

Grade 10 Cumulative Competition Packet

Quantitative systems, evidence quality, and model transfer

Fictional paper models only. Show units, assumptions, and evidence limits. No real laboratory procedure, product-safety, or consumer-use claim is requested. Total: 20 points.

1. A hydrate is 36.0% water by mass. A 25.0 g sample is heated. Calculate mass of water lost, then state one assumption required before calling the residue anhydrous salt. [4 pts]

2. A calorimetry card: 100.0 g water warms 5.0 C, $c = 4.184 \text{ J}/(\text{g}^\circ\text{C})$. Calculate q_{water} , infer q_{rxn} for insulated cup, and state one boundary on the inference. [4 pts]

3. A controlled kinetics card doubles $[A]$ from 0.10 M to 0.20 M and rate from 2.0 to 4.0 units/s. Combine this with $Q = 3.0$, $K = 1.0$ for a separate equilibrium card: state one rate conclusion, one equilibrium direction, and one conclusion neither card supports. [4 pts]

4. A galvanic cell has $E^\circ_{\text{cathode}} = +0.34 \text{ V}$ and $E^\circ_{\text{anode}} = -0.76 \text{ V}$. Calculate cell potential, trace electron flow, and explain why this does not establish battery lifetime. [4 pts]

Item 5 — Extended CER

5. A fictional polymer retains more mass after the same exposure than comparison material. Make a bounded claim, cite evidence, connect a structure/property model, state one limitation, and name a next measurement. [4 pts]
-