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VCE Chemistry ½

Functional Groups in Organic Chemistry [2.7]

Homework

Admin Info & Homework Outline:

Student Name	
Questions You Need Help For	
Compulsory Questions	Pg 02 - Pg 17
Supplementary Questions	Pg 18 - Pg 31

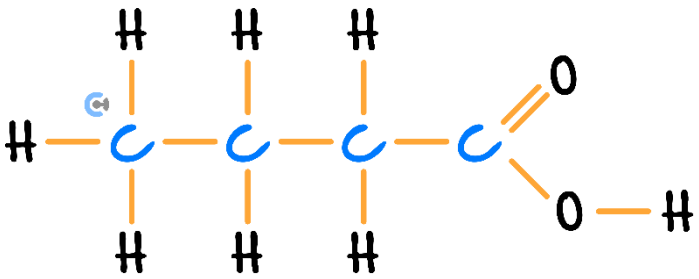
Section A: Compulsory Questions (65.5 Marks)

Sub-Section [2.7.1]: Apply IUPAC Conventions to Identify, Draw & Write IUPAC Names of Straight-Chained & Branched Carboxylic Acids

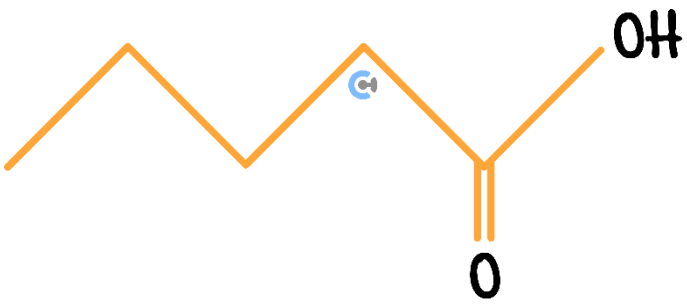
Question 1 (12.5 marks)

a. Identify the carboxyl group in each of the organic compounds below. If there is no carboxyl group present, draw an 'X' through the compound.

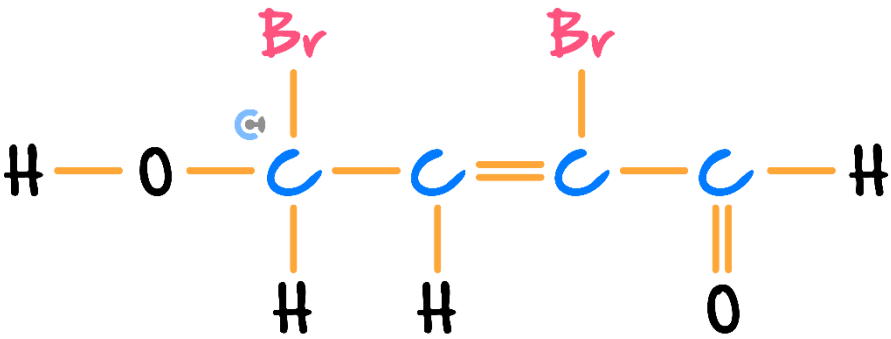
i. (0.5 marks)



ii. (0.5 marks)



iii. (0.5 marks)



b. Draw the structural formula for each of the organic compounds below.

i. 3-bromo-3-methylpentanoic acid. (1 mark)

ii. Ethanedioic acid. (1 mark)

c. Draw the skeletal structure for each of the organic compounds below.

i. Butanoic acid. (1 mark)

ii. 3-bromo-4,5-dimethylheptanedioic acid. (1 mark)

d. Draw the semi-structural formula for each of the organic compounds below.

i. 3,3-dimethylpentanoic acid. (1 mark)

