked examples

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

■ Electric potential

$V = \frac{U}{q}$, measured in volts — the potential energy per unit charge. For a point charge,
 $V = k\frac{q}{r}$, a **scalar** (just add potentials).

■ Work and potential difference

$W = q\Delta V$ to move a charge q through a potential difference ΔV .

■ Field and potential

The electric field points from **high** to **low** potential.

2 Practice

2.1 Find the potential 0.30 m from a $+6.0 \mu\text{C}$ charge ($k = 8.99 \times 10^9$). [2]

2.2 State whether electric potential is a scalar or a vector quantity. [1]

2.3 Find the work needed to move a $+2.0 \mu\text{C}$ charge through a potential difference of 100 V. [2]

3 Exam-style questions

3.1 Electric potential is [1]

- A potential energy per unit charge
- B force per unit charge
- C charge per unit energy
- D field $\times$ distance only

3.2 The electric field points in the direction of [1]

- A increasing potential
- B decreasing potential
- C zero potential
- D constant potential

3.3 A $+3.0 \mu\text{C}$ charge sits at the origin.

(a) Find the potential 0.20 m from it. [3]

(b) Find the potential energy of a $+1.0\ \mu\text{C}$ charge placed there.

[1]

Solutions

2.1 $V = k \frac{q}{r} = 8.99 \times 10^9 \times \frac{6.0 \times 10^{-6}}{0.30} = 1.8 \times 10^5 \text{ V}.$

2.2 a scalar.

2.3 $W = q \Delta V = 2.0 \times 10^{-6} \times 100 = 2.0 \times 10^{-4} \text{ J}.$

3.1 A.

3.2 B.

3.3 (a) $V = 8.99 \times 10^9 \times \frac{3.0 \times 10^{-6}}{0.20} = 1.35 \times 10^5 \text{ V}.$ (b) $U = qV = (1.0 \times 10^{-6})(1.35 \times 10^5) = 0.135 \text{ J}.$