Chemistry activity for students

FREE SAMPLE | Chemistry activity from the AI Assignment Makeover Kit

Learning goal and conditions

Interpret molarity, conserve the amount of solute during dilution, and distinguish final solution volume from added solvent volume. This is a paper exercise with hypothetical data; no experiment or chemical handling is required. Assume no solute loss and use the stated final volumes.

Your starting problem

A sample contains 50.0 mL of 0.100 mol/L sodium chloride solution. It is diluted until the final solution volume is 250.0 mL. What is the final molarity?
Before reading the supplied response, write your prediction: higher, lower, or unchanged concentration? Explain in one sentence. Then show your calculation.

Supplied response to evaluate

This response was deliberately written for critique; it is not an authentic model transcript.

The sample contains 0.00500 mol of sodium chloride. Add 250.0 mL of water to the 50.0 mL sample so the final volume is 250.0 mL. Dividing 0.00500 mol by 0.2500 L gives 0.0200 mol/L. The amount of dissolved salt decreases fivefold during dilution.

Your task

Identify two conceptual errors in the response. Explain why its reported concentration can be numerically correct even though parts of its explanation are wrong. Rewrite the explanation in 100 to 150 words. Use a claim verification record for one error.
Checkpoint: If 250.0 mL of water were actually added and volumes were approximately additive, what final concentration would you estimate?

Submit and permissions

Submit your prediction, calculation, two corrections, rewritten explanation, checkpoint, and disclosure. AI is optional only after your initial attempt; the supplied response is sufficient. If you use a tool, check its calculations independently. Use the rubric on page 3 of this sample.

Chemistry answer key

FREE SAMPLE | Instructor answer key from the AI Assignment Makeover Kit

Correct calculation

n = M1 x V1 = (0.100 mol/L)(0.0500 L) = 0.00500 mol.
M2 = n / V2 = 0.00500 mol / 0.2500 L = 0.0200 mol/L.
Equivalently, M1V1 = M2V2 when the amount of solute is conserved. The final result has three significant figures.

Two errors to identify

Error 1: Added water volume and final solution volume are treated as interchangeable. The problem specifies dilution to a final volume of 250.0 mL. Adding 250.0 mL of water to an existing 50.0 mL sample is a different condition.
Error 2: The response says the amount of salt decreases. With no solute loss, the amount stays 0.00500 mol; the concentration falls because the solution volume increases.

Checkpoint solution

Under the stated approximate additivity assumption, 50.0 mL + 250.0 mL = 300.0 mL = 0.3000 L.
M = 0.00500 mol / 0.3000 L = 0.0167 mol/L to three significant figures.
Volume additivity is an explicit approximation here. Preparing a specified solution concentration relies on final solution volume.

Model correction

The sample initially contains 0.00500 mol of sodium chloride. Dilution adds solvent while keeping the amount of solute unchanged under the stated assumptions. The final solution volume is 0.2500 L, so the final concentration is 0.0200 mol/L. That is one fifth of the initial concentration. Diluting to 250.0 mL is different from adding 250.0 mL of water. The supplied response gives the correct concentration for the stated final volume, but its solvent instruction and statement about losing salt are incorrect.

Calibration and transfer

For full understanding credit, require the correct amount of solute, final-volume denominator, and distinction between amount and concentration. Reward a clear explanation of the incorrect prose even when the student initially made a numerical error and then corrected it. Extension: Ask students to derive the factor by which concentration changes when final volume triples.

A rubric that rewards reasoning

FREE SAMPLE | The 20-point assessment rubric

Apply the scale consistently

4 = accurate, complete, and justified for the criterion below.
3 = sound overall, with a minor omission that does not change the conclusion.
2 = partly correct, with a consequential gap or weak justification.
1 = an attempt is present, but reasoning is largely unsupported or incorrect.
0 = no relevant evidence submitted for that criterion.
Score each criterion separately. Use assignment-specific examples to calibrate the scale.

Criterion 1 | Disciplinary understanding

Full-credit evidence: Uses the relevant course concepts correctly and reaches a defensible answer. In the dilution example, distinguishes solute amount from concentration and uses the correct final volume.

Criterion 2 | Evidence and verification

Full-credit evidence: Checks a consequential claim using an appropriate source or calculation, supplies a usable locator or steps, and explains whether the evidence supports the claim.

Criterion 3 | Revision decisions

Full-credit evidence: Identifies a meaningful correction or improvement and explains why it strengthens the work. A student may retain a sound initial answer when the decision is justified.

Criterion 4 | Explanation and transfer

Full-credit evidence: Explains the approach and applies it to the checkpoint or a changed condition. Assess the reasoning through the agreed accessible format, not speaking speed or accent.

Criterion 5 | Process transparency

Full-credit evidence: Provides the requested initial attempt and an accurate, concise disclosure or supplied-response/no-AI record. Include only relevant process evidence.

Grading note: Publish any percentage conversion in advance. This rubric is a learning assessment; it is not an AI-detection score.