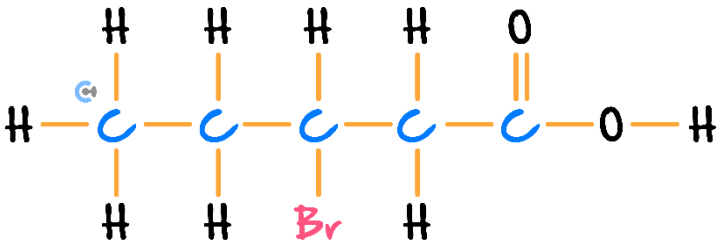
_____

ii. Butanedioic acid. (1 mark)

_____

e. Fill out the table for each of the following molecules.

i. (2 marks)



Name	Semi-structural

ii. (2 marks)

Name	Semi-structural

iii. $HOOCCH(CH_3)CH_2CH_2CH_3$. (1 mark)

Name: _____

Question 2 (9 marks)

a. Draw the structural formula for each of the organic compounds below.

i. 3-hydroxybutanoic acid. (1 mark)

ii. 3-hydroxypent-2-enedoic acid. (1 mark)

b. Draw the skeletal structure for each of the organic compounds below.

i. 3-hydroxy-2-methylpentanoic acid. (1 mark)

ii. 2-hydroxypent-3-enoic acid. (1 mark)

c. Draw the semi-structural formula for each of the organic compounds below.

i. 2,3-dihydroxybutanoic acid. (1 mark)

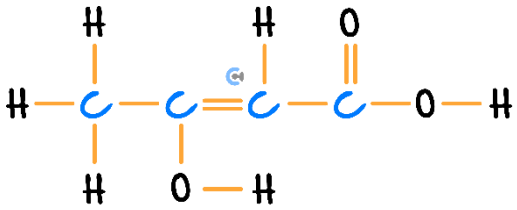
_____

ii. Hexa-2,4-dienedioic acid. (1 mark)

_____

d. Name the following organic compounds.

i. (1 mark)



_____

ii. (1 mark)

_____

iii. $CH_3CHCOHCH_2CH_2COOH$. (1 mark)

_____

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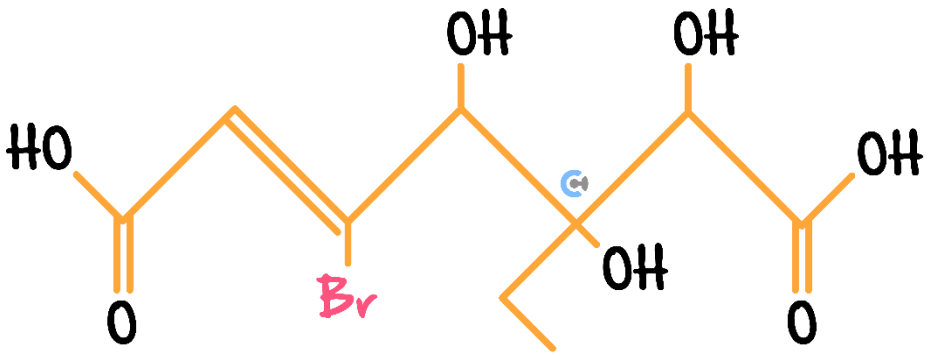
Question 3 (4 marks)

Jaldhi is studying the following organic compound.



a. On the diagram above, circle the carboxyl group(s). (1 mark)

b. Draw the structural formula for the organic compound Jaldhi is studying. (1 mark)

c. Draw the semi-structural formula for the compound. (1 mark)

_____

_____

d. Write the IUPAC name for the compound. (1 mark)

