This is a Class 1 exam

Lebanon Evangelical School
for Boys and Girls — Loueizeh - Baabda

Stage Exam 04
27MAR2023

Do NOT write in this box. Your MARK will be placed here.

Subject :	Chemistry	
Class :	12E and 12M	
Teacher :	Mrs. Saydeh Nasrallah	
Duration :	1 hour	
Your name :		*Time taken to complete exam*
Your Class :		
Exam Room :		
How many sheets, including cover sheet :		

- Do not open this paper until the teacher in charge instructs you to do so.
- The most important thing to remember in taking an exam is NEVER PANIC.
- If you are caught cheating in this exam, you will be awarded zero for ALL exams that are taken on this day.

Exercise 1 (7 points) **Lactic Acid**

The quantity of free lactic acid contained in commercial yogurt should not be less than 0.7 gram per 100 grams of yogurt when sold to the consumer. It is important to verify regularly that the sold yogurt respects the given standards.
It is assumed that the acidity of the yogurt is only due to lactic acid.

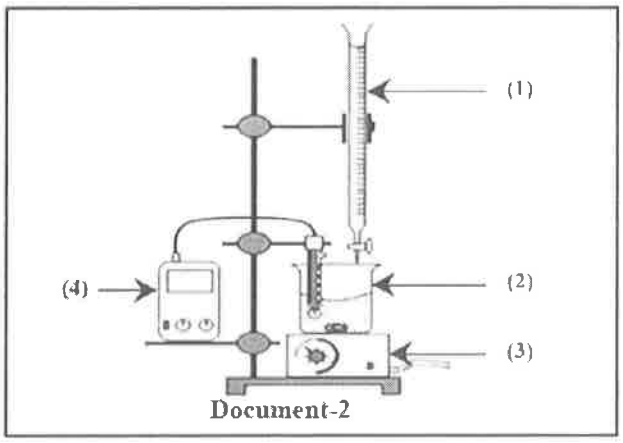
Document-1

The aim of this exercise is to titrate the lactic acid noted HA contained in the commercial yogurt and to study some of its characteristics.

Given: - Molar mass of lactic acid: $M = 90\,g.mol^{-1}$
- Lactic acid is a weak acid.

1. pH-metric Titration of Lactic Acid Contained in Commercial Yogurt

Lactic acid contained in a sample of mass m = 10.0g of commercial yogurt is titrated with a sodium hydroxide solution ($Na^+ + HO^-$) of concentration $C_b = 0.10\,mol.L^{-1}$.
Before starting titration, a sufficient quantity of distilled water is added while stirring to the sample of yogurt to homogenize the solution.
The schema of the titration setup used is shown in **document-2**



Document-2

1.1- Name the parts 1, 2, 3 and 4 of the titration setup of **document-2**.
1.2- Write the equation of the titration reaction.
1.3- Choose which one of the values given below corresponds to the pH of the solution at equivalence. Justify.
a- 5.6 **b**- 7.0 **c**- 8.3
1.4- The equivalence point is reached when the volume of the basic solution added is V_{bE} = 12mL. Determine the number of moles of lactic acid contained in the titrated sample.
1.5- Deduce the mass percentage of lactic acid in the commercial yogurt.
1.6- Referring to **document-1**, specify whether the yogurt respects the above given standards.

2. Characteristics of Lactic Acid

The condensed structural formula of lactic acid is:

$$CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - COOH$$

2.1- Name the two functional groups present in the above formula.
2.2- Give the systematic name of lactic acid.
2.3- Why lactic acid molecule is chiral?
2.4- Represent according to Cram the two enantiomers of lactic acid.
2.5- Lactic acid undergoes a mild oxidation with an acidified potassium permanganate solution ($K^+ + MnO_4^-$) to produce pyruvic acid.
2.5.1- Indicate in lactic acid molecule the functional group which is involved in this mild oxidation.
2.5.2- Indicate the colour change which occurs when the above reaction takes place.
2.5.3- Write the condensed structural formula of pyruvic acid.

Exercise 2 (3 points) **Identity of an Organic Compound A**

The complete combustion of 5.65ml of a liquid (A) lead to the formation of 9.60g of carbon dioxide and 4.86g of water.

Given: - Density of (A) = $0.713\,g.mL^{-1}$
- Liquid (A) is formed of carbon, hydrogen and oxygen only.
- $M(A)=74\,g.mol^{-1}$
- $M(C)=12\,g.mol^{-1}$ $M(H)=1\,g.mol^{-1}$ $M(O)=16\,g.mol^{-1}$

1- Determine the empirical formula of liquid (A). Deduce its molecular formula.
2- Give the condensed structural formulae of all possible isomers of (A).
3- (A) can be prepared using partial dehydration of another organic liquid (B).
Identify both compounds (A) and (B), by giving their condensed structural formulae.

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Exercise 1

NaOH | $C_b = 0.1$ mol.L^{-1}, $V_{bE} = 12$ ml | Lactic acid | $m_{sample} = 10$ g.

1_ pH-metric titration of Lactic Acid.

