4.6 EMPIRICAL AND MOLECULAR FORMULAS

PRACTICE

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Understanding Concepts

1. Empirical means derived from observation and experimentation.
2. A molecular formula gives the number of each kind of atom or ion, as opposed to an empirical formula which gives the simplest numerical ratio of the component atoms and/or ions.
3. Different compounds can exist because the same number and kind of atoms are bonded together differently, like ethanol, CH_3CH_2OH, and dimethyl ether, CH_3OCH_3. These two different compounds have very different properties, but would have the same percentage composition.
4. Possible molecular formulas could be C_2H_6, C_3H_9, C_4H_{12}, or indeed, any compound with the general formula C_nH_{2n}, where n is any integer.
5. (a) NO_2
   (b) CO_2
   (c) CH_2O
   (d) C_3H_2Cl
6. Sodium chloride does not exist as molecules, but as a three-dimensional lattice of ions; so there is no such concept as a molecular formula for this, or any other, ionic compound. The same rule applies to network solid elements and compounds — the formulas we use are always the simplest ratio of component ions or atoms.

Try This Activity : Distinguish Between Empirical and Molecular Formulas

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Name	Empirical Formula	Molecular Formula
ethane	CH_3	C_2H_6
butane	C_2H_5	C_4H_{10}
hexane	C_3H_7	C_6H_{14}
ethene	CH_2	C_2H_4
butene	CH_2	C_4H_8
hexene	CH_2	C_6H_{12}

4.7 CALCULATING CHEMICAL FORMULAS

PRACTICE

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Understanding Concepts

1. Empirical formulas can be determined from mass percent information.
2. Molecular formulas can be determined if one also has molar mass information.
3. Assume a 100 g sample, for convenience.

$m_{K^+} = 28.9 \text{ g} \qquad M_{K^+} = 39.10 \text{ g/mol}$

$m_S = 23.7 \text{ g} \qquad M_S = 32.06 \text{ g/mol}$

$m_O = 47.4 \text{ g} \qquad M_O = 16.00 \text{ g/mol}$

$$n_{K^+} = 28.9 \cancel{\text{g}} \times \frac{1 \text{ mol}}{39.10 \cancel{\text{g}}}$$

$$n_{K^+} = 0.739 \text{ mol}$$