_____

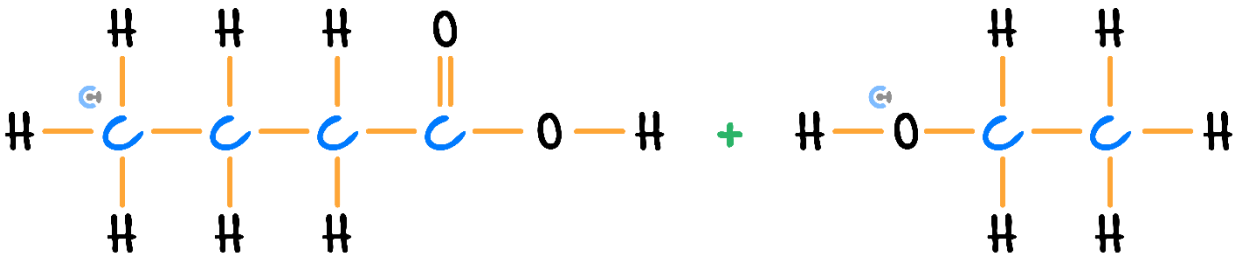
_____

Sub-Section [2.7.2]: Write Condensation Reactions for the Formation of Esters & Relevant Catalysts/Conditions

Question 4 (4 marks)

Some reactions are being investigated.

a. Complete the reaction below using the structural formula for all organic compounds. States are not required for organic compounds. (3 marks)



b. State the type of reaction in **part a.** (1 mark)

_____

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Question 5 (4 marks)

Write the semi-structural formula for the esterification reaction for the following.

a. Methanoic acid and ethanol. (2 marks)

_____

_____

b. Propan-1-ol and ethanoic acid. (2 marks)

_____

_____

Question 6 (7 marks)

a. Complete the reaction below using the semi-structural formula for any organic compounds. States are not required for organic compounds. (2 marks)

$CH_3CH_2COOH +$ _____ $\xrightarrow{\text{_____}}$ $CH_3CH_2COOCH_2CH_2CH_2CH_3 +$ _____

b. State the type of reaction in **part a.** (1 mark)

_____

c. H_2SO_4 is sometimes called a dehydrating agent.

i. Explain the function of H_2SO_4 in terms of esterification reactions. (1 mark)

_____

ii. Identify a safety risk associated with H_2SO_4 solutions used in esterification reactions. (2 marks)

_____

_____

_____

d. Name the ester formed in **part a.** (1 mark)

_____

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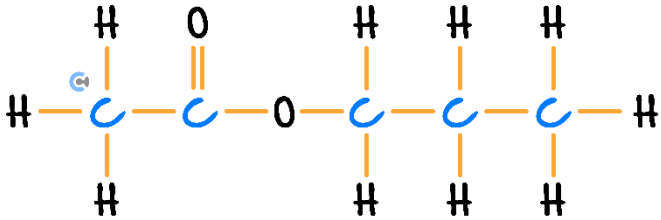
Sub-Section [2.7.3]: Apply IUPAC Conventions to Identify, Draw & Write IUPAC Names of Straight-Chained Esters

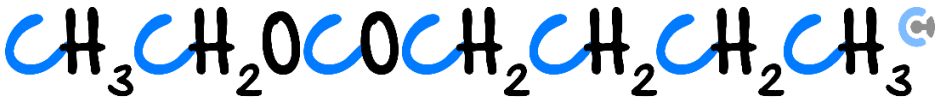
Question 7 (3 marks)

Circle the ester groups in each of the following organic compounds.

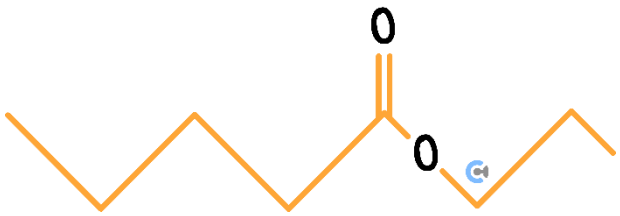
a. (1 mark)



b. (1 mark)



c. (1 mark)