1.1_ (1): graduated buret ✓
(2): beaker ✓ (1/4)
(3): magnetic stirrer ✓ (1/4)
(4): pH_meter ✓

1.2_ $HA + OH^- \longrightarrow A^- + H_2O$ ✓ (1/2)

1.3_ At the equivalence point, the species present are Na^+, H_2O and A^-. ✓
Na^+ is a spectator ion while A^- is the conjugate base of HA, making the medium slightly basic according to the equation: (1/2) ✓

$A^- + H_2O \longrightarrow HA + OH^-$

=> answer : (c) $pH_E = 8.3$ ✓ (1/2)

1.4_ At equivalence point and by stichiometry

$n_{HA} = n_{OH^-}$

=> $n_{HA} = C_b \cdot V_{bE} = 0.1 \times 12 \times 10^{-3} = 1.2 \times 10^{-3}$ mol ✓ (1/2)

1.5_ $m_{HA} = 1.2 \times 10^{-3} \times 90 = 0.108$ g ✓ (1/4)

=> % HA in sample $= \frac{0.108}{10} \times 100 = 1.08\%$ ✓ (1/4)

1.6_ $1.08\% > 0.7\%$ (1/4) ✓ which is in accordance with document -1 ✓ (1/4)

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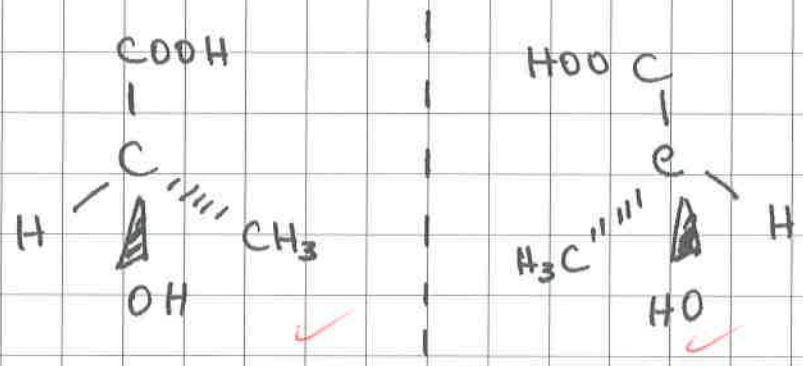
2- Characteristics of Lactic Acid.

2.1- carboxyl group and hydroxyl group. (1/4) (1/4)

2.2- 2-hydroxypropanoic acid (1/2)

2.3- Lactic acid is chiral for it contains an assymetric carbon atom, which is carbon number 2. (1/2)

2.4-



(1/2)

2.5.1- $CH_3 - CH(OH) - COOH$ (1/2)

(OH) → the hydroxyl group.

2.5.2- From purple to light pale pink. (1/2)

2.5.3- $CH_3 - \overset{\overset{O}{\|}}{C} - COOH$ (1/2)

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Exercise 2

Given : (A) | $C_xH_yO_z$
$V = 5.65\ mL$
$d = 0.713\ g.mL^{-1}$
$M = 74\ g.mol^{-1}$

1- $\frac{12g\ of\ C}{44g\ (CO_2)} = \frac{m_{(C)}}{9.60} \Rightarrow m_{(C)} = 2.62\ g$ (1/4)

$\frac{2g\ (H)}{18g\ (H_2O)} = \frac{m_{(H)}}{4.86} \Rightarrow m_{(H)} = 0.54\ g.$ (1/4)

$m_{(A)} = d \times V = 0.713 \times 5.65 = 4.03\ g$ (1/4)

$\Rightarrow m_{(O)} = 4.03 - (2.62 + 0.54) = 0.87\ g$ (1/4)

C	H	O
$\frac{2.62}{12}$	$\frac{0.54}{1}$	$\frac{0.87}{16}$
$\frac{0.218}{0.054}$	$\frac{0.54}{0.054}$	$\frac{0.054}{0.054}$
4	10	1

(1/4)

$\Rightarrow$ E.F of (A) is $(C_4H_{10}O)_x$ (1/4)

$x = \frac{74}{4\times12 + 10 + 16} = \frac{74}{74} = 1 \Rightarrow$ M.F of (A) is $C_4H_{10}O$.

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2- $CH_3 - CH_2 - CH_2 - CH_2 - OH$ ✓ (1/4)

$CH_3 - \underset{\underset{OH}{|}}{CH} - CH_2 - CH_3$ ✓ (1/4)

$CH_3 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - OH$ ✓ (1/4)

$CH_3 - O - CH_2 - CH_2 - CH_3$ ✓

$CH_3 - CH_2 - O - CH_2 - CH_3$ ✓ (1/4)

3- Alcohols undergo partial dehydration to produce ether according : ✓

$2\ C_nH_{2n+1}OH \longrightarrow H_2O + C_nH_{2n+1} - O - C_nH_{2n+1}$

$B \longrightarrow H_2O + A$ ✓

=> (A) : $CH_3CH_2 - O - CH_2 - CH_3$ ✓ (1/4)

(B) : $CH_3 - CH_2 - OH$ ✓ (1/4)