HW 20

Answers to HW19

HW19

$C_3H_6 + O_2 \rightarrow CO_2 + H_2O$

what volume of carbon dioxide is produced when 0.36 L of propene react with 0.36 L of O_2 at STP.

1. coefficients

$2C_3H_6 + 9O_2 \rightarrow 6CO_2 + 6H_2O$

2. We need 4.5 times more O_2 than C_3H_6. But we don't have it, so our limiting reactant is O_2. We will base calculation on 0.36 L of O_2.

3. ratio of O_2 to CO_2 3:2

The volume of CO_2 $\frac{0.36 \times 2}{3} = 0.24L$

An explosion took place

$2Na + 2H_2O \rightarrow H_2 + 2NaOH$

$2H_2 + O_2 \rightarrow 2H_2O$ (explosion)

How much (by volume) hydrogen exploded if 2.3 g of Na reacted?

1. Let's find moles of Na

2.3 g of Na $\rightarrow = \frac{2.3g}{23 g\,mol^{-1}} = \boxed{0.1 \text{ mol}}$

2. Based on the coefficients we will get two times less $H_2 \rightarrow \boxed{0.05 \text{ mol}}$

3. If 22.4 L has 1 mole of H_2, 1.12 L will contain 0.05 mol of H_2.

We have a flask with a volume of 5.6 L, at 0°C. We mix 36.5 g of HCl

7.1 g of Cl_2

3.4 g of NH_3

We have the following reaction:

$HCl(g) + NH_3(g) \rightarrow NH_4Cl(s)\downarrow$

The NH_4Cl – crystal form.

Figure out the atmospheric pressure inside the flask.

1. Convert everything to moles

36.5 g HCl

M of HCl 35.5+1 = 36.5

n of moles = 1

7.1 g of Cl_2 $n = 7.1 \div 71 g\,mol^{-1} = 0.1 mol$

3.4 g of NH_3 $3.4 \div 17 = 0.2$ mol

2. Cl_2 does not participate in the reaction. We can keep in mind 0.1 mol

$HCl + NH_3 \rightarrow NH_4Cl\downarrow$

1 mol 0.2 mol

NH_3 is limiting reactant only 0.2 mol of HCl will be used. We are left wit $1 - 0.2 = 0.8$ mol of HCl

0.8 mol of HCl and 0.1 mol of Cl_2 left as gases in the flask, total 0.9 moles

$P = \frac{nRT}{V} = \frac{0.9 \times 22.4}{5.6 L} = 3.6$ atm

Oxygen

- To calculate masses of products and reactants using *balanced* chemical equations we use a unit called **mole**. One mole of a substance is the amount whose mass equals the molecular or atomic weight (in atomic mass units, amu) of the substance **expressed in grams**. This means that molecular weight of any substance in amu (from periodic table) is equal to molar weight in grams.
- *A mole of anything has 6.022×10^{23} particles*. This is called Avogadro's number, after Amedeo Avogadro, who first suggested that equal volumes of gas have equal numbers of molecules.
- 1 mole of any gas takes a volume of 22.4 liters at "normal conditions ". This is a molar gas volume under the normal conditions. Normal conditions are temperature of 0^oC (273 K) and pressure of 1 atm (101 325 Pa)
- For conditions that differ from normal we use the ideal gas equation: pV = nRT

  n – gas mole number
  p – gas pressure (atm)
  V – gas volume (liters)
  T – temperature (K)
  R – gas constant (0.0821 l x atm/mole x K)

  Questions

1. A person needs about 1 mole of oxygen per hour to breath. Calculate how much Na_2O_2 in grams will be needed for a 24-h trip in a single-person submarine using the following equation:

   $Na_2O_2 + CO_2 \rightarrow Na_2CO_3 + O_2$

2. There are 10 g of each: $KMnO_4$, $KClO_3$, KNO_3 in the lab. How many liters of oxygen can be obtained from each of these reagents? Use the following equations:

   $2KMnO_4 \text{->} K_2MnO_4 + MnO_2 + O_2(g)$

   $2KClO_3 \rightarrow 2KCl + 3O_2 (g)$

   $2KNO_3 \rightarrow 2KNO_2 + O_2 (g)$