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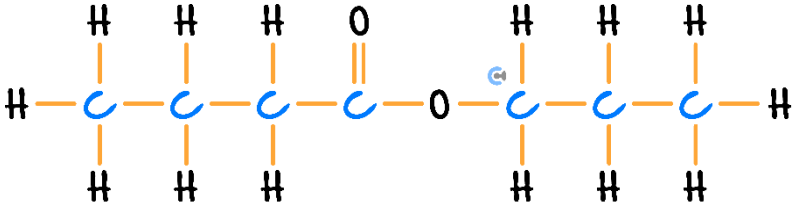
Question 8 (4 marks)

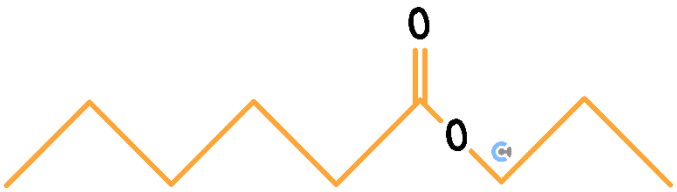
Identify the carboxylic acid and the alcohol that are reacted to form the following esters.

a. (1 mark)



b. $CH_3CH_2COOCH_2CH_3$. (1 mark)

c. (1 mark)



d. Hexyl pentanoate. (1 mark)

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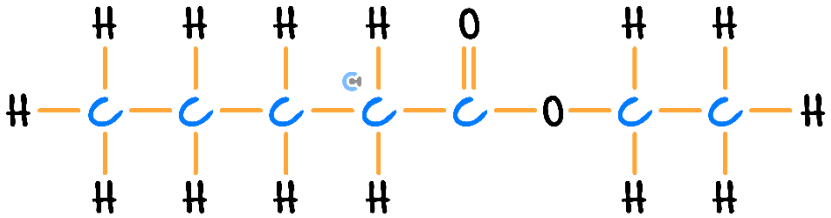
Question 9 (5 marks)

a. State the IUPAC name for each of the following compounds.

i. (1 mark)

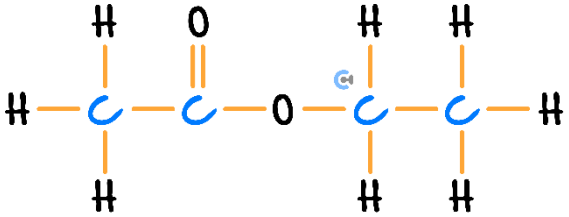


_____

ii. $CH_3CH_2CH_2COOCH_2CH_2CH_2CH_2CH_2CH_3$. (1 mark)

_____

iii. (1 mark)



_____

b. For the following, draw the skeletal formulas.

i. Hexyl propanoate. (1 mark)

ii. Ethyl propanoate. (1 mark)

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Sub-Section: The 'Final Boss'

Question 10 (13 marks)

Aaron is working with some organic compounds on Ester Sunday. He decides he would like to synthesise an ester with 7 carbon atoms for the occasion.

a. Aaron is going to use the ethanol in a bottle of vodka (which was gifted to him) to synthesise his ester.

i. Explain why Aaron cannot use vinegar (which is composed of ethanoic acid) to synthesise his ester. (2 marks)

_____

_____

_____

ii. Draw the skeletal structure of a potential carboxylic acid Aaron could use. Circle the carboxyl group on your drawing. (2 marks)

b. Aaron decides to react hexanoic acid with ethanol to synthesise his ester.

i. Using semi-structural formula, write the equation for the esterification reaction between hexanoic acid and ethanol. States are not required for organic compounds. (3 marks)

_____

_____

ii. What type of reaction is Aaron using to synthesise his ester? (1 mark)

_____

iii. State the IUPAC name of the ester produced by the reaction in **part b. i.** (1 mark)

_____

iv. With reference to relevant molecular formulae, explain why Aaron should not use hexanoic acid to synthesise the ester he desires. (2 marks)

_____

_____

_____

_____

_____

c. After some trial and error, Aaron synthesises the ester he desires using the ethanol from his bottle of vodka.

i. Draw the structural formula for the ester that Aaron synthesises. (1 mark)

ii. Using the table above, describe the smell of the ester Aaron has synthesised. (1 mark)

