

The image features two ball-and-stick molecular models. On the left, a water molecule (H2O) is shown with a central yellow oxygen atom bonded to two red hydrogen atoms. On the right, a methane molecule (CH4) is shown with a central black carbon atom bonded to four white hydrogen atoms. Both models are set against a light grey background and are partially enclosed by a red circular border.

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Key Concepts for
A Level
Chemistry

Chemistry Calculations Part 5

Gases in Equations

This resource may be downloaded for free at

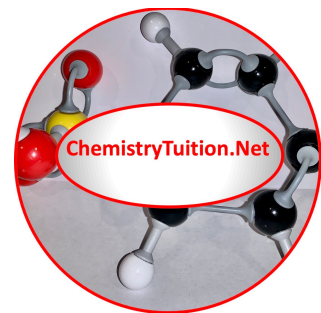
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$$\text{Number of moles} = \frac{\text{Mass in grams}}{\text{Relative Atomic or Molecular Mass}}$$

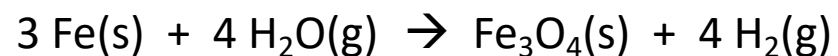
$$\text{Mass in grams} = \text{Number of moles} \times \text{Relative Atomic or Molecular Mass}$$

$$\text{Volume of gas} = \text{Number of moles} \times 24000$$

$$\text{Number of moles} = \frac{\text{Volume of gas}}{24000}$$



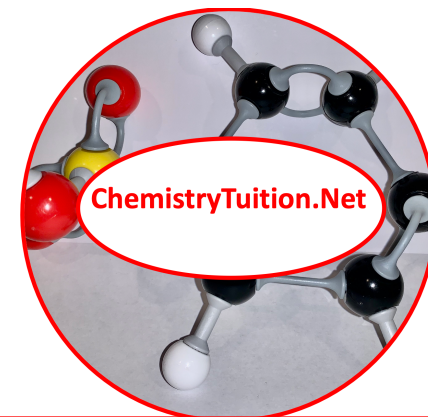
1) Iron reacts with excess steam as shown below. What volume of hydrogen, at RTP, is produced when 100 g of iron reacts with steam?



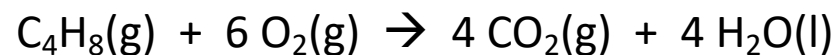
$$\text{Moles of Iron} = \frac{\text{Mass}}{\text{Molar Mass}} = \frac{100}{55.8} = 1.79 \text{ moles}$$

$$\text{Moles of H}_2 = \frac{1.79}{3} \times 4 = 2.39 \text{ moles}$$

$$\begin{aligned} \text{Volume of H}_2 &= \text{moles} \times 24000 = 2.39 \times 24000 = \mathbf{57,348 \text{ cm}^3} \\ &= \mathbf{57,300 \text{ cm}^3 \text{ to 3 sf}} \end{aligned}$$



2) What volume of oxygen at RTP is required for the complete combustion of 1000 g of butene (C₄H₈)?

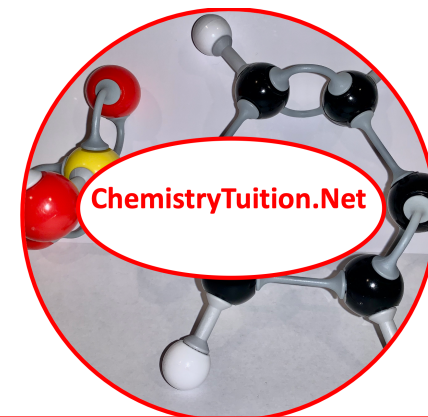


$$\text{Moles of Iron} = \frac{\text{Mass}}{\text{Molar Mass}} = \frac{1000}{56} = 17.86 \text{ moles}$$

$$\text{Moles of O}_2 = 17.86 \times 6 = 107 \text{ moles}$$

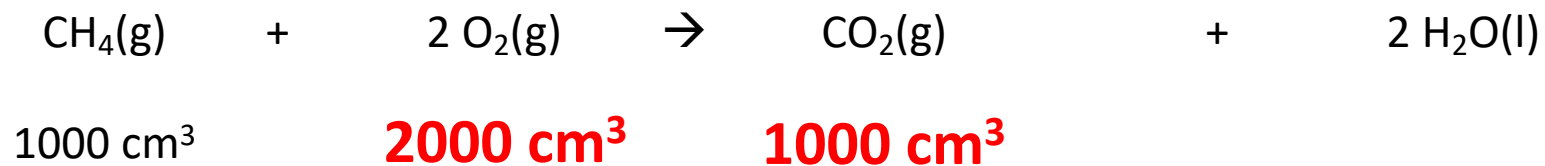
$$\text{Volume of O}_2 = \text{moles} \times 24000 = 107 \times 24000 = \mathbf{2,571,428 \text{ cm}^3}$$

