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VCE Chemistry ½ Functional Groups in Organic Chemistry [0.19]

Workshop

Error Logbook:

New Ideas/Concepts	Didn't Read Question
Pg / Q #:	Pg / Q #:
Algebraic/Arithmetic/ Calculator Input Mistake	Working Out Not Detailed Enough
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Section A: Recap

Definition

<u>Learning Objective: [2.7.1] - Apply IUPAC Conventions to Identify, Draw & Write IUPAC Names of Straight-Chained & Branched Carboxylic Acids</u>

Structural Formula	Functional Group	<u>Class of</u> <u>Molecule</u>	<u>Prefix / Suffix</u>
H			
H 0-H			

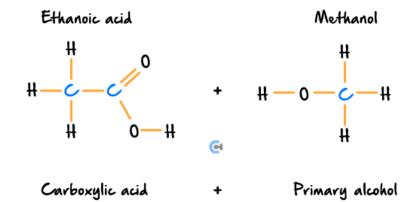
- As carboxyl groups must always be at the end, numbers [do] / [do not] need to be specified!
- Multiple Functional Groups Naming Steps:
 - 1. Find the primary functional group first (highest on the table in the databook).
 - 2. Primary functional group assigned: [Prefix] / [Suffix] naming.
 - **3.** Other functional groups assigned: [Prefix] / [Suffix] naming.





<u>Learning Objective: [2.7.2] - Write Condensation Reactions for the Formation of Esters & Relevant Catalysts / Conditions</u>

Condensation Reaction Produces: ______



6 4	Ester Name:		

<u>Learning Objective: [2.7.3] - Apply IUPAC Conventions to Identify, Draw & Write IUPAC Names of Straight-Chained Esters</u>



Naming Esters:

<u>Main Chain</u>	<u>Side Chain</u>
Originally [carboxylic acid] / [alcohol] end	Originally [carboxylic acid] / [alcohol] end
Naming:	Naming:
[Prefix] / [Suffix] of	[Prefix] / [Suffix] like alkyl groups



Drawing Esters from Name:

Beginning Portion of name ending with '-yl'	Ending Portion of name ending with '-oate'
[Main] / [Side] chain	[Main] / [Side] chain
Attached to side with $[C = 0] / [-0 -]$	Attached to side with $[C = 0] / [-0 -]$

Question 1 Walkthrough.

Name the following molecule.



Question 2 Walkthrough.

Name the following molecule.



Question 3 Walkthrough.		
Larry knows that a particular ester is ethyl propanoate.		
a. Draw the structural formula of ethyl propanoate.		
b. Write the semi-structural formula for the reaction between an alcohol and carboxylic acid to form ethyl propanoate.		
c. Draw the skeletal formula for the functional isomer of ethyl propanoate.		
Space for Personal Notes		

Section B: Warm Up (14 Marks)

INSTRUCTION: 14 Marks. 9 Minutes Writing.



Question 4 (5 marks)

Provide the IUPAC name for the following molecules:

a. (1 mark)

b. (1 mark)

c. (1 mark)

d. (1 mark)

e. (1 mark)



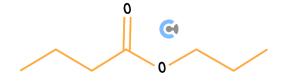
Question 5 (1.5 marks)

For the following esters, identify the reactants which were used to produce them.

a. (0.5 marks)

c. (0.5 marks)

b. (0.5 marks)



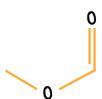


Question 6 (1.5 marks)

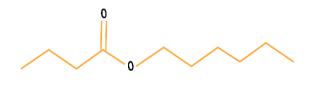
Provide the IUPAC name for the following esters.

a. (0.5 marks)

c. (0.5 marks)



b. (0.5 marks)





Question 7 (6 marks)

For the following molecules, draw their structural formula and give the semi-structural formula.

- **a.** 3-fluoro-2,3-dimethylpentane-1,2-diol.
 - i. Structural formula. (1 mark)

- ii. Semi-structural formula. (1 mark)
- **b.** Propanedioic acid.
 - i. Structural formula. (1 mark)

ii. Semi-structural formula. (1 mark)



c.	2-b	promopent-2-en-3-ol.
	i.	Structural formula. (1 mark)
	ii.	Semi-structural formula. (1 mark)





Section C: Ramping Up (13 Marks)

INSTRUCTION: 13 Marks. 10 Minutes Writing.