_____

_____

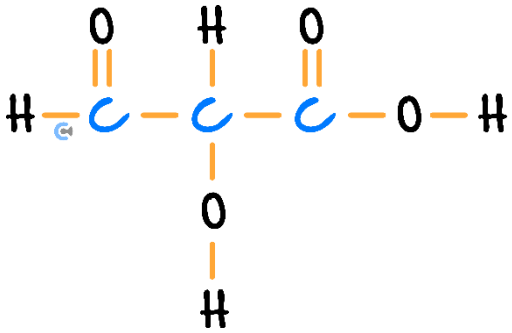
Section B: Supplementary Questions (58 Marks)

Sub-Section [2.7.1]: Apply IUPAC Conventions to Identify, Draw & Write IUPAC Names of Straight-Chained & Branched Carboxylic Acids

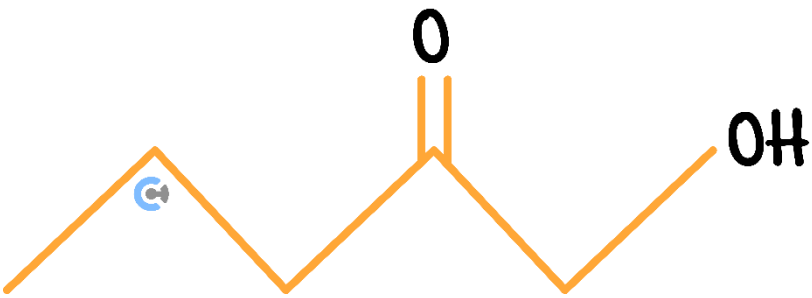
Question 11 (6 marks)

a. Identify the carboxyl group in each of the organic compounds below. If there is no carboxyl group present, draw an 'X' through the compound.

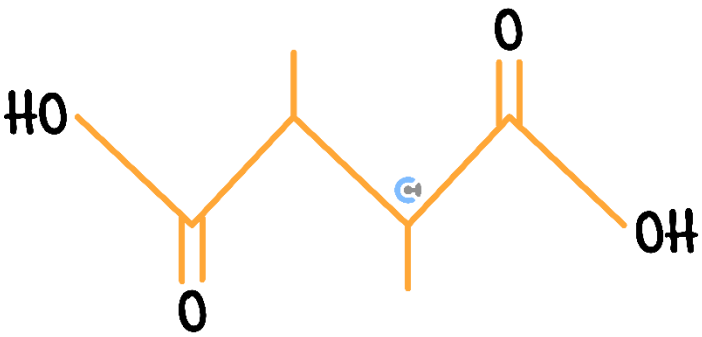
i. (1 mark)



ii. (1 mark)



iii. (1 mark)



b. Complete the following:

i. Draw the semi-structural formula for ethanoic acid. (1 mark)

_____

ii. Draw the structural formula of hexanoic acid. (1 mark)

iii. Draw the skeletal structure of butanoic acid. (1 mark)

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Question 12 (9 marks)

a. Draw the structural formula for each of the organic compounds below.

i. 3-bromo-4-ethyl-2-methylhexanoic acid. (1 mark)

ii. 2,2-dimethylpropanedioic acid. (1 mark)

b. Draw the skeletal structure for each of the organic compounds below.

i. 2-bromo-3-methylpentanoic acid. (1 mark)

ii. 2-methylpropanoic acid. (1 mark)

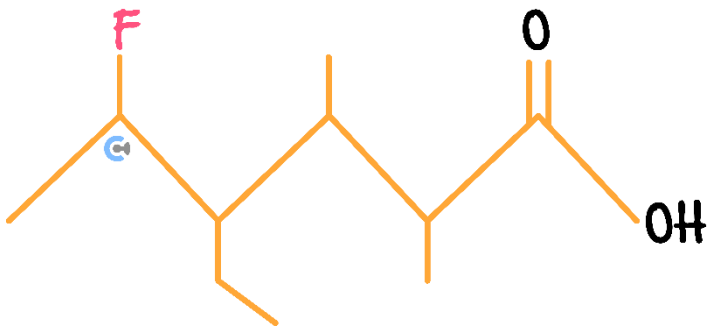
c. Draw the semi-structural formula for each of the organic compounds below.

