This is a Class 1 exam

Lebanon Evangelical School
for Boys and Girls
Loueizeh - Baabda

Mock Exams : Pt1

9, 10, 11 MAY022

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

Subject :	Chemistry	
Class :	12ME	
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.

First Exercise (14 points)
Carboxylic Acid Derivatives

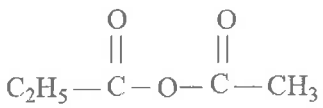
Acid derivatives are more reactive than the corresponding carboxylic acids, especially in the preparation of esters. The aim of this exercise is to recognize some acid derivatives, their reactions and their preparations.

Given:

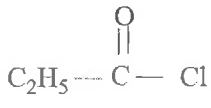
- Molar mass in $g.mol^{-1}$: M(H) = 1; M(C) = 12; M(O) = 16; M(Cl) = 35.5
- Density of the liquid compound (B): $d = 1.065\, g.ml^{-1}$.

1- Structural Formulas of Some Acid Derivatives

The condensed structural formulas of some acid derivatives are given below:



(A)



(B)

1.1- Give the systematic name of (B).
1.2- Write, using condensed structural formulas of the organic compounds, the equation of one preparation reaction of (B).

2- Preparation of the Compound (A)

The compound (A) is a mixed anhydride less important than acetic anhydride. It is used as an intermediate in the manufacture of many industrial chemicals: perfumes, plastics … The compound (A) is obtained, in the pure state, by proceeding as follows:

A volume V= 7 mL of liquid compound (B) is introduced into a dry beaker containing an excess of solid sodium ethanoate CH_3COONa. A fast reaction occurs according to the following equation:

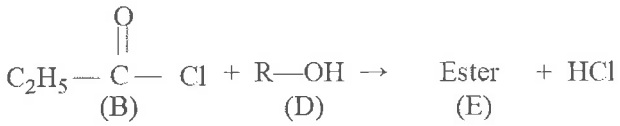
$$CH_3COONa + (B) \rightarrow (A) + (C)$$

A mass of 6.9 g of the compound (A) is obtained at the end of the reaction.

2.1- Write the formula of the compound (C).
2.2- Determine the percentage of the compound (B) which has reacted.
2.3- This reaction should be carried out in a dry beaker. Justify.

3- Preparation of an Ester (E) from the Compound (B)

0.05 mol of the compound (B) is treated with an excess of a saturated non cyclic monoalcohol (D), noted as (R-OH), in the presence of an appropriate catalyst. At the end of the reaction, an ester (E) having a fruity odor and a mass of 5.8g is obtained according to the following equation:



3.1- Determine the molar mass of the ester (E).
3.2- Deduce the molecular formula of the alcohol (D).
3.3- In order to identify the ester (E), we have to determine the identity of the alcohol (D) by the following experimental approach:
The alcohol (D) gives, by catalytic dehydrogenation, a compound (M) which is identified with the following tests.
Test 1: compound (M) + 2.4-DNPH →Yellow- orange precipitate.
Test 2: compound (M) + Fehling's solution → Brick- red precipitate.
3.3.1- Specify the chemical family of the compound (M) and the class of the alcohol (D).
3.3.2- Write the condensed structural formula and give the systematic name of each of the compounds: (D), (M) and (E).

Second Exercise (6 points)
Identification of an Alcohol

The hydration of an alkene, in the presence of sulfuric acid as a catalyst, leads to the formation of an alcohol A, according to the following equation:

$$C_nH_{2n} + H_2O \rightarrow C_nH_{2n+1}OH$$

The aim of this exercise is to identify this alcohol A.
Given: Molar mass in $g.mol^{-1}$: M (H) = 1 ; M (C) = 12 ; M (O) = 16.

1- Determination of the Molecular Formula of A

The elementary analysis of the alcohol A shows that it contains 21.62 % by mass of oxygen.
1.1- Show that the molecular formula of A is $C_4H_{10}O$.
1.2- Write the possible condensed structural formulas of the alcohol A.

2- Identification of A

2.1- The catalytic dehydrogenation of A, in the presence of reduced copper, leads to the formation of an organic compound which gives a yellow-orange precipitate with 2,4-DNPH.
Give, by justifying, the possible names of A.

