

AP Free Response
or How I Learned to Stop Worrying and Love AP Chemistry

The AP Chemistry test absolutely love love loves to give you very long questions, where many of the answers rely on answers determined in earlier parts of the question. This has stymied many a determined AP chemistry student in the past and can significantly lower your overall score. You need to know how to best show AP chemistry graders (and me!) all of the chemistry you know as quickly as possible, which means not getting stuck on one tiny part of a problem.

Question: What do you do when you know exactly how to answer parts d. – g., but you have no idea how to get the answer to part c. (which you need for the rest of the question)?

Answer: Make up an answer! For reals. The AP Chemistry scorers will give you FULL POINTS if you correctly show your work and chemistry knowledge on a question part, *even* if your final answer is wrong because you started with an incorrect value from a previous wrong answer. (The wrong calculation will still be counted wrong, as it should be.)

AP Free Response Sample Question (10 points)

- In the laboratory, a sample of pure nickel was placed in a clean, dry, weighted crucible. The crucible was heated so that the nickel would react with the oxygen in the air. After the reaction appeared complete, the crucible was allowed to cool and the mass was determined. The crucible was reheated and allowed to cool. Its mass was then determined again to be certain that the reaction was complete. The following data was collected during the experiment. Use this data to answer the questions below.

Data Table 1: Calculation of Empirical Formula of Nickel Oxide

Mass of crucible	30.02 g
Mass of nickel and crucible	31.07 g
Mass of nickel oxide and crucible	31.36 g

- What is the mass of nickel used? [1 point]
- What is the mass of nickel oxide produced? [1 point]
- What mass of oxygen reacted? [1 point]
- Based on your calculations, what is the empirical formula for the nickel oxide? [2 points]
- Based on your knowledge of reduced layered perovskite synthesis, what is the molecular weight of the compound? [2 points]
- Determine the molecular formula of the compound. [1 point]
- While waiting for the sample to cool, the student begins to clean up the lab station using a nearby sink. If, unknown to the student, some water splashed into the crucible, how would this affect the calculated empirical formula? [1 point]

$$(a) 31.07 - 30.02 = 1.05 \text{ g Ni}$$

$$(b) 31.36 - 30.02 = 1.34 \text{ g nickel oxide}$$

$$(c) 1.34 - 1.05 = 0.29 \text{ g O}$$

$$\begin{array}{l}
 \text{(d) Ni: } 1.05 \text{ g} / 58.69 \text{ g/mol} = 0.01789 \text{ mol} \\
 \text{O: } 0.29 \text{ g} / 16.00 \text{ g/mol} = 0.01813 \text{ mol}
 \end{array}
 \left. \begin{array}{l}
 \div 0.01789 = 1 \\
 \approx 1
 \end{array} \right\} \boxed{\text{NiO}}$$

$$\text{(e) mol. weight} = 149.38 \text{ g/mol}$$

$$\text{(f) } \frac{\text{mol. weight}}{\text{FW (empirical)}} = \frac{149.38}{74.69} = 2 \times \text{NiO} = \boxed{\text{Ni}_2\text{O}_2}$$

(g) Adding extra water would cause the measured mass of NiO + crucible to be too high, so the calculated mass of NiO and mass of O to be too high. Therefore, the calculated empirical formula would show a higher ratio of O to Ni than actually exists.