Question 8 (8 marks)				
Janita is interested in the molecular structure and arrangement of different chemical compounds, especially those in organic chemistry. Of these structures, she particularly wishes to investigate functional groups.				
a. Draw an ether functional group. (1 mark)				
b. Draw a carbonyl functional group. (1 mark)				
c. Why can oxygen not be bound to 3 different atoms? Explain with reference to the valence number. (2 mark	ks)			
d. Draw a molecule of butanoic acid, circling the primary functional group. (2 marks)				



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e. Draw a molecule of methanol, circling the primary functional group. (2 marks)
Question 9 (5 marks)
Adya is investigating the isomerism of organic compounds such as esters and wishes to take a look at a few specific examples.
a. Explain the difference between a structural and functional isomer. (2 marks)
b. List all of the functional isomers of butanoic acid with an ester functional group. (2 marks)
c. Adya finds another molecule which is not an acid or an ester but has the same formula as butanoic acid. What type of functional group could this molecule have? (1 mark)
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Section D: Getting Trickier I (9 Marks)

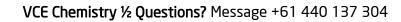
INSTRUCTION: 9 Marks. 7 Minutes Writing.



Question 10 (9 marks)		

Consider the carboxylic acid 3-chloropropanoic acid.

- ${f a.}~~$ State the ${f two}$ functional groups that make up the carboxyl group. (1 mark)
- **b.** Draw the structural formula of the carboxylic acid. (1 mark)





c.	• Given that structure drawn in part b. , certain assumptions can be made using your prior knowledge of intermolecular bonding.		
	i.	List the type(s) of intermolecular bonding can 2-chloro-2-methylbutanoic acid form. (2 marks)	
	ii.	Is it likely that when this carboxylic acid is mixed with water, it will dissolve? Justify your answer. (3 marks)	
	iii.	The chlorine atom is then replaced with a hydrogen atom, resulting in the molecule turning into propanoic acid. State the impact would this have on the intermolecular bonding exerted by the molecule. (2 marks)	
Spa	ace	for Personal Notes	



Section E: Getting Trickier II (10 Marks)

INSTRUCTION: 10 Marks. 9 Minutes Writing.



Question 11 (10 marks)				
Consider organic molecules that fall under the category of carboxylic acids.				
a. Draw the structural formula for a molecule of 4,4-dimethylpentanoic acid. (1 mark)				
b. Write out the semi-structural formula for the molecule above and circle the primary functional group of the structural formula. (1 mark)				
c. Explain why the carboxyl group is always at the end of the organic molecule and never in the centre. (2 marks)				



i.	Name the type of reaction. (1 mark)	
ii.	Write out the structural formula of the reaction, showing all bonds. (3 marks)	
iii.	What is the percentage composition of oxygen in the resulting ester? (2 marks)	
	Let's take a <u>BREAK</u> !	
ice	for Personal Notes	



Section F: VCAA-Level Questions I (10 Marks)

INSTRUCTION: 10 Marks. 30 Seconds Reading. 10 Minutes Writing.



Overtion 12 (10 morks)					
Question 12 (10 marks)					
Esters are widely used for scents on a global scale, being mass-produced in factories for specialised smells which are then sent to companies for specific purposes. One of the main esters produced is that of propylethanoate.					
a. Identify the reactants required to produce this ester. (1 mark)					
b. Identify the conditions required to produce this ester. (1 mark)					
c. Draw the structural equation of the formation of this ester. (2 marks)					
Thus the structural equation of the formation of this ester. (2 marks)					
d. How many other structural isomers of this ester exist? (1 mark)					
e. Draw a functional isomer of ethanoic acid. (1 mark)					



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Another ester which is also commonly produced, is formed by mixing ethanol and ethanoic acid. Write the semi-structural formula for this reaction. (2 marks)					
Name the ester produced in this reaction. (1 mark)					
Explain what a catalyst is and why one is required for this reaction. (1 mark)					
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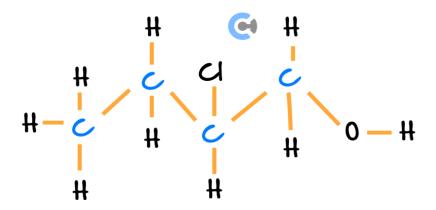
Section G: Multiple Choice Questions (10 Marks)

INSTRUCTION: 10 Marks. 10 Minutes Writing.



Question 13 (1 mark)

What is the IUPAC name for the following molecule?



- A. 2-chlorobutan-1-ol
- **B.** 3-chlorobutan-4-ol
- C. 1-chlorobutan-2-ol
- D. 2-chlorobutanol

Question 14 (1 mark)

In organic molecules, how many double bonds can oxygen form?

- **A.** 0
- **B.** 1
- **C.** 2
- **D.** 3

Space for Personal Notes

20

Question 15 (1 mark)

Which one of the following molecules contains a carbonyl group?

