AP CHEMISTRY • EXERCISE SHEET

9.8 Galvanic and Electrolytic Cells

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

KEY WORDS anode 阳极 • cathode 阴极 • electrolytic 电解池 • galvanic (voltaic) 原电池

Objective

Build the skills to answer exam questions on **galvanic and electrolytic cells**.

You must be able to:

- distinguish a **galvanic (voltaic)** 原电池 cell from an **electrolytic** 电解池 cell
- identify the **anode** (oxidation) and **cathode** (reduction)
- state the direction of electron flow

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.

■ Two kinds of cell

- **Galvanic (voltaic)** cell — a **favorable** redox reaction produces electricity ($\Delta G < 0$, $E_{\text{cell}} > 0$).
- **Electrolytic** cell — electricity **drives** an unfavorable reaction ($\Delta G > 0$, needs an external power source).

■ Anode and cathode

In **both** cells: **oxidation** happens at the **anode**; **reduction** at the **cathode** (remember "an ox, red cat"). Electrons flow from anode to cathode through the wire.

■ A worked galvanic cell

$\text{Zn}|\text{Zn}^{2+}\,||\,\text{Cu}^{2+}|\text{Cu}$: Zn is oxidized (anode), Cu^{2+} is reduced (cathode); electrons flow $\text{Zn} \rightarrow \text{Cu}$.

■ The salt bridge

A **salt bridge** keeps each half-cell electrically neutral by letting ions move, completing the circuit.

2 Practice

Now apply the methods above.

2.1 At which electrode does oxidation occur? [1]

2.2 Which cell produces electricity from a favorable reaction? [1]

2.3 In which direction do electrons flow in a galvanic cell? [1]

3 Exam-style questions

3.1 In any electrochemical cell, reduction occurs at the [1]

- **A** anode
- **B** cathode
- **C** salt bridge
- **D** wire

3.2 A galvanic cell uses $\mathrm{Zn|Zn^{2+}\,||\,Cu^{2+}|Cu}$.

(a) Identify the anode and cathode. [2]

(b) State the direction of electron flow. [1]

3.3 Explain the difference between a galvanic and an electrolytic cell in terms of ΔG and energy. [2]

Solutions

2.1 The anode.

2.2 A galvanic (voltaic) cell.

2.3 From the anode to the cathode.

3.1 B — the cathode.

3.2 (a) Anode: Zn (oxidized); cathode: Cu (where Cu^{2+} is reduced). (b) From the Zn electrode to the Cu electrode.

3.3 A galvanic cell runs a favorable reaction ($\Delta G < 0$) and **releases** electrical energy; an electrolytic cell uses an external power source to drive an unfavorable reaction ($\Delta G > 0$).