2 PLAN

$$x(\text{empirical formula}) = \text{molecular formula}$$

$$x = \frac{\text{molecular formula mass}}{\text{empirical formula mass}}$$

3 COMPUTE

Molecular formula mass is numerically equal to molar mass. Thus, changing the g/mol unit of the compound's molar mass to amu yields the compound's molecular formula mass.

molecular molar mass = 283.89 g/mol
molecular formula mass = 283.89 amu

The empirical formula mass is found by adding the masses of each of the atoms indicated in the empirical formula.

mass of phosphorus atom = 30.97 amu
mass of oxygen atom = 16.00 amu
empirical formula mass of $P_2O_5 = 2 \times 30.97 \text{ amu} + 5 \times 16.00 \text{ amu} = 141.94 \text{ amu}$

Dividing the experimental formula mass by the empirical formula mass gives the value of x. The formula mass is numerically equal to the molar mass.

$$x = \frac{283.89 \cancel{\text{ amu}}}{141.94 \cancel{\text{ amu}}} = 2.0001$$

The compound's molecular formula is therefore P_4O_{10}.

$$2 \times (P_2O_5) = P_4O_{10}$$

4 EVALUATE

Checking the arithmetic shows that it is correct.

PRACTICE

Answers in Appendix E

1. Determine the molecular formula of the compound with an empirical formula of CH and a formula mass of 78.110 amu.
2. A sample of a compound with a formula mass of 34.00 amu is found to consist of 0.44 g H and 6.92 g O. Find its molecular formula.

extension
Go to **go.hrw.com** for more practice problems that ask you to determine molecular formulas.
Keyword: HC6FRMX

SECTION REVIEW

1. A compound contains 36.48% Na, 25.41% S, and 38.11% O. Find its empirical formula.
2. Find the empirical formula of a compound that contains 53.70% iron and 46.30% sulfur.
3. Analysis of a compound indicates that it contains 1.04 g K, 0.70 g Cr, and 0.86 g O. Find its empirical formula.
4. If 4.04 g of N combine with 11.46 g O to produce a compound with a formula mass of 108.0 amu, what is the molecular formula of this compound?

Critical Thinking

5. **RELATING IDEAS** A compound containing sodium, chlorine, and oxygen is 25.42% sodium by mass. A 3.25 g sample gives 4.33×10^{22} atoms of oxygen. What is the empirical formula?