

9.3 Conservation of Electric Energy

Name: _____ Class: _____ Date: _____

Total: 11 marks

KEY WORDS electron volt 电子伏特 • conservation of energy 能量守恒 • work 功 • potential difference 电势差
• kinetic energy 动能

Objective

Build the skills to answer exam questions on **conservation of electric energy**.

You must be able to:

- relate the change in a charge's **kinetic energy** to $W = q \Delta V$
- apply **conservation of energy** 能量守恒 to a charge moving through a potential difference
- define and use the **electron volt** 电子伏特 (eV)
- find the final **speed** of a charge accelerated through a potential difference

1 Worked examples

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

■ **Energy from a potential difference**

$\Delta KE = q \Delta V$: the field does work $q \Delta V$ on a charge that falls through ΔV .

■ **The electron volt**

1 eV is the energy an electron gains through 1 V: $1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$.

■ **Final speed**

Set $\frac{1}{2}mv^2 = q \Delta V$ and solve for v .

2 Practice

2.1 An electron moves through a potential difference of 50 V. State the energy it gains, in eV. [1]

2.2 Convert 3.0 eV to joules ($e = 1.6 \times 10^{-19} \text{ C}$). [2]

2.3 A $+2.0\ \mu\text{C}$ charge moves through $300\ \text{V}$. Find the energy it gains, in joules. [2]

3 Exam-style questions

3.1 One electron volt equals [1]

- **A** $1\ \text{J}$
 - **B** $1.6 \times 10^{-19}\ \text{J}$
 - **C** $1\ \text{V}$
 - **D** $1\ \text{C}$
-

3.2 A charge accelerated through a potential difference ΔV gains kinetic energy [1]

- **A** $q/\Delta V$
 - **B** $q\Delta V$
 - **C** $\Delta V/q$
 - **D** $\frac{1}{2}q\Delta V^2$
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3.3 A proton ($m = 1.67 \times 10^{-27}\ \text{kg}$, $q = 1.6 \times 10^{-19}\ \text{C}$) accelerates from rest through $500\ \text{V}$.

(a) Find its kinetic energy in joules. [2]

(b) Find its final speed. [2]

Solutions

2.1 50 eV.

2.2 $3.0 \times 1.6 \times 10^{-19} = 4.8 \times 10^{-19}$ J.

2.3 $\Delta KE = q \Delta V = (2.0 \times 10^{-6})(300) = 6.0 \times 10^{-4}$ J.

3.1 B.

3.2 B.

3.3 (a) $\Delta KE = q \Delta V = (1.6 \times 10^{-19})(500) = 8.0 \times 10^{-17}$ J. (b) $\frac{1}{2}mv^2 = 8.0 \times 10^{-17} \Rightarrow$
$$v = \sqrt{\frac{2(8.0 \times 10^{-17})}{1.67 \times 10^{-27}}} = 3.1 \times 10^5 \text{ m s}^{-1}.$$