STOICHIOMETRY

Acetylene gas (C_2H_2) undergoes combustion to produce 75.0 L carbon dioxide and water vapor at STP. Determine [A_r C = 12.0, O = 16.0, H = 1.0]

a. How many liters of C_2H_2 are required to produce the CO_2 ?

b. What mass of H_2O is produced ?

Equation

Make sure the equation is balanced.

$\square\ C_2H_2 + \square\ O_2 \rightarrow \square\ CO_2 + \square\ H_2O$

Convert to mole

Given 75.0 L CO_2, (convert vol(L) to mole)

$n_{CO_2} = \dfrac{\text{volume } CO_2}{\text{molar volume}}$

At STP, molar volume of gas = 22.4 L

$= \dfrac{\square\ L}{\square\ L} = \square\ \text{mol } CO_2$

At 4 decimal places

Value given in the question

Compare

Write the stoichiometry.

From equation, (theoretically)

$\square\ \text{mol } C_2H_2 \equiv \square\ \text{mol } O_2 \equiv \square\ \text{mol } CO_2 \equiv \square\ \text{mol } H_2O$

a) compared only CO_2 and C_2H_2

$\square\ \text{mol } CO_2 \equiv \square\ \text{mol } C_2H_2$

so, (given in the question)

$\square\ \text{mol } CO_2 = \dfrac{\square \times \square}{\square}$

$= \square\ \text{mol } C_2H_2$

b) compared only CO_2 and H_2O

$\square\ \text{mol } CO_2 \quad \square\ \text{mol } H_2O$

so, (given in the question)

$\square\ \text{mol } CO_2 = \dfrac{\square \times \square}{\square}$

$= \square\ \text{mol } H_2O$

Convert to mass/volume

convert to volume.

$V_{C_2H_2} = n_{C_2H_2} \times \text{molar volume(stp)}$

$= \square \times \square$

$= \square\ L$ *

convert to mass.

$\text{mass } H_2O = n_{H_2O} \times M_r\ H_2O$

$= \square \times \square$

$= \square\ g$ *

PRACTICE 2

How many grams of $ZnCl_2$ can be obtained using 5.0 grams of zinc metal?
[A_r Zn = 65.35, Cl = 35.5, H = 1.0]

$$Zn(s) + HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$$

[redacted] $Zn(s)$ + [redacted] $HCl(aq)$ → [redacted] $ZnCl_2(aq)$ + [redacted] $H_2(g)$ → Always check equation

Given [redacted] zinc metal,

n [redacted] = mass [redacted] / Mr [redacted]

= [redacted] / [redacted] = [redacted] mol [redacted]

overall stoichiometry,

[redacted] mol Zn ≡ [redacted] mol HCl ≡ [redacted] mol $ZnCl_2$ ≡ [redacted] mol H_2

From equation, [redacted] mol Zn ≡ [redacted] mol $ZnCl_2$

thus, [redacted] mol Zn = [redacted] X [redacted] / [redacted]

= [redacted] mol $ZnCl_2$

mass $ZnCl_2$ = [redacted] X [redacted]

= [redacted] g *

M_r $ZnCl_2$ = [redacted] g/mol

EXERCISE :

SOLVE THIS QUESTION IN A TEST PAD.

1. Hydrogen peroxide, H_2O_2, decomposes to produce water and oxygen as in the following equation:

$$2\ H_2O_2(aq) \longrightarrow 2H_2O(l) + O_2(g)$$

What would be the volume of O_2 released from the decomposition of 250 mL of 2.0 M H_2O_2 at STP ?

5.6 L

2. Assume that 5.60 L of hydrogen gas at STP reacts with copper (II) oxide according to the following balanced equation. [A_r Cu = 63.5]

$$CuO\ (s) + H_2\ (g) \longrightarrow Cu\ (s) + H_2O\ (g)$$

a) How many moles of H_2 react? 0.25 mol

b) How many grams of copper are produced? 15.875g

3. Assume that 13.5 g of solid aluminum react with HCl according to the following balanced equation at STP. [A_r Al = 27.0, Cl = 35.5, H = 1.0]

$$2\ Al\ (s) + 6\ HCl\ (aq) \longrightarrow 2\ AlCl_3\ (aq) + 3\ H_2\ (g)$$

a) How many moles of Al react? 0.5 mol

b) How many gram of HCl reacted ? 54.75g

d) How many liters of H_2 are produced ? 16.8g

4. The complete combustion of copper(I) sulphide is according to the following equation: [A_r Cu = 63.5, S = 32.0, O = 16.0]

$$2Cu_2S(s) + 3O_2(g) \longrightarrow 2Cu_2O(s) + 2SO_2(g)$$

If the mass of Cu_2S in the mixture is 14.0 g, calculate

a) the number of molecules of oxygen gas reacted. 7.9955×10^{22} molcules

b) the mass of SO_2 gas produced. 5.64g

c) the volume of SO_2 gas at STP. 1.97 L

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