

Cells and batteries

4.5.2.1 · Energy changes · revision notes

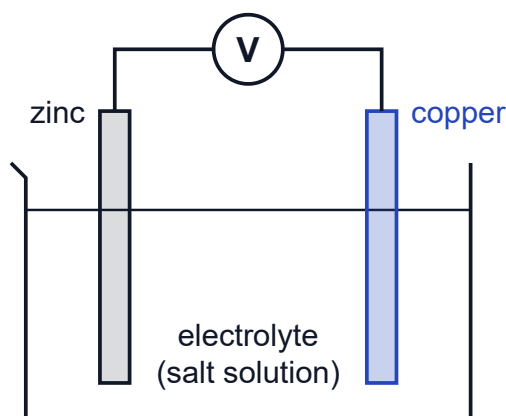
Chemistry only (not in Combined Science). A cell uses chemical reactions to produce electricity. You need to know how simple cells and batteries are made, the difference between rechargeable and non-rechargeable cells, and how to use voltage data to compare the reactivity of metals and to evaluate the use of cells.

Key facts

- Cell: contains chemicals that react to produce electricity
- Voltage depends on the type of electrodes and the electrolyte
- Battery: two or more cells in series; the voltages add
- Rechargeable: reactions reversed when an external electrical current is supplied
- Simple cell: two different metals in contact with an electrolyte
- Bigger difference in reactivity = bigger voltage; same metal on both sides = 0 V
- Non-rechargeable (e.g. alkaline): stops when a reactant is used up

Simple cells

- A **cell** contains chemicals that react to produce electricity.
- You can make a simple cell by connecting two **different metals** in contact with an **electrolyte** (a solution containing ions, such as salt solution).



two different metals + an electrolyte

The bigger the difference in reactivity between the two metals, the bigger the voltmeter reading.

- The voltage of a cell depends on several factors, including the type of electrodes (which metals) and the electrolyte.
- The **bigger the difference in reactivity** between the two metals, the **bigger the voltage**.
- If both electrodes are the same metal, the voltage is zero.

Batteries

- A **battery** is two or more cells connected together **in series** to give a bigger voltage.
- The voltages of cells in series add up, e.g. three 1.5 V cells give 4.5 V.

Non-rechargeable and rechargeable

- In **non-rechargeable** cells and batteries, the chemical reactions stop when one of the reactants has been used up. Alkaline batteries are non-rechargeable.
- **Rechargeable** cells and batteries can be recharged because the chemical reactions are **reversed** when an external electrical current is supplied.
- Rechargeable cells cost more to buy, but they can be reused many times, so they are cheaper over time and fewer are thrown away. They need a charger, and recharging takes time.
- Non-rechargeable cells are cheap and ready to use, but they are thrown away after one use, which wastes resources and adds to landfill unless they are recycled.

How to answer each type of question

Recall: simple cells and batteries

1 to 2 marks

Grade 4

1. Simple cell: two different metals and an electrolyte.
2. Battery: cells joined in series, so add the voltages.
3. Why a cell stops: one of the reactants has been used up.

Example. (a) Give the **two** things needed to make a simple cell. (2)

(b) A battery is made from three cells in series. Each cell has a voltage of 2.0 V. What is the voltage of the battery? (1)

(c) Explain why a non-rechargeable cell eventually stops producing electricity. (1)

Model answer. (a) two different metals (1); an electrolyte (1)

(b) $3 \times 2.0 = 6.0 \text{ V}$ (1)

(c) one of the reactants has been used up, so the chemical reactions stop (1)

Don't lose marks

- ✗ Saying a cell 'runs out of electricity' or 'runs out of energy'. Say one of the reactants is used up, so the reactions stop.
- ✗ Saying a rechargeable cell is recharged by 'adding more chemicals'. An external electrical current reverses the reactions.
- ✗ Saying the cells in a battery are joined in parallel. They are joined in series.
- ✗ Expecting a voltage from two electrodes made of the same metal.
- ✗ In 'evaluate' questions, only giving points for one type of cell, or giving no conclusion.

More tips

Memory tricks

- 'Bigger gap, bigger voltage': the further apart two metals are in the reactivity series, the bigger the voltage.
- Same metal on both sides: no difference in reactivity, so 0 V.
- Cells in series: just add the voltages.
- REcharge = REverse: recharging reverses the chemical reactions.
- The more reactive metal gives away electrons, so it is the negative electrode.

Exam technique

- In data questions, quote numbers: 'magnesium gave the highest voltage, 2.6 V, so it is the most reactive'.
- Learn the key wording: 'the chemical reactions are reversed when an external electrical current is supplied'.
- For 'evaluate', give at least one point for each type of cell, use the data (a cost per hour is a strong point), and end with a justified conclusion.
- When asked to predict a voltage, check your answer fits the pattern: tested against the same metal, a metal between two others in reactivity should give a voltage between theirs.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

State what a cell does

A cell contains chemicals that react to produce electricity.

Grade 4

Describe how to make a simple cell

Put two different metals in contact with an electrolyte and connect them with wires, e.g. to a voltmeter.

Grade 4

Explain how a battery gives a bigger voltage

A battery is two or more cells connected in series, so their voltages add together.

Grade 5

Explain why non-rechargeable cells stop working

The chemical reactions stop when one of the reactants has been used up.

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