ANSWERS TO "TRY YOURSELF" PROBLEMS FROM STUDY SECTIONS 4.1 TO 4.3

Try Yourself 4.1

Consider the following unbalanced equation.

$BaCl_2(aq) + AgNO_3(aq) \rightarrow AgCl(s) + Ba(NO_3)_2(aq)$

- 1. Write the balanced equation
- 2. What mass of AgNO₃, in grams, is required for complete reaction with 0.156 g of BaCl₂?
- 3. What mass of AgCl in grams, is produced?

Answer:

1.
$$BaCl_2(aq) + 2AgNO_3(aq) \rightarrow 2AgCl(s) + Ba(NO_3)_2(aq)$$

2.

Mass of Ag NO3 required: $m_{Bacl2} = \frac{m_{Bacl2}}{M_{Bacl2}} = \frac{0.156g}{208.23g.mol^{-1}}$ $= \frac{0.000749}{(7.49 \times 10^{4} mol Bacl2)}$ * Mol Ratio between Back and Ag Noz Back : Ag Noz => There fore, for every 1 mil of Back 2 moles of Ag Noz is required. i. nAgNO3 = 2 (noach) = 2(7.49×154)
= 0.001498 mol AgNO3
(1.498×103 mol AgNO3)
====> mAgNO3 required = nAgNO3 × MAgNO3 = (1.498+103 hund) + 169.87 g.md e.254 g of AgNOS is required to react for pletely with 0.156 g of Baclz

mass of Agel produced: => Mol ratio between Ballz and Agel Back : Agci * Therefore, for every I mad of Back 2 used, 2 moles of Agel will form. .. nAger = 2 (nBacl2) = 2 (7.49×104) = 1.498×103 pul Ager that will form. MAGCI = nagci × Magci = (1.498 + 15 3 mol) (143.32 g.mol) = 0.215 gram. ... O. 156 grans of Ballz will produce O. 215 grams of Agel

3.

Try Yourself 4.2 a

 $TiCl_4$ is an important industrial chemical that can be prepared from TiO_2 during a reaction with carbon and chlorine gas. In the preparation of $TiCl_4$ equal amounts of chlorine gas and carbon (125 g each) and an excess of TiO_2 was used.

- 1. Identify the limiting reagent.
- 2. What is the mass $TiCl_4$ that can be formed?

Answer:

1.

You will need a balanced chemical equation: TiOz(s) + C(s) + 2(12(g) -> TiCly + CO2 Y Cormant 125g 125g M=? (cxcess) K) 1) Limiting Reagent=? nc = 1250 = 10.42 mol C Na2 = 1259 70.90g.me⁻¹ = 1.76 mel Cl2 Mol ratio between C and Ch C: Ch L: 2 • So, for 10.42 mod of C, you will need 2(10.42) = 20.84 and of Clz. You only have 1.76 mod of Clz. Therefor the Clz will be the limiting reagent. \$ 2) Mass of Ticly produced =? The limiting reagent always determines the amount of product that can form.

mol ratio between Ch2 and Ticly Cl2: Ti 44 2:1 $\therefore \Lambda_{Tidy} = \frac{\Lambda_{C12}}{2} = \frac{1.76 \text{ mol}}{2}$ = 0.88 mol Ticly that will form. MTicly = NTicly × MTicly = 0.88 mol + 189.67 g. Mol -1 = 166.91 gram Ticly will form.

Try Yourself 4.2 b

Aluminium chloride, AlCl₃, is an inexpensive reagent used in many industrial processes. It is made by treating scrap aluminium with chlorine according to the following balanced equation:

$$2Al(s) + 3Cl_2(g) \rightarrow 2AlCl_3(s)$$

- a) Which reactant is limiting if 2.70 g of Al and 4.05 g of Cl_2 are mixed?
- b) What mass of AlCl₃ can be produced?
- c) What mass of the excess reagent remains when the reaction is completed?

Answer:

) mass of excess reagent remaining ofter the reaction is completed =? 1st determine how much of the excess reagent will be used, then subtract that from the available mass. mot ratio between Al and AICI3 You can do the AI: AICI, You can be tween 2:2 Al and cl2 also. from the previous calculation we saw that 0.058 mel of AICI3 will form. => Therefore you will need 0.038 mel of Al. MAI that will react = NAI + MAI = 0.038 mil x 26.98 g/m = 1.0390 : 1.03 g of Al will react. mass of Al remaining after the reaction: 2.70g -1.03g =1.67g p 1. 1.67 g of Al was in excess.

Try Yourself 4.3a

Methanol can decompose to hydrogen gas that can be used as a fuel.

$$CH_3OH(\ell) \rightarrow 2H_2(g) + CO(g)$$

- (a) If 125 g methanol decomposes, what is the theoretical yield of hydrogen?
- (b) If only 13.6 g hydrogen is obtained, what is the percentage yield of the gas?

Answer:

CH30H -> 2H2 + CO 125 g R) Theoretical yield of Hz =? Ratio between CHSOH and Hz is: CHSOH: Hz 1 : 2 MCH30H = 1250 32.039.mol-1 = 3.90 mol ctts off $\therefore n_{H_{L}} \text{ that will form: } n_{H_{L}} = 2(n_{cH_{S}OH})$ = 2(3.90) $= 7.81 \text{ mol } H_{L}$ MH2 = NH2 × MHL = 7.81 mol × 2.02 g.mol -1 = 115.77 g H2 will theoretically form 6) % Yield = Real yield + 100 = 13.6 g + 100 = 15.77 g + 100 = 86.24 %

Try Yourself 4.3b

If 454 g of NH_4NO_3 decomposes, theoretically 204 g of H_2O should be formed. Determine the theoretical yield of N_2O . Calculate the percent yield of N_2O if 131 g is the actual yield.

Answer:

NH4N03 - 02H20 + N20 4 4 4 4 4548 204g Yield =? -DUSing the Law of Conservation of Matter J 454 g - 204 g = 250 g N20 should form theoretically. 70 Yield: Real Yield × 100 Theoretical Yield = 131 g + 100 250 g 7 = 52.490 P