- A. $CH_3CH(CH_3)OCH_2CH_3$
- B. CH₃CH₂OH
- C. CH₃CH₂OCH₂CH₃
- **D.** CH₃COCH₂CH₃

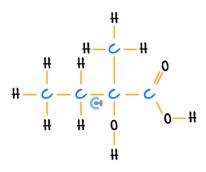
Question 16 (1 mark)

Which one of the following semi-structural formulae correctly represents the molecule of methylpropanoic acid?

- A. CH₃CH₂CH₂COOH
- B. CH₃CH₂COOH
- C. $CH_3CH_2(CH_3)COOH$
- **D.** $CH_3CH_2CH_2(CH_3)COOH$

Question 17 (1 mark)

What is the IUPAC name for the following organic molecule?



- A. 2-hydroxy-2-methylpropanoic acid
- B. 2-hydroxy-2-methylbutanoic acid
- C. 2,2-methylhydroxybutanoic acid
- D. 2-methyl-2-hydroxybutanoic acid

Question 18 (1 mark)

What is the name of the product that is formed between ethanol and propanoic acid in an esterification reaction?

- A. Propyl propanoate
- B. Ethyl propanoate
- C. Propyl ethanoate
- **D.** Ethyl ethanoate

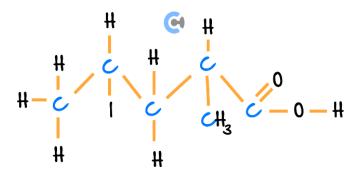
Question 19 (1 mark)

Which one of the following details the reaction that produces the ester propyl methanoate as a result?

- A. $CH_3CH_2CH_2OH + HCOOH \rightarrow HCOOCH_2CH_2CH_3$
- **B.** $CH_3CH_2OH + HCOOH \rightarrow HCOOCH_2CH_3 + H_2O$
- C. $CH_3CH_2CH_2OH + HCOOH \rightarrow HCOOCH_2CH_2CH_3 + H_2O$
- **D.** $CH_3OH + CH_3CH_2COOH \rightarrow CH_3CH_2COOCH_3 + H_2O$

Question 20 (1 mark)

What is the IUPAC name for the following organic molecule?



- A. 3-iodo-3-methylpentanoic acid
- **B.** 4-iodo-2-methylpentanoic acid
- C. 2-iodohexanoic acid
- **D.** 2-iodo-4-methylpentanoic acid



Question 21 (1 mark)

Which one of the following is **not** necessary for an esterification reaction to occur?

- A. Concentrated sulfuric acid catalyst.
- **B.** High-pressure environment.
- **C.** High-temperature environment.
- **D.** The presence of an alcohol and a carboxylic acid.

Question 22 (1 mark)

What is the semi-structural formula for pentyl propanoate?

- A. $CH_3(CH_2)_4CH_2CH_2CH_3$
- **B.** CH₃CH₂CH₂CH₂COOHCH₂CH₂CH₃
- $C. CH_3CH_2COOCH_2CH_2CH_2CH_3$
- **D.** $CH_3(CH_2)_2COOHCH_2(CH_2)_3CH_3$



Section H: VCAA-Level Questions II (9 Marks)

INSTRUCTION: 9 Marks. 30 Seconds Reading. 9 Minutes Writing.



Question 23 (9 marks)					
The analysis of a certain organic molecule that contains 54.5% carbon, 36.4% oxygen and the remainder is hydrogen.					
e identity of the molecule is required before any further analysis can be done.					
i. Determine the empirical formula for the molecule. (2 marks)					
ii. The molecule has a molar mass of 74 $g\ mol^{-1}$. State the molecular formula. (1 mark)					
iii. From this molecular formula, is it possible to determine the presence of any specific functional groups? Explain your answer. (2 marks)					



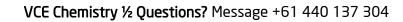
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b. Given your answer to part a., information has been provided that the molecule is an unbranched ester.i. State all possible names for the ester. (2 marks)						
	ii.	Draw the semi-structural esterification reaction for the ester that is produced from ethanoic acid. (2 marks)				
Space for Personal Notes						



Section I: Extension Questions (10 Marks)

Question 24 (10 marks) The way that an organic molecule is structured, especially with the addition of certain functional groups, relates directly to their observed properties.					
_					
_					





	Given the molecular formula of $C_3H_6O_2$, multiple isomers can be considered.			
i.	What type of functional groups can this be attributed to? (2 marks)			
ii.	Draw out the structural formulae of all the possible isomers of $C_3H_6O_2$ that are either a carboxylic acid an ester. (3 marks)			
iii.	Could the molecular formula be an isomer for an alcohol? Justify your answer with relevant structural formulae. (3 marks)			



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