NAME: **Solutions**

Stoichiometry of gases

1. What volume of oxygen (O_2) and hydrogen (H_2) gas is obtained during the decomposition of one mole of water at STP?

$2H_2O_{(l)} \rightarrow 2H_{2\,(g)} + O_{2\,(g)}$

2 mole — 2 mole
1 mole — x

x = 1 mole of H_2 gas

$PV = nRT$

$V = \frac{nRT}{P}$

$T = 273$
$P = 101.3$
$n = 1$

$V = \frac{(1)(8.31)(273)}{101.3}$

$V = 22.4\,L$ of H_2 gas

Answer: _____

1. What volume of oxygen (O_2) and hydrogen (H_2) gas is obtained during the decomposition of one mole of water at STP?

$2H_2O_{(l)} \rightarrow 2H_{2\,(g)} + O_{2\,(g)}$

2 mole — 1 mole
1 mole — y

$y = 0.5$ mole O_2 gas

$PV = nRT$

$V = \frac{nRT}{P}$

$T = 273$
$P = 101.3$
$n = 0.5$

$V = \frac{0.5(8.31)(273)}{101.3}$

$V = 11.2\,L$ of O_2 gas

Answer: _____

2. Hydrogen sulphide (H_2S) is a gas that reacts spontaneously with sulphur dioxide (SO_2) to produce sulphur (S) and water according to the following equation:

$H_2S_{(g)} + SO_{2\,(g)} \quad S_{(s)} + H_2O_{(g)}$

a) Balance the equation.

$2H_2S_{(g)} + SO_{2\,(g)} \rightarrow 3S_{(s)} + 2H_2O_{(g)}$

b) At SATP, what volume of sulphur dioxide must react with 3.5 L of hydrogen sulphide to make all of the hydrogen sulphide disappear?

$2H_2S_{(g)} + SO_{2(g)} \rightarrow 3S_{(s)} + 2H_2O_{(g)}$

2 mole : 1 mole

3.5 L : x

$x = 1.75\ L\ SO_2$

Answer:

c) What mass of sulphur is obtained?

P = 101.3
T = 298
V = 3.5
$M_{H_2S} = 34$
m = ?

$PV = \frac{mRT}{M}$

$\frac{PVM}{RT} = m$

$\frac{(101.3)(3.5)(34)}{(8.31)(298)} = m$

$4.86g = m$

Answer:

$2H_2S_{(g)} + SO_{2(g)} \rightarrow 3S_{(s)} + 2H_2O_{(g)}$

2 mole : 3 mole

$n = \frac{m}{M}$: $n = \frac{m}{M}$

$2 = \frac{m}{34}$: $3 = \frac{m}{32}$

$m = 68g$: $m = 96g$

4.86g : x

$x = 6.87g$

3. The industrial manufacture of nitric acid (HNO_3) from nitrogen monoxide (NO) is called the Ostwald process and occurs according to the following reaction:

$$NH_{3(g)} + O_{2(g)} \quad NO_{(g)} + H_2O_{(g)}$$

a) Balance the equation.

$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$

b) If this reaction requires the presence of a catalyst and a temperature of 850°C under a pressure of 101.3 kPa, how many moles of oxygen (O_2) will be needed to produce 475 L of nitrogen monoxide (NO)?

$4NH_{3(g)} + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(g)}$

5 mole : 4 mole

x : 475 L

$x = 593.75\ L\ O_2$

n = ?
P = 101.3
T = 850°C → 1123 K
V = 593.75 L

$PV = nRT$

$\frac{PV}{RT} = n$

$\frac{(101.3)(593.75)}{(8.31)(1123)} = n$

$6.44\ moles = n$

Answer: