Exam: CHEMICAL CALCULUS 1. Batxilergoa	
Name:	Course:

EXERCISE #1

18.5 M

- The number of moles

$$n = 18.5 \frac{\text{mol } H_2SO_4}{L} \times 0.005\ L$$

m	
n	9.25×10^{-2} mol
V	0.005 L

$n = 9.25 \times 10^{-2}$ mol H_2SO_4

- The mass percent

The molar mass is:

$M = (2\times1) + (1\times32) + (4\times16) = 98$ g/mol

c	18.5 M
	98 %

$d = 1850 \frac{g}{L}$

$$c(\%) = 18.5 \frac{\text{mol}}{L} \times \frac{98\ g\ H_2SO_4}{1\ \text{mol}} \times \frac{1\ L}{1850\ g\ \text{solution}} \times 100$$

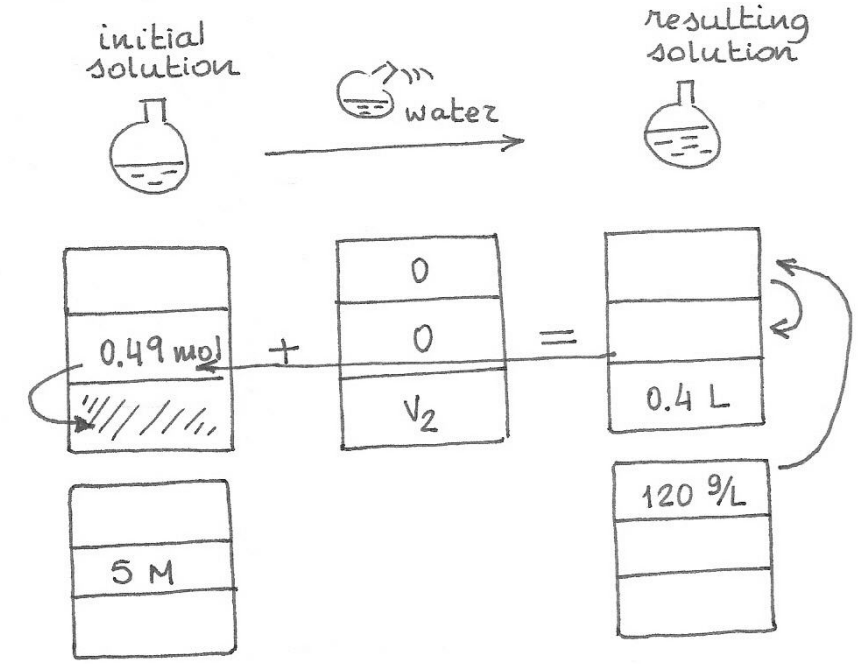
$c(\%) = 98\%$

- Volume to obtain 120 g of solute

$$V = 120\ g\ H_2SO_4 \times \frac{1\ \text{mol}}{98\ g\ H_2SO_4} \times \frac{1\ L}{18.5\ \text{mol}} = 6.62 \times 10^{-2}\ L$$

V = 66.2 mL solution

EXERCISE #2



a) Determination of n_1 (initial number of moles)

Molar mass: $M(H_2SO_4) = (2\times1) + (1\times32) + (4\times16) = 98$ g/mol

$$n_1 = n_3 = 0.4\,L \times \frac{120\ g\ H_2SO_4}{L} \times \frac{1\ mol\ H_2SO_4}{98\ g} = 0.49\ mol\ H_2SO_4$$

b) Determination of V_1 (initial volume)

$$V_1 = \frac{1\ L\ solution}{5\ mol\ H_2SO_4} \times 0.49\ mol\ H_2SO_4 = 0.098\ L$$

$V_1 = 98$ mL of initial solution

EXERCISE #3

- The balanced equation

$$Mg + 2\ HCl \rightarrow MgCl_2 + H_2$$

1 mol	2 mol	1 mol	1 mol
24 g	73 g	95 g	2 g

Molar masses:

$M(Mg) = 24\ g/mol$; $M(HCl) = 1 + 35.5 = 36.5\ g/mol$

$M(MgCl_2) = (1 \times 24) + (2 \times 35.5) = 95\ g/mol$

$M(H_2) = 2\ g/mol$

- The amount of HCl that reacts:

$$n_{total} = 0.1\ L \times 0.75\ \frac{mol}{L} = 0.075\ mol\ HCl$$

$$n_{react} = 0.075\ mol - 0.0125\ mol = 0.0625\ mol\ HCl$$

- The amount of Mg that reacts:

$$m(Mg) = 0.0625\ mol\ HCl \times \frac{24\ g\ Mg}{2\ mol\ HCl} = 0.75\ g\ Mg$$

- Mass % Mg in the sample:

$$X = \frac{0.75\ g\ Mg}{1.32\ g} \times 100 = \boxed{56.8\ \%}$$

EXERCISE #4

- The balanced equation

$$2\ N_2H_4 + N_2O_4 \rightarrow 3\ N_2 + 4\ H_2O$$

2 mol	1 mol	3 mol	4 mol
64 g	92 g	84 g	72 g

$M(N_2H_4) = (2 \times 14) + (4 \times 1) = 32\ g/mol$

$M(N_2O_4) = (2 \times 14) + (4 \times 16) = 92\ g/mol$

$M(N_2) = (2 \times 14) = 28\ g/mol$

$M(H_2O) = (2 \times 1) + (1 \times 16) = 18\ g/mol$

- The limiting reactant

$100\ g\ N_2H_4$ needs... $x = 100\ g\ N_2H_4 \times \frac{92\ g\ N_2O_4}{64\ g\ N_2H_4} = 143.75\ g\ N_2O_4$

N_2H_4 is the limiting reactant.

$$m(N_2) = 100\ g\ N_2H_4 \times \frac{84\ g\ N_2}{64\ g\ N_2H_4} = \boxed{131.25\ g\ N_2}$$

- The volume of N_2 gas

$$n(N_2) = 131.25\ g\ N_2 \times \frac{1\ mol\ N_2}{28\ g\ N_2} = 4.69\ mol\ N_2$$

$$V = \frac{nRT}{P} = \frac{4.69\ mol \times 0.082\ \frac{atm.L}{K.mol} \times (273+23)K}{2.2\ atm}$$

$$\boxed{V = 51.7\ L\ N_2}$$