

EXAM: GASES, SOLUTIONS and CHEMICAL REACTIONS

Name: _____

Group: _____

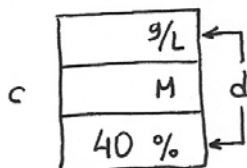
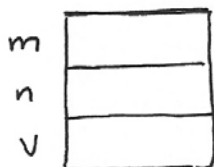
1 A tank contains a solution of sulfuric 40%. The density of that solution is 1.31 g/mL

- a) Calculate the concentration in g/L
- b) Calculate the molarity of the solution
- c) Calculate the number of molecules of solute in 200 mL

Atomic weights: S=32; O=16; H=1

$N_A = 6.02 \times 10^{23}$

①



$$\textcircled{a} \quad c(\text{g/L}) = \frac{40 \text{ g H}_2\text{SO}_4}{100 \text{ g solution}} \cdot \frac{1310 \text{ g solution}}{1 \text{ L}} = 524 \text{ g/L}$$

⑥ Molar mass:

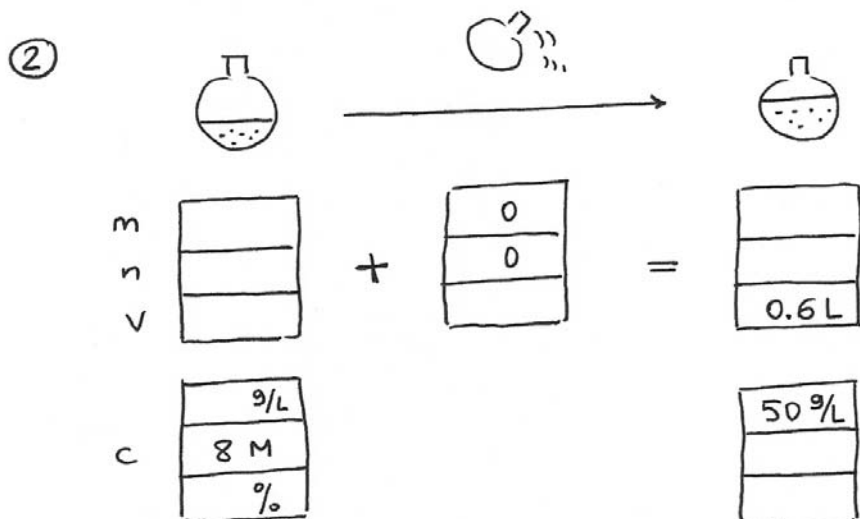
$$M = (2 \times 1) + 32 + (4 \times 16) = 98 \text{ g/mol}$$

$$c(\text{M}) = \frac{524 \text{ g H}_2\text{SO}_4}{\text{L}} \cdot \frac{1 \text{ mol}}{98 \text{ g}} = 5.35 \text{ M}$$

$$\textcircled{c} \quad x = 0.2 \text{ L} \cdot \frac{5.35 \text{ mol}}{1 \text{ L}} \cdot \frac{6.02 \times 10^{23} \text{ molecule}}{1 \text{ mol}} = 6.44 \times 10^{23} \text{ molecule H}_2\text{SO}_4$$

2 In a container there is a sodium hydroxide solution 8 M. Calculate the volume of this first solution if we want to get a final solution 600 mL 50 g/L by dilution (adding water).

Atomic weights: Na=23; O=16; H=1



$$M(\text{NaOH}) = 23 + 16 + 1 = 40 \text{ g/mol}$$

$$m_3 = 0.6 \text{ L} \frac{50 \text{ g NaOH}}{1 \text{ L}} = 30 \text{ g NaOH}$$

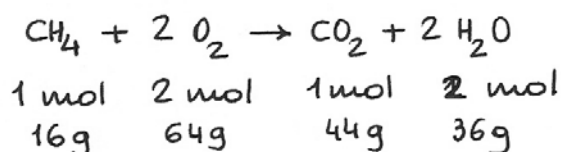
$$n_3 = 30 \text{ g NaOH} \frac{1 \text{ mol}}{40 \text{ g}} = 0.75 \text{ mol NaOH}$$

$$n_1 = n_3$$

$$V_1 = 0.75 \text{ mol NaOH} \frac{1 \text{ L}}{8 \text{ mol NaOH}} = 0.094 \text{ L} = 94 \text{ mL solution}$$