3- Some Reactions of A

Write, by using molecular formulas of the compounds, the equations of the following reactions:
3.1- Reaction of A with phosphorous pentachloride.
3.2- Reaction of A with excess potassium dichromate in acidic medium.
Given the redox couple: $Cr_2O_7^{2-}/Cr^{3+}$

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1- Structural Formulas of Some Acid derivatives

1.1- Propanoyl Chloride ✓ (1)

1.2- $C_2H_5COOH + PCl_5 \longrightarrow C_2H_5COCl + HCl + POCl_3$ ✓ (3/4) ✓ (3/4)

2- Preparation of the compound (A)

2.1- NaCl

2.2- By Stoichiometry :

$$n_{(A)} = n_{(B)}$$ ✓ (1/2)

$$\Rightarrow \frac{m_{(B)}}{M_{(B)}} = \frac{m_{(A)}}{M_{(A)}} \Rightarrow m_{(B)} = \frac{m_{(A)} \times M_{(B)}}{M_{(A)}}$$

$$\Rightarrow m_{(B)} = \frac{6.9 \times 92.5}{116}$$ ✓

$$\Rightarrow m_{(B)} = 5.502\ g$$ ✓ (1)

$$m_{(B)\,initial} = 7 \times 1.065 = 7.455\ g$$ ✓ (1/2)

$$\Rightarrow \%\,(B)\ reacted = \frac{5.502}{7.455} \times 100 = 73.8\%$$ (1/2)

2.3- Propanoyl chloride is instantaneously hydrolysed in the presence of water. ✓ (1)

3. Preparation of an Ester (E) from the Compound (B)

3.1- By stoichiometry

$$n_{(B)} = n_{(E)} = 0.05 \text{ mol} \quad (\tfrac{1}{2})$$

$$\Rightarrow M_{(E)} = \frac{5.8}{0.05} = 116 \text{ g.mol}^{-1} \quad (1)$$

3.2- The general formula of E is $C_nH_{2n}O_2$,

then : $14n + 32 = 116$

$$n = \frac{116-32}{14} = 6 \quad (\tfrac{3}{4})$$

$\Rightarrow$ (E) is $C_6H_{12}O_2$ $(\tfrac{1}{4})$

$\Rightarrow$ (D) is C_3H_7OH (1)

3.3.1- (M) gave a positive result with 2,4-DNPH and with Fehling's solution $(\tfrac{1}{2})$, then (M) is an aldehyde (1). This implies that (D) is a primary alcohol. (1)

3.3.2- (D) is a primary alcohol and has the formula of C_3H_7OH, then: $CH_3-CH_2-CH_2-O-H$ $(\tfrac{1}{2})$

1-propanol $(\tfrac{1}{2})$

(M) : $CH_3 - CH_2 - C(=O)-H$ (½) propanal (½)

(E) : $CH_3-CH_2-C(=O)-O-CH_2-CH_2-CH_3$ (½) propylpropanoate (½)

Second Exercise

1- Determination of the Molecular Formula of A.

1.1- $\%O = \frac{m(O)}{M(A)} \times 100 \Rightarrow M_{(A)} = \frac{m(O)}{\%O} \times 100$

$\Rightarrow M_{(A)} = \frac{16}{21.62} \times 100$

(¾) $\Rightarrow M_{(A)} = 74\ g.mol^{-1}$

(A) is an alcohol of general formula $C_nH_{2n+1}OH$, then:

$14n + 16 + 2 = 74$

$\Rightarrow n = \frac{74-18}{14} = 4$ (¾)

therefore (A) : $C_4H_{10}O$ (verified).

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

$CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-OH$ ✓ (1/2)

$CH_3-\underset{\underset{OH}{|}}{CH}-CH_2-CH_3$ ✓ (1/2)

$CH_3-\underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3$ ✓ (1/2)

2- <u>Identification of A</u>

2.1- The product of the catalytic dehydrogenation gives a yellow - orange precipitate with 2,4-DNPH, then it's either an aldehyde or a ketone. ✓

(1/4) Therefore, (A) can be either a primary or a secondary alcohol. ✓

The possible names of (A) are:

1- butanol (1/4), 2-butanol ✓, (1/4)

methylpropan-1-ol. ✓ (1/4)

3- Some Reactions of A

3.1- $C_4H_{10}O + PCl_5 \longrightarrow C_4H_9Cl + HCl + POCl_3$ (1/2)

3.2- $C_4H_9OH + H_2O \longrightarrow C_4H_8O_2 + 4H^+ + 4e^-$ (x3)

(1/2) $Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$ (x2)

$3C_4H_9OH + 2Cr_2O_7^{2-} + 16H^+ \longrightarrow 3C_4H_8O_2 + 4Cr^{3+} + 11H_2O$ (1/2)