

Answer on question #61606, Chemistry, Inorganic Chemistry

A gaseous hydrocarbon R of mass 7.0g occupies a volume of 2.24dm³ at s.t.p. If the percentage composition by mass of hydrogen is 14.3, determine its

1. Empirical formula

2. Molecular formula

[H=1.00, C=12.00, Molar volume of gas at s.t.p.=22.4 dm³]

Solution:

1 mole of gas R occupies a volume of 22.4 dm³ at s.t.p.,

If 2.24 dm³ of R weighs 7.0 g at s.t.p, then 22.4 dm³ of R will weigh y g

$$y = 7 \times 22.4 / 2.24 = 70\text{g}$$

Since R is a hydrocarbon, therefore, it contains only carbon and hydrogen. If the percentage composition by mass of H is 14.3%, it implies that the balance will be C is 100 - 14.3 = 85.7%

(1) Empirical Formula

Elements C and H% by mass 85.7 % and 14.3 %

Atomic mass C= 12.0, H= 1.0

Mole ratio

$$85.7/12.0 = 14.3/1.0 = 7.14 \quad 14.3$$

by least ratio

$$7.14/7.14 = 1$$

$$14.3/7.14 = 2$$

Empirical formula = CH₂

(2) Since molecular formula is a multiple of the empirical formula, then:

(Empirical formula) n = Molecular mass/formula.

Therefore,

$$(CH_2)n = 70 \quad (12+2)n = 70$$

$$14n = 70$$

$$n = 70 / 14 = 5$$

Substituting the value of n into the equation above gives the molecular formula as: (CH₂)₅ = C₅H₁₀

Answer: 1) Empirical formula = CH₂ 2) molecular formula = C₅H₁₀