3	<p>We want to burn 200 g of methane gas.</p> <ul style="list-style-type: none"> • Write the balanced chemical equation and the table of proportions • Calculate the volume of oxygen gas we need at P=800 mmHg and T=27 °C
Atomic weights: O=16; H=1; C=12 ; R = 0.082 $\frac{\text{atm.L}}{\text{K.mol}}$	

③ a) The balanced chemical equation:



$$M(\text{CH}_4) = 12 + (4 \times 1) = 16 \text{ g/mol}$$

$$M(\text{O}_2) = 2 \times 16 = 32 \text{ g/mol}$$

$$M(\text{CO}_2) = 12 + (2 \times 16) = 44 \text{ g/mol}$$

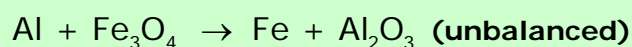
$$M(\text{H}_2\text{O}) = (2 \times 1) + 16 = 18 \text{ g/mol}$$

b) Volume of oxygen

$$n(\text{O}_2) = 200 \text{ g CH}_4 \frac{2 \text{ mol O}_2}{16 \text{ g CH}_4} = 25 \text{ mol O}_2$$

$$V = \frac{nRT}{P} = \frac{25 \text{ mol} \times 0.082 \frac{\text{atm.L}}{\text{K.mol}} \times 300 \text{ K}}{\frac{800}{760} \text{ atm}} = 584.25 \text{ L O}_2$$

- 4 The following unbalanced reaction is called the thermite reaction. It releases tremendous amounts of energy and is sometimes used to generate heat:

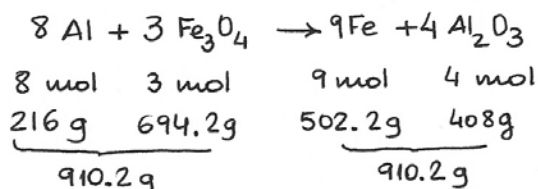


If the masses of reactants are 200 g Al and 700 g Fe_3O_4

- Write the balanced chemical equation
- Determine the limiting reactant
- Calculate the amount of iron formed in grams
- Calculate the amount of the reactant in excess (in grams)

Atomic weights: Al=27; O=16; Fe=55.8

- ④ a) The balanced chemical equation



$$M(\text{Al}) = 27 \text{ g/mol}$$

$$M(\text{Fe}_3\text{O}_4) = (3 \times 55.8) + (4 \times 16) = 231.4 \text{ g/mol}$$

$$M(\text{Fe}) = 55.8 \text{ g/mol}$$

$$M(\text{Al}_2\text{O}_3) = (2 \times 27) + (3 \times 16) = 102 \text{ g/mol}$$

- b) Determination of the limiting reactant

$$x(\text{Al}) = \frac{200 \text{ g Al}}{216 \text{ g Al}} = 0.926 \text{ times the value of the table}$$

$$x(\text{Fe}_3\text{O}_4) = \frac{700 \text{ g Fe}_3\text{O}_4}{694.2 \text{ g}} = 1.008 \text{ times the value of the table}$$

↳ Aluminum is the limiting reactant

- c) The amount of iron formed

$$m(\text{Fe}) = 200 \text{ g Al} \frac{502.2 \text{ g Fe}}{216 \text{ g Al}} = \text{465 g Fe}$$

- d) Excess of Fe_3O_4

↳ Fe_3O_4 consumed:

$$m(\text{Fe}_3\text{O}_4) = 200 \text{ g Al} \frac{694.2 \text{ g Fe}_3\text{O}_4}{216 \text{ g Al}} = 642.78 \text{ g Fe}_3\text{O}_4$$

↳ Excess:

$$m(\text{Fe}_3\text{O}_4) = 700 \text{ g Fe}_3\text{O}_4 - 642.78 \text{ g Fe}_3\text{O}_4 = \text{57.22 g Fe}_3\text{O}_4$$