i. 2-methylbutanoic acid. (1 mark)

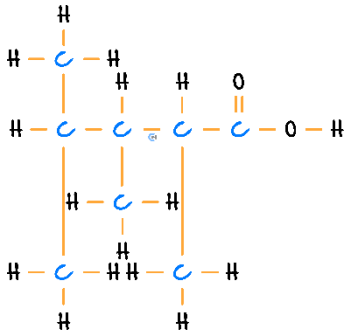
ii. 3-ethyl-4-iodopentanoic acid. (1 mark)

d. Name the following organic compounds:

i. (1 mark)



ii. (1 mark)



iii. HCOOH. (1 mark)

Question 13 (9 marks)

a. Draw the structural formula for each of the organic compounds below.

i. 3,3-dihydroxybutanoic acid. (1 mark)

ii. 4-bromo-2,4-dihydroxybuta-2,3-enoic acid. (1 mark)

b. Draw the skeletal structure for each of the organic compounds below.

i. 2-hydroxypropanedioic acid. (1 mark)

ii. 2-3-dihydroxy-4-methylpent-2-enoic acid. (1 mark)

c. Draw the semi-structural formula for each of the organic compounds below.

i. But-3-enoic acid. (1 mark)

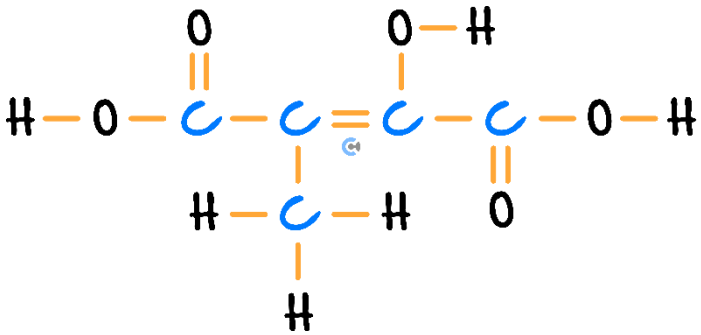
_____

ii. 2,2,3,3-tetrahydroxybutanedioic acid. (1 mark)

_____

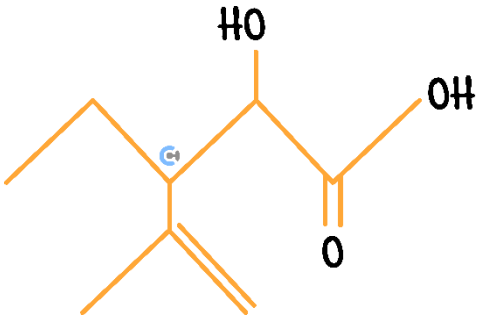
d. Name the following organic compounds.

i. (1 mark)



_____

ii. (1 mark)



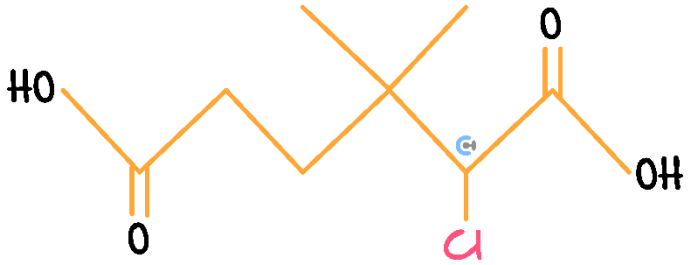
_____

iii. $CH_2CH\left(CH(OH)\right)_3COOH$. (1 mark)

