

Mass and Molecular-Formula Evidence

g12_u02_w05

Purpose and boundary

Analyze supplied original fictional mass-evidence cards as arithmetic constraints. No sample, instrument, interpretation of a real substance, procedure, or identification claim is requested.

Targets: I can calculate nominal formula mass, compare candidate formulas, and state what a mass constraint cannot prove. **Use:** $C = 12$, $H = 1$, $O = 16$ mass units. **Vocabulary:** nominal mass, molecular-formula candidate, fragment, constraint, ambiguity. **Prerequisites:** formula mass, percent composition, significant figures.

Fictional Card M gives one nominal mass constraint. It does not name a substance or establish a complete identity.

1. What does a nominal-mass constraint help a reader compare?

2. Why is a nominal mass alone not a complete molecular identity?

3. Calculate the nominal formula mass of CH_2O .

4. Calculate the nominal formula mass of C_2H_4O .

5. Calculate the nominal formula mass of C_3H_8 .

6. Card M reports a nominal mass of 44. Which of CH_2O , C_2H_4O , and C_3H_8 fit the mass constraint?

7. Explain why the answer to item 6 remains ambiguous.

8. Calculate the nominal formula mass of C_3H_6O .

9. Calculate the nominal formula mass of C_4H_{10} .

10. Calculate the nominal formula mass of $C_2H_2O_2$.

11. Card N reports a nominal mass of 58. Which candidates in items 8–10 fit?
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12. For C_3H_6O , calculate the carbon mass percent to three significant figures.
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13. For C_4H_{10} , calculate the carbon mass percent to three significant figures.
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14. For $C_2H_2O_2$, calculate the carbon mass percent to three significant figures.
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15. Card N also supplies a fictional carbon percentage of 62.1%. Which listed candidate is most consistent with both stated constraints?
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16. State one reason even two matching constraints do not prove a complete identity.
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17. A smaller fictional peak is labeled fragment-like. What cautious statement does that label support?
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18. Why should a student avoid treating a displayed peak as a direct picture of a whole molecule?
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19. Name one additional kind of supplied evidence that could distinguish remaining formula candidates without naming a real substance.
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20. Write a two-sentence evidence-bounded conclusion for Card N.
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