Quantitative Retrieval and Measurement Models

Student Worksheet | g11_u01_w01

I can: distinguish a quantity from a claim about that quantity, preserve units and significant digits, and state the boundary of a measurement model.
Scope: All numbers are original, fictional paper-data cards. No laboratory procedure or chemical handling is requested. A calculator is allowed; round once at the end unless a question asks about displayed precision.

1. A balance display reads 12.340 g. What is the smallest displayed increment, and how many significant figures does the reading show?

2. Convert 0.00456 kg to grams. Preserve the appropriate significant figures.

3. Convert 18.2 mL to liters and to cubic centimeters.

4. A card reports 3.40×10^2 mg. Write it in grams in ordinary decimal notation.

5. A sample label says "mass = 7.20." Identify the missing information needed to make this a usable quantitative statement.

6. An accepted reference value is 25.00 mL. A paper reading is 24.62 mL. Calculate the signed error and absolute error.

7. Use item 6 to calculate percent error. State which value belongs in the denominator and why.

8. A length model uses $L = 2.00$ cm and $W = 4.0$ cm. Calculate area and report a defensible number of significant figures.

9. A data card lists three independent mass readings: 8.21, 8.20, and 8.22 g. Calculate the mean.

10. For item 9, calculate the range and propose a simple half-range uncertainty.

11. A second set reads 8.210, 8.211, and 8.209 g. Which set is more precise? Explain without claiming it is necessarily more accurate.

12. A fictional instrument is checked with a 10.00 g reference and reads 10.06 g. What does this one check support, and what does it not establish?

13. Convert 2.50 mol of a model substance with molar mass 44.01 $\mathrm{g\,mol^{-1}}$ to grams. Show unit cancellation.

14. A data card gives 88.0 g of that substance. Convert to moles using 44.01 $\mathrm{g\,mol^{-1}}$.

15. A concentration claim is 0.125 $\mathrm{mol\,L^{-1}}$ in 0.400 L. Calculate amount in moles.

16. A mass is listed as 4.6 g with no uncertainty. Give one appropriate way to communicate a reasonable measurement limit and one reason not to invent a precise limit.

17. A graph's horizontal axis is time in seconds and vertical axis is mass in grams. What units would a slope have?

18. A team calculates 6.2/0.0031. Before calculating, estimate the order of magnitude. Then calculate and round appropriately.

19. Compare these claims: “The model predicts 5.20 g” and “5.20 g was measured.” What evidence boundary differs?

20. A fictional data table has a missing unit in one column. Explain why averaging that column with a column labeled grams is not justified, even if the digits look similar.