

**First Exercise (10 points)****Organic Chemistry****1- Identification and mild reaction of the alcohol (B)**

The percentage by mol of oxygen in an alcohol is 6.66 %

1.1. Show that the molecular formula of the alcohol (B) is $C_4H_{10}O$

1.2. Draw the condensed structural formula of two positional isomers of (B).

1.3. Give the name of the tertiary class isomer of the alcohol (B).

1.4. An isomer (X) of the alcohol (B) undergoes mild oxidation to produce a straight chain of a carbonyl compound of formula R-CHO

1.4.1. Identify the isomer (X) of the alcohol (B)

1.4.2. Write the equation of the preparation of the carbonyl compound R-CHO.

1.4.3. Give the type of the mild oxidation used in the preparation of the (X). Define mild oxidation.

2- Esterification reaction

For an equimolar mixture of an alcohol and a carboxylic acid, the % yield of the esterification reaction is given in document-1 in the table below:

Class of alcohol	% Yield
Primary (1^0)	67%
Secondary (2^0)	60%

Document-1

A mixture of 0.25 mol of 2-butanol and a volume $V = 30$ ml of propanoic acid $C_3H_6O_2$ is heated to reflux. At instant t, heating is stopped. The mass of the ester (E) obtained at instant t is 19.5 g.

M (propanoic acid) = 74 g/mol Density propanoic acid = 0.99 g.ml⁻¹ M (Ester E) = 130 g/mol

2.1. Write, using the condensed structural formulas, the equation of the esterification reaction taking place. Name the ester (E).

2.2. Calculate the initial number of moles of propanoic acid used.

2.3. Determine the % yield of this reaction at instant t.

2.4. Referring to document-1, verify whether the equilibrium is reached at the instant t.

2.5. It is suggested to extend the duration of heating. Specify the effect of this modification on the % yield of the reaction.

Second Exercise (10 points)

Reaction between a strong Acid and a strong Base

Given: Molar Mass of picric acid in g.mol^{-1} : $M=229$;

Ion product of pure water K_w at $25^\circ\text{C} = 1 \times 10^{-14}$

Picric acid is a strong monoprotic acid. It is present in the form of a yellow crystalline substance at ordinary temperature (25°C). Picric acid is used in dyeing, surgery, and explosives.

1- Preparation of a Solution of a Strong Acid:

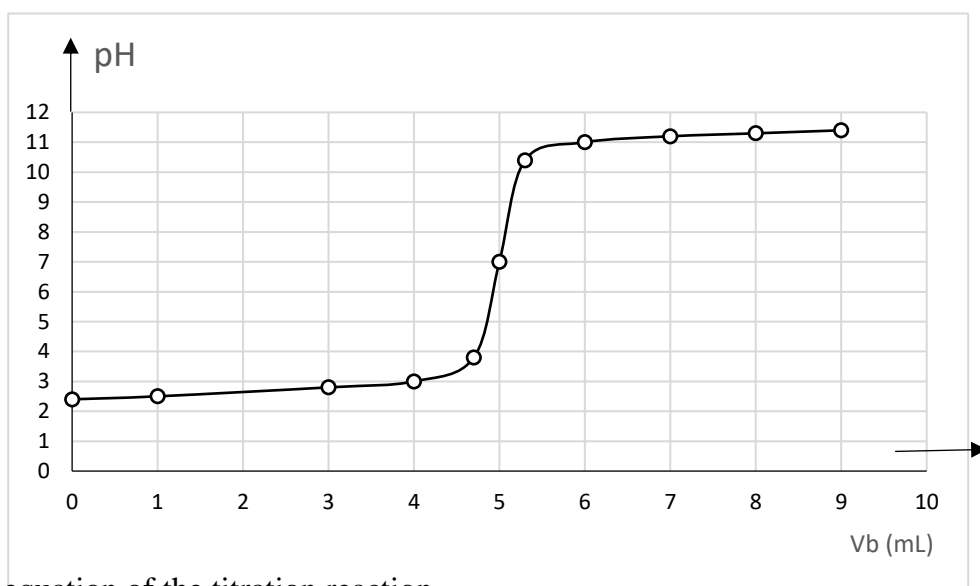
0.65g of a commercial sample of picric acid is used to prepare 500mL solution (S).

1.1- Write the equation of the reaction of picric acid with water (picric acid is denoted by HA).

1.2- Indicate the materials used to weigh the commercial sample of picric acid.

2- pH-metric Titration of a Strong Acid against a Strong Base:

10mL of solution (S) is titrated against sodium hydroxide solution of $\text{pH}=11.9$. The pH-metric titration permits to draw the following graph:



2.1- Write the equation of the titration reaction.

2.2- Determine the molar concentration of solution (S).

2.3- Deduce the percentage by mass of picric acid in the commercial product.

2.4- Justify whether the addition of distilled water to the acidic solution while immersing electrode modifies pH at equivalence point.

2.5- Another titration process is performed by placing 5mL of the basic solution in the beaker and the acidic solution in the burette.

2.5.1. Choose the correct answer. Justify

The pH of the resulting solution upon adding an excess amount of the acidic solution is:

- a) equal 2.4 b) greater than 2.4 c) less than 2.4

2.5.2. Give the shape of the curve and indicate on it the coordinates of two remarkable points:

A (0, pH_0), B (V_{aE} , pH_{E}).

Good Work