Key Concepts for A Level Chemistry

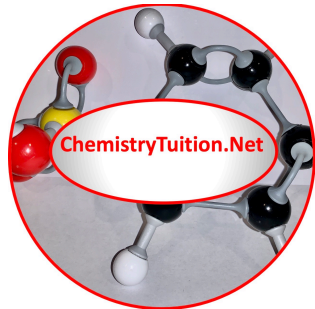
Chemistry Calculations Part 5 Gases in Equations

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

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

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

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



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?

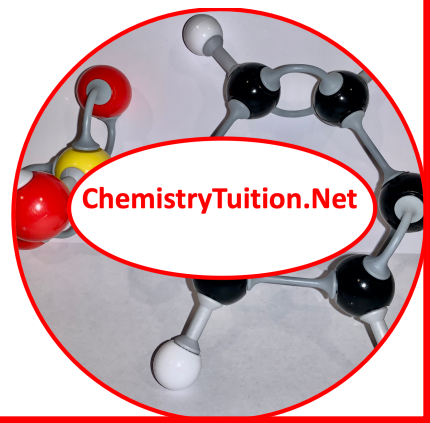
$$3\ Fe(s) + 4\ H_2O(g) \rightarrow Fe_3O_4(s) + 4\ H_2(g)$$

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

$$\text{Moles of } H_2 = \frac{1.79}{3} \times 4 = 2.39 \text{ moles}$$

Volume of H_2 = moles x 24000 = 2.39 x 24000 = **57,348 cm^3**

= **57,300 cm^3 to 3 sf**



2) What volume of oxygen at RTP is required for the complete combustion of 1000 g of butene (C_4H_8)?

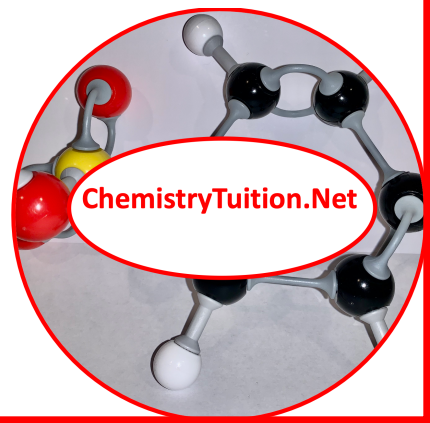
$$C_4H_8(g) + 6\ O_2(g) \rightarrow 4\ CO_2(g) + 4\ H_2O(l)$$

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

$$\text{Moles of } O_2 = 17.86 \times 6 = 107 \text{ moles}$$

Volume of O_2 = moles x 24000 = 107 x 24000 = **2,571,428 cm^3**

= **2,570,000 cm^3 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 cm^3 of methane

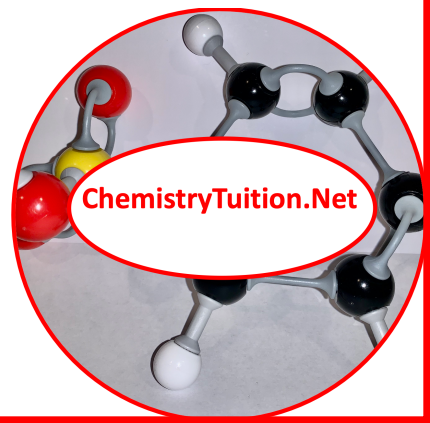
$CH_4(g)$ + 2 $O_2(g)$ → $CO_2(g)$ + 2 $H_2O(l)$

1000 cm^3 **2000 cm^3** **1000 cm^3**

b) 20 cm^3 of butene

$C_4H_8(g)$ + 6 $O_2(g)$ → 4 $CO_2(g)$ + 4 $H_2O(l)$

20 cm^3 **6 x 20 = 120 cm^3** **4 x 20 = 80 cm^3**



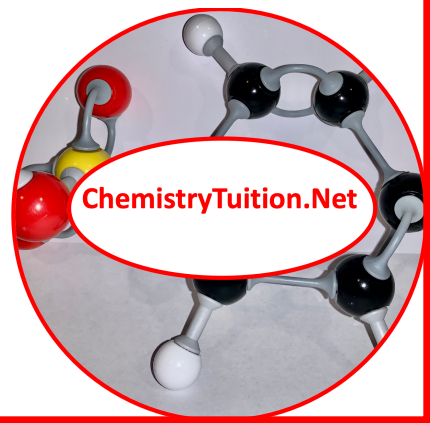
3) 100 cm^3 of methane was reacted with 500 cm^3 of oxygen. What is the total volume of all gases at the end, and indicate how much there is of each gas at RTP?

$CH_{4(g)}$ + $2O_{2(g)}$ → $CO_{2(g)}$ + $2H_2O_{(l)}$

100 cm^3 **2 x 100 cm^3** **100 cm^3**

= 200 cm^3

Unreacted O_2 = 500 cm^3 - 200 cm^3 = 300 cm^3



Dr Simon Orchard