$$= \mathbf{2,570,000 \text{ cm}^3 \text{ to 3 sf}}$$

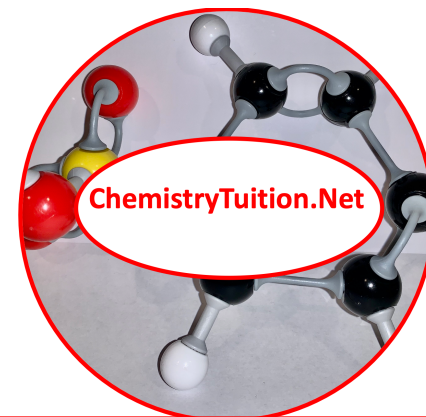
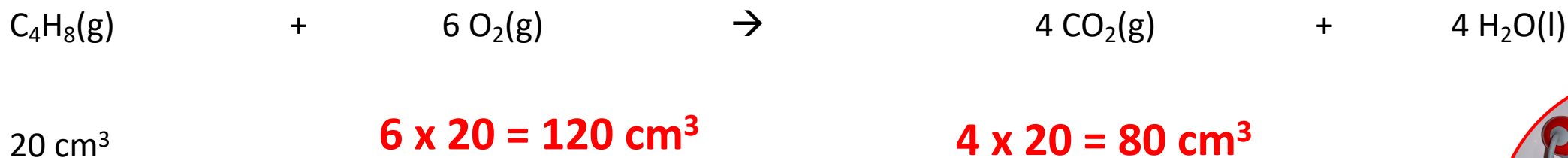


What volume of oxygen is required to burn the following gases, and what volume of carbon dioxide is produced at RTP?

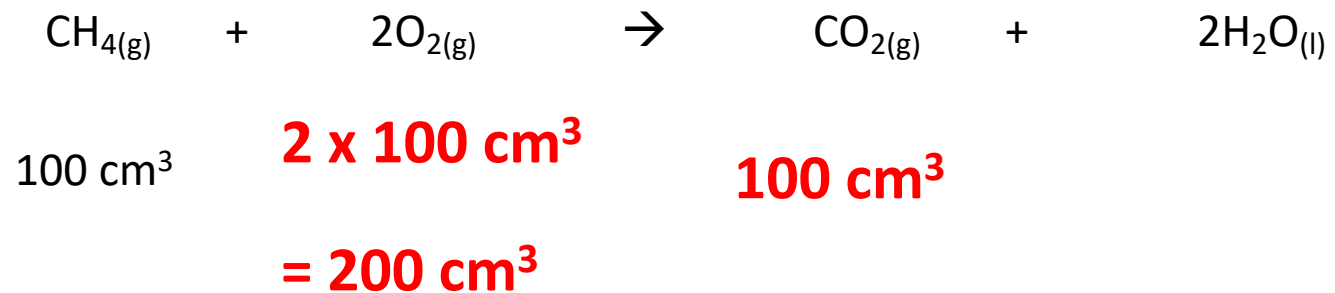
a) 1000 cm³ of methane



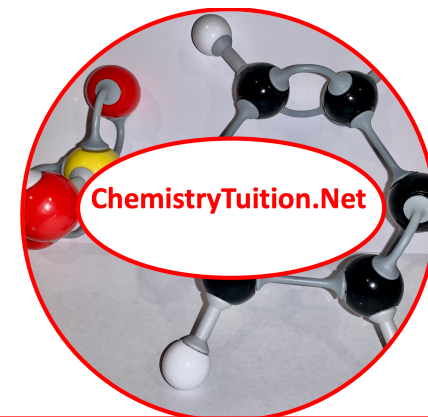
b) 20 cm³ of butene



3) 100 cm³ of methane was reacted with 500 cm³ of oxygen. What is the total volume of all gases at the end, and indicate how much there is of each gas at RTP?



$$\text{Unreacted O}_2 = 500 \text{ cm}^3 - 200 \text{ cm}^3 = 300 \text{ cm}^3$$





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