Cumulative Mixed-Topic Competition Reasoning

Student Worksheet | g10_u09_w33

I can: select a model, calculate from supplied values, and state the limit on a mixed-topic chemistry claim.
Scope card: Every card below is fictional paper data. Use only the printed equation, values, and stated conditions. These cards support the listed calculations and model comparisons; they do *not* direct experiments, assess hazards, predict a real system, establish a health/environmental claim, or choose an industrial, consumer, or engineering action.

topic card	supplied data and boundary
stoichiometry	$2H_2 + O_2 \rightarrow 2H_2O$; 0.50 mol H_2 and 0.30 mol O_2
thermochemistry	idealized process card: $\Delta H = +50$ kJ per stated reaction amount
kinetics	at fixed conditions, $[X]$: 0.10 to 0.20 M; model rate: 4.0 to 8.0 units
equilibrium	for a stated model mixture, $Q = 0.50$ and $K = 2.0$
acid-base	fictional aqueous card: pH = 3.00; use $[H_3O^+] = 10^{-\mathrm{pH}}$
electrochemistry	reduction potentials: cathode +0.34 V, anode −0.76 V

Model note: Rate units, equilibrium direction, pH calculation, and cell potential are each limited to their printed model cards. Do not merge them into an experiment, safety judgment, product choice, or real-world prediction.

1. From the balanced equation, how many moles of H_2 are required per mole of O_2?

2. If 0.50 mol H_2 reacts completely, how many moles of H_2O does the equation predict?

3. How many moles of O_2 are required for 0.50 mol H_2?

4. Identify the limiting reactant for the supplied amounts.

5. Calculate the excess O_2 remaining in the equation model.

6. Is the stated thermochemistry card endothermic or exothermic? Explain from the sign.

7. What energy change does the card assign to twice the stated reaction amount?

8. In the kinetics card, by what factor does $[X]$ change?

9. In the kinetics card, by what factor does the model rate change?

10. Write the narrowest supported rate statement for this fixed-condition card.

11. Compare Q and K in the equilibrium card.

12. What net-direction label does the equilibrium model assign when $Q < K$?

13. Why does a $Q < K$ comparison not state how fast the model mixture changes?

14. Calculate $[H_3O^+]$ for pH 3.00.

15. Why does a calculated pH value not by itself identify every dissolved substance in the card?

16. Calculate $E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$.

17. In the electrochemical model, state the external-circuit electron direction using anode and cathode labels.

18. Critique: "A positive cell potential card proves a safe product or a real device lifetime."

19. Critique: "The pH and equilibrium cards together prove a health, environmental, or industrial conclusion."

20. Write a cautious mixed-topic CER using one stoichiometry or energy value and one kinetics, equilibrium, acid-base, or electrochemistry value. Name both model boundaries.