LEBANESE UNIVERSAL ACADEMY

Class: LS
Subject: Chemistry
Duration: 80min

Exercise 1:(5POINTS)

It is required to study, at 25°C, the kinetics of a complete reaction between

Ester (CH3-COO-C2H5) and a Base (NaOH):

A slow and complete reaction takes place:

$$Ch_3\text{-}COO\text{-}C_2H_5 + HO^- \text{----> } CH_3COO^- + C_2H_5OH$$

At t=0, a volume V_1= 250ml of CH_3-COO-C_2H_5 solution of Molar concentration C_1= 0.01mol/l

are mixed with a volume V_2= 250ml of NaOH solution of Molar concentration C_2= 0.01mol/l.

The table below shows the variation of concentration of C_2H_5OH with time:

Time(min)	2	4	6	10	12	14	16
$[C_2H_5OH]\times10^{-3}$ mol/l	1.3	2.3	3.1	3.7	3.9	4	4.1

1.1- Calculate the initial concentration of hydroxide ion [HO^-] and ester [CH_3-COO-C_2H_5] in the mixture reaction.

1.2- Show that the initial mixture of reactants is stoichiometric.

2. Determine if the end time of the reaction is equal to t=16min.

3. Plot the curve representing the variation of the concentration of C_2H_5OH as a function of time, $[C_2H_5OH]$ =f (t) in the interval of time [0-16min].
Take the scales In abscissa: 1cm for 2 min;
In ordinates 1cm for 1×10^{-3}mol/l.

4. Determine graphically the half life time of the reaction $t_{1/2.}$

5. Deduce graphically how the rate of formation of C_2H_5OH varies as function of time.

6. The above reaction is replaced with changing the concentration of one reactant (ester) C'>C, at same temperature of 25°C.
Specify the effect of the change of concentration on:
1- The rate of formation of C_2H_5OH.
2- The concentration of C_2H_5OH at the end of the reaction.

Exercise 2: (5points)

A solution (S) is prepared by mixing a volume 5mL of a potassium iodide solution ($K^+ + I^-$) of concentration $C_1 = 5 \times 10^{-3}$ mol.L^{-1} with a volume 5mL of hydrogen peroxide solution (H_2O_2) of concentration $C_2 = 0.25$ mol.L^{-1} previously acidified with an excess amount of sulfuric acid.
A brown color of iodine (I_2) is observed which intensifies with time representing a complete reaction that takes place at a constant temperature **T** according to the following equation:

$$H_2O_{2\,(aq)} + 2I^-_{(aq)} + 2H^+_{(aq)} \rightarrow I_{2\,(aq)} + 2H_2O_{(l)}$$

The aim of this exercise is to study the kinetic of this reaction.

1. **Preliminary Study**

1.1. Calculate the initial concentrations of iodide ions $[I^-]_0$ and hydrogen peroxide $[H_2O_2]_0$ in the reactional mixture.
1.2. Deduce that hydrogen peroxide H_2O_2 is in excess.
1.3. Show that at each instant of time t, the concentration in (mmol.L^{-1}) of iodide ions $[I^-]_t$ is given by the following relation:

$$[I^-]_t = 2.5 - 2\,[I_2]_t$$

2. **Kinetic Study**

The follow-up of the evolution of the molar concentration of iodine as a function of time, using an appropriate method, permits to construct the table represented by **document-1.**

Time (min)	1	2	3	4	5	6	7
$[I_2]$ mmol.L^{-1}	0.28	0.51	0.7	0.82	0.93	1	1.05

Document-1

2.1. Plot the curve representing the variation of the concentration of I_2 as a function of time: $[I_2] = f(t)$ in the interval of time: [0 – 7 min].
Take the following scales: 1 cm for 1 min in abscissa
1 cm for 0.2 mmol.L^{-1} in ordinate

2.2. Specify whether each of the following two propositions is true or false.

Proposition 1: The instant t = 7min represents the end time of reaction.
Proposition 2: At the same instant t, the rate of disappearance of iodide ions (I^-) is twice the rate of formation of iodine (I_2).

2.3. Determine, graphically, the half-life time of the reaction t_{2}^{1}.
2.4. The above kinetic study is carried out but with only one modification: T ' > **T**.
Choose, by justifying, the correct answer:
2.4.1. The relation between t_{2}^{1} and half-life at temperature (T ') denoted by t'^{1}_{2} is:
a. $t_{2}^{1} = t'^{1}_{2}$ b. $t_{2}^{1} < t'^{1}_{2}$ c. $t_{2}^{1} > t'^{1}_{2}$
2.4.2. The intensity of the brown color observed at instant t = 4 min:
a. decreases b. increases c. remains the same