

Multi-Constraint Quantitative Chemistry

Student Worksheet | g11_u01_w04

Scope: Solve supplied fictional quantitative cards only. No chemical preparation, reaction, or instrument use is requested.

1. A modeled sample has mass 2.50 ± 0.03 g and occupies 1.20 ± 0.02 mL. Report density using the conservative rule from Week 2.

2. A supplied line is $s = 0.080c + 0.010$ for $0 \leq c \leq 6.0$. Infer c for $s = 0.250 \pm 0.005$.

3. Does item 2 satisfy the stated calibration-range constraint?

4. A card sets a reporting limit of relative uncertainty at most 3.0%. Does item 2's signal-only relative uncertainty meet it?

5. A mass fraction is m_A/m_T with $m_A = 0.625$ g and $m_T = 2.50$ g. Calculate percent by mass.

6. If m_A has 0.005 g uncertainty and m_T has 0.03 g uncertainty, estimate conservative relative uncertainty in item 5.

7. Convert item 6 to a percent-by-mass absolute uncertainty.

8. A stoichiometric model predicts 1.80 g from 2.50 g input. A paper result is 1.71 g. Calculate apparent percent yield.

9. State why item 8 does not by itself identify a physical cause.

10. A report has two constraints: mass fraction $25.0 \pm 1.0\%$ and calibrated concentration 3.00 ± 0.06 . Which is closer to a 2% relative-uncertainty threshold?

11. A model requires a signal within 0.010–0.490. Is 0.505 eligible?

12. A card says “accept only values with residual magnitude below 0.020.” Is residual -0.018 acceptable by that rule?

13. Is residual $+0.025$ acceptable?

14. A student rounds an intermediate 3.004 to 3.0 before multiplying by 0.080. Explain why guard digits matter here.

15. Two model routes give 2.98 and 3.04 for the same quantity. Give a quantitative comparison and a cautious conclusion.

16. A mass conversion gives 0.0879 mol from 3.87 g and 44.01 g mol^{-1} . Verify with units.

17. A claim says a result is “exact” after using a calibration line. Replace “exact” with defensible language.

18. List the order for checking a multi-constraint claim: calculation, range, uncertainty, residual, conclusion.

19. A result is numerically plausible but outside the line range. What must the conclusion say?

20. Write a two-sentence evidence-bound conclusion for one card using a number, uncertainty, and one explicit limit.
