

Cells, cell potential and electrolysis

AP Chemistry · Lab answers

Model answers use the sample data in the Results tables. Your own readings will differ a little, so judge your work by the pattern: the gradient near 0.030 V and the order of the metals.

Level: AP Chemistry · **Curriculum:** AP Chem Unit 9

Question 1 Identify the anodes

The metal is the negative electrode and the copper is the positive terminal in every pair, so each of Mg, Zn, Fe and Pb is oxidised at the anode. For magnesium: $\text{Mg} \rightarrow \text{Mg}^{2+} + 2\text{e}^-$.

Question 2 Experimental potentials

$E^\circ(\text{M}^{2+}/\text{M}) = 0.34 - E_{\text{measured}}$. Mg: $0.34 - 2.61 = -2.27 \text{ V}$; Zn: $0.34 - 1.07 = -0.73 \text{ V}$; Fe: $0.34 - 0.75 = -0.41 \text{ V}$; Pb: $0.34 - 0.45 = -0.11 \text{ V}$. (Mg -2.27 , Zn -0.73 , Fe -0.41 , Pb -0.11 .)

Question 3 Percentage difference

Difference = $-2.27 - (-2.37) = 0.10 \text{ V}$. Percentage = $0.10 / 2.37 \times 100 = 4.2 \%$. The agreement is good for a school lab.

Question 4 Graph for the Nernst equation

The points are linear. Gradient = $(1.09 - 1.00) / (0 - (-3)) = 0.09 / 3 = 0.030 \text{ V}$ per unit of $\log [\text{Cu}^{2+}]$.

Question 5 Compare with theory

$n = 2$, so the gradient is $0.0592 / 2 = 0.0296 \text{ V}$. The measured 0.030 V agrees within 2 %, confirming $n = 2$.

Question 6 Predict a new voltage

$\log [\text{Cu}^{2+}] = -4$, which is one decade beyond the data: $1.00 - 0.03 = 0.97 \text{ V}$.

Question 7 Why readings differ

An oxide film on magnesium or iron adds resistance and lowers the reading; the bridge adds a small junction potential; the solutions were 0.50 mol/dm^3 rather than 1.0 , so voltages differ

from standard values; a temperature of 22 °C instead of 25 °C changes the constant slightly.
Clean strips and 1.0 mol/dm³ solutions reduce these errors.

Question 8 Role of the bridge

The bridge completes the circuit and lets ions move so that charge does not build up and stop the reaction. A high-resistance meter draws almost no current, so the reading is the **open-circuit voltage** and the concentrations do not change during the measurement.