

# Galvanic cells, electrode potentials and electrolysis

Chemistry grades 11-12 (A Level · IB · Class 11-12) · Test

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Class: \_\_\_\_\_ Mark: \_\_\_\_ / 20

This test covers standard electrode potentials, cell emf, feasibility, fuel cells and electrolysis calculations. You have 45 minutes and may use a calculator. Show all working, use  $F = 96\,500$  C/mol and give units with every answer.

**Level:** Chemistry grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** IB R3.2

Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

## Question 1 Standard conditions (2 marks)

State two of the standard conditions needed to measure a standard electrode potential, and give the potential of the standard hydrogen electrode.

## Question 2 Magnesium-silver cell (3 marks)

Magnesium ( $E^\circ = -2.37$  V) and silver ( $E^\circ = +0.80$  V) half-cells are connected.

- Calculate  $E^\circ_{\text{cell}}$ . (1 mark)
- Write the overall equation. (1 mark)
- State which electrode is the anode. (1 mark)

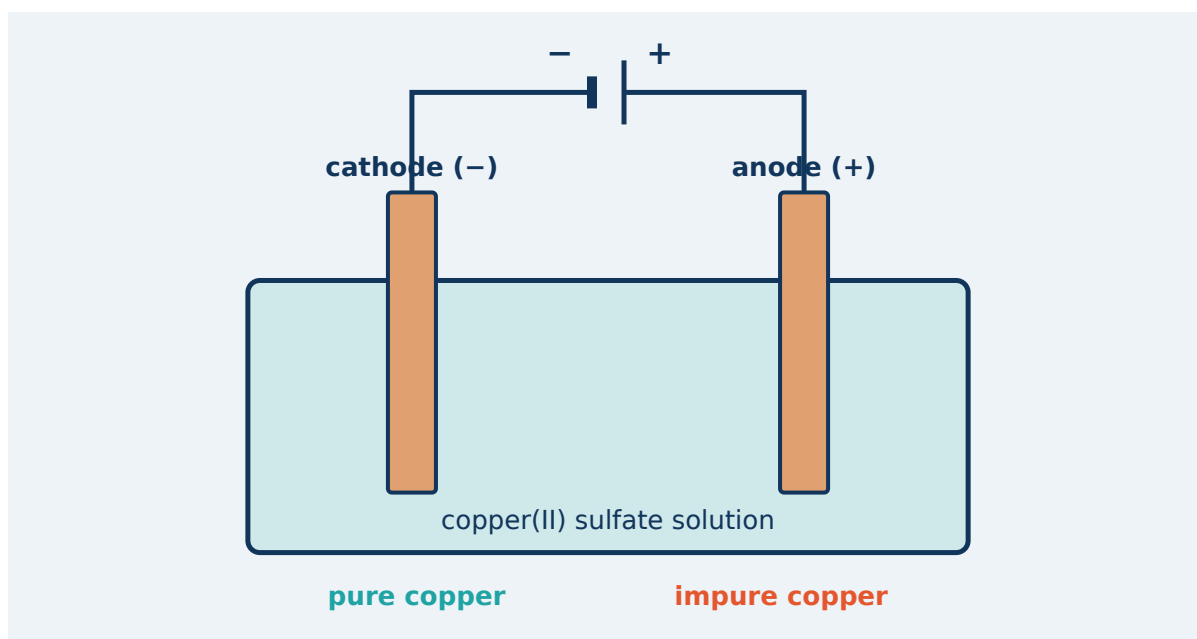
## Question 3 Iron(III) and iodide (2 marks)

Predict whether  $\text{Fe}^{3+}$  ions oxidise iodide ions to iodine.  $E^\circ: \text{Fe}^{3+}/\text{Fe}^{2+} +0.77$  V,  $\text{I}_2/\text{I}^- +0.54$  V.

## Question 4 Refining copper (2 marks)

The diagram shows impure copper refined in copper(II) sulfate solution.

- State at which electrode the copper dissolves. (1 mark)
- State at which electrode the mass increases. (1 mark)



*Refining copper.*

### Question 5 Nickel plating (3 marks)

A current of 1.50 A flows for 45.0 minutes in a nickel(II) plating bath ( $A_r \text{ Ni} = 58.7$ ;  $F = 96\,500 \text{ C/mol}$ ). Calculate the mass of nickel deposited.

### Question 6 Hydrogen fuel cell (3 marks)

A hydrogen fuel cell has an acidic electrolyte.

- Write the half-equations at the anode and the cathode. (2 marks)
- State one advantage of fuel cells over rechargeable batteries. (1 mark)

### Question 7 The salt bridge (2 marks)

Explain what would happen to the voltmeter reading if the salt bridge were removed from a zinc-copper cell.

### Question 8 Brine electrolysis (3 marks)

Concentrated sodium chloride solution is electrolysed with graphite electrodes. Explain why hydrogen, not sodium, forms at the cathode, and name the product at the anode with an equation.