

Empirical and Molecular Formulas

Student Worksheet | g09_u07_w28

I can: use composition data to determine an empirical formula, then use molar mass to determine a molecular formula.

Frozen values: Classroom calculation values from `audits/atomic_masses_v2024.1.json`, derived from CIAAW/IUPAC Standard Atomic Weights 2024 (accessed 2026-07-26). H 1.008, C 12.011, N 14.007, O 15.999, Mg 24.305. Treat a percentage as grams in a 100.0 g sample; show factor-label conversion and keep guard digits.

1. Put these empirical-formula steps in order: convert each mass to mol, divide by the smallest mole amount, make whole-number ratios, write the formula.

2. Use factor labels to convert 24.022 g C to mol C.

3. A sample has 1.000 mol C, 2.000 mol H, and 1.000 mol O after division by the smallest value. Write its empirical formula.

4. A 100.0 g compound contains 40.00 g C, 6.71 g H, and 53.29 g O. Find its empirical formula.

5. Find the empirical-formula mass of CH_2O .

6. A compound has empirical formula CH_2O and molar mass 180.156 g/mol. Find its molecular formula.

7. A 100.0 g compound contains 52.14 g C, 13.13 g H, and 34.73 g O. Find its empirical formula.

8. The compound in item 7 has molar mass 92.138 g/mol. Find its molecular formula.

9. A 100.0 g compound contains 57.14 g C, 4.80 g H, and 38.06 g O. Find its empirical formula.

10. The compound in item 9 has molar mass 84.074 g/mol. Find its molecular formula.

11. A 100.0 g binary compound contains 27.29 g C and 72.71 g O. Find its empirical formula.

12. The compound in item 11 has molar mass 88.018 g/mol. Find its molecular formula.

13. An oxide is 60.30% Mg and 39.70% O by mass. Find its empirical formula.
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14. The oxide in item 13 has formula-unit mass 80.608 g/mol. Find the multiple of MgO and explain why this result is a formula unit, not necessarily a discrete molecule.
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15. A sample contains 3.003 g C, 0.504 g H, and 3.999 g O. Determine its empirical formula with factor-label conversions.
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16. A sample contains 2.00 g C, 0.336 g H, and 2.664 g O. Determine its empirical formula.
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17. A 100.0 g analysis reports 40.02 g C, 6.72 g H, and 53.26 g O. Determine the simplest formula; explain how rounding affects your ratios.
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18. A sample contains 12.011 g C, 2.016 g H, and 15.999 g O. Find its empirical formula and total sample mass.
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19. A 100.0 g unknown reports 39.90% C, 6.75% H, and 53.35% O. Does the data support CH_2O as its empirical formula? Show a ratio table and state one uncertainty limit.
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20. An unknown has empirical formula CH_2O and molar mass 90.078 g/mol. Find its molecular formula. What structural information is still missing from these data?
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