

LEBANESE UNIVERSAL ACADEMY



Class: LS

Subject: Chemistry

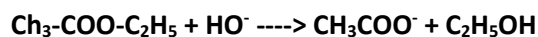
Duration: 80min

Exercise 1:(5POINTS)

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

Ester ($\text{CH}_3\text{-COO-C}_2\text{H}_5$) and a Base (NaOH):

A slow and complete reaction takes place:



At $t=0$, a volume $V_1= 250\text{ml}$ of $\text{CH}_3\text{-COO-C}_2\text{H}_5$ solution of Molar concentration $C_1= 0.01\text{mol/l}$

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

The table below shows the variation of concentration of $\text{C}_2\text{H}_5\text{OH}$ with time:

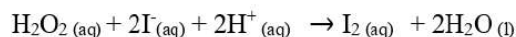
Time(min)	2	4	6	10	12	14	16
$[\text{C}_2\text{H}_5\text{OH}] \times 10^{-3}$ mol/l	1.3	2.3	3.1	3.7	3.9	4	4.1

- 1.1- Calculate the initial concentration of hydroxide ion $[\text{HO}^-]$ and ester $[\text{CH}_3\text{-COO-C}_2\text{H}_5]$ 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 $t=16\text{min}$.
3. Plot the curve representing the variation of the concentration of $\text{C}_2\text{H}_5\text{OH}$ as a function of time, $[\text{C}_2\text{H}_5\text{OH}] = f(t)$ in the interval of time $[0-16\text{min}]$.
Take the scales In abscissa: 1cm for 2 min;
In ordinates 1cm for $1 \times 10^{-3}\text{mol/l}$.
4. Determine graphically the half life time of the reaction $t_{1/2}$.
5. Deduce graphically how the rate of formation of $\text{C}_2\text{H}_5\text{OH}$ 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 $\text{C}_2\text{H}_5\text{OH}$.
 - 2- The concentration of $\text{C}_2\text{H}_5\text{OH}$ 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 $C_1 = 5 \times 10^{-3} \text{ mol.L}^{-1}$ with a volume 5mL of hydrogen peroxide solution (H_2O_2) of concentration $C_2 = 0.25 \text{ mol.L}^{-1}$ 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:



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
$[I_2] \text{ mmol.L}^{-1}$	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: $[0 - 7 \text{ min}]$.
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 $t = 7 \text{ min}$ 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 $t'^1_{2^1}$ is:
a. $t_{2^1} = t'^1_{2^1}$ b. $t_{2^1} < t'^1_{2^1}$ c. $t_{2^1} > t'^1_{2^1}$
 - 2.4.2. The intensity of the brown color observed at instant $t = 4 \text{ min}$:
a. decreases b. increases c. remains the same