AP CHEMISTRY • EXERCISE SHEET

9.11 Electrolysis and Faraday's Law

Name: _____ Class: _____ Date: _____ **Total: 13 marks**

Objective

Build the skills to answer exam questions on **electrolysis and Faraday's law**.

You must be able to:

- convert **charge** 电荷 to **moles of electrons** with $F = 96\,500$ C/mol
- use $Q = It$ (current × time)
- find the mass or moles of product deposited

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.

The electrolysis chain

Current deposits or releases substances at the electrodes. The route:

$$\text{charge } Q = It \;\rightarrow\; \text{mol } e^- = \frac{Q}{F} \;\rightarrow\; \text{mol product} \;\rightarrow\; \text{mass}.$$

$F = 96\,500$ C/mol is the charge on one mole of electrons.

A worked deposit

A current of 2.0 A for 965 s: $Q = It = (2.0)(965) = 1930$ C; mol $e^- = 1930/96\,500 = 0.020$ mol.

Electrons per ion

Use the half-reaction's electron count. $Cu^{2+} + 2e^- \rightarrow Cu$ needs **2** electrons per Cu, so mol Cu = (mol e^-)/2.

Finish with mass

Mass = mol × molar mass. For 0.020 mol e^- depositing Cu: mol Cu = 0.010; mass = $0.010 \times 63.5 = 0.635$ g.

2 Practice

Now apply the methods above.

2.1 Write the equation for charge in terms of current and time. [1]

2.2 Find the charge from 3.0 A for 200 s. [2]

2.3 How many moles of electrons are in 9650 C? [2]

3 Exam-style questions

3.1 One mole of electrons carries a charge of about [1]

- **A** 6.02×10^{23} C
- **B** 96 500 C
- **C** 1 C
- **D** 8.314 C

3.2 A current of 5.0 A flows for 1930 s through molten NaCl, depositing sodium ($Na^+ + e^- \rightarrow Na$).

(a) Find the total charge and the moles of electrons. [3]

(b) Find the mass of sodium deposited ($M = 23$ g/mol). [2]

3.3 A current deposits copper from Cu^{2+}. If 0.40 mol of electrons pass, find the moles of

Cu deposited. [2]

4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **9.11 Electrolysis and Faraday's Law** lesson on the **Learn** page;
- read the **Electrolysis and Faraday's Law** section of the AP Chemistry handout on the **Know** page.

Solutions

2.1 $Q = It$.

2.2 $Q = (3.0)(200) = 600$ C.

2.3 $\dfrac{9650}{96\,500} = 0.10$ mol.

3.1 B —96 500 C (Faraday's constant).

3.2 (a) $Q = (5.0)(1930) = 9650$ C; mol $e^- = 9650/96\,500 = 0.10$ mol. (b) $\mathrm{Na^+} + e^- \rightarrow \mathrm{Na}$ (1:1), so 0.10 mol Na; mass $= 0.10 \times 23 = 2.3$ g.

3.3 $\mathrm{Cu^{2+}} + 2e^- \rightarrow \mathrm{Cu}$, so mol Cu $= 0.40/2 = 0.20$ mol.