Electrochemical Stoichiometry and Faraday's Law

g11_u05_w18

Purpose and boundary

Use original fictional paper data to model charge, electrons, and product amount. No electrolysis, circuit connection, metal handling, gas generation, device operation, or construction is requested.

Targets: I can convert charge to moles of electrons and use a balanced half-reaction to model amount of product. I can compare measured and theoretical values without overclaiming. **Vocabulary:** charge, current, Faraday constant, half-reaction, theoretical amount, percent agreement. **Prerequisites:** mole ratios, molar mass, balancing charge, dimensional analysis.

For this packet use $F = 96\,485\ \mathrm{C\,mol^{-1}\ e^-}$, $Q = It$, $M_{\mathrm{Cu}} = 63.55\ \mathrm{g\,mol^{-1}}$, and $M_{\mathrm{Al}} = 26.98\ \mathrm{g\,mol^{-1}}$. Treat every card as a calculation model, not a real-device claim.

1. State what one faraday represents in this model.

2. Write the units that turn charge Q in C into amount of electrons in mol e^-.

3. A fictional log reports $Q = 1930$ C. Find $n(e^-)$.

4. A paper current-time card gives $I = 0.500$ A for 120. s. Find Q.

5. Convert the charge from item 4 into mol e^-.

6. For $Cu^{2+} + 2e^- \rightarrow Cu$, how many moles of electrons correspond to 1 mol Cu?

7. Use item 3 and the copper half-reaction to find modeled moles Cu.

8. Convert item 7 to modeled mass Cu.

9. Explain why the coefficient 2 in item 6 changes the mole ratio but does not double an electrode potential.

10. Write a dimensional-analysis chain from I and t to mass Cu.

11. A fictional card gives $Q = 4824$ C for $\mathrm{Al^{3+}} + 3\mathrm{e^-} \rightarrow \mathrm{Al}$. Find mol $\mathrm{e^-}$.

---

12. Use item 11 to find modeled moles Al and mass Al.

---

13. A class compares 0.00500 mol $\mathrm{e^-}$ with 0.00150 mol Al. Is that pair exactly consistent with the stated aluminum half-reaction? Show a ratio.

---

14. A paper record predicts 0.6355 g Cu and lists 0.6000 g as a measured value. Find $\frac{\text{measured}}{\text{theoretical}} \times 100\%$.

---

15. Give one bounded conclusion from item 14 and one conclusion the data alone cannot support.

---

16. Name one missing measurement that would limit interpretation of the difference in item 14.

---

17. A log uses 1.25 A for 154. s. Compute charge and modeled mass Cu.

---

18. A student writes $0.0100 \text{ mol Cu} \times 96\,485 \text{ C mol}^{-1} \text{ e}^-$ to find charge. Identify the missing conversion factor.

---

19. Distinguish theoretical amount from a mechanism claim or efficiency claim.

---

20. Write a two-sentence evidence claim for a fictional paper data set that predicts 0.320 g Cu and reports 0.316 ± 0.004 g.