_____

Question 14 (3 marks)

Elijah is studying an organic compound. The compound is shown below.



a. Draw the semi-structural formula for this organic compound. (1 mark)

_____

b. State the IUPAC name for this compound. (1 mark)

_____

c. Draw the structural formula for this organic compound. (1 mark)

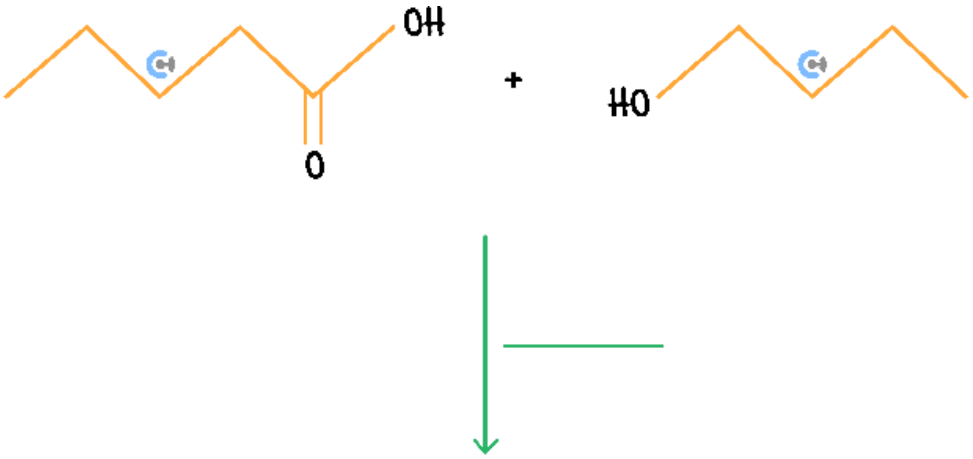
Question 15 (1 mark)

Draw the skeletal structure for methanoic acid.

Sub-Section [2.7.2]: Write Condensation Reactions for the Formation of Esters & Relevant Catalysts/Conditions

Question 16 (3 marks)

Complete the reaction below using the structural formula for all organic compounds. States are not required for organic compounds.



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Question 17 (4 marks)

a. Complete the esterification word equation below. States are not required. (2 marks)

$$\_\_\_\_\_ + \text{Alcohol} \xrightarrow{\text{catalyst}} \_\_\_\_\_ + \_\_\_\_\_$$

b. State the type of reaction in **part a.** (1 mark)

_____

c. State a suitable catalyst for this reaction. (1 mark)

_____

Question 18 (5 marks)

a. Complete the reaction below using the semi-structural formula for any organic compounds. States are not required for organic compounds. (2 marks)

$$\_\_\_\_\_ + \_\_\_\_\_ \xrightarrow{H_2SO_4(l)} CH_3CH_2CH_2CH_2COOCH_2CH_2CH_3 + H_2O(l)$$

b. Explain why the reaction above is called a 'condensation' reaction. (1 mark)

_____

_____

_____

c. State the function of H_2SO_4 in terms of esterification reactions. (1 mark)

_____

_____

d. Name the ester formed in **part a.** (1 mark)

_____

Question 19 (5 marks) **Extension.**

The reaction combining an alcohol and an acid to form an ester is known as a 'condensation' reaction and is reversible under the correct conditions. The reverse reaction separates an ester into an alcohol and an acid by adding water to the ester. This reaction is known as a 'hydrolysis' reaction.

a. Complete the hydrolysis reaction below using your knowledge of esterification reactions. States are not required. (2 marks)

$$CH_3CH_2CH_2CH_2COOCH_2CH_2CH_2CH_2CH_3 + H_2O(l) \xrightarrow{H_2SO_4(aq)} \_\_\_\_\_ + \_\_\_\_\_$$

b. Explain why this reaction is called a 'hydrolysis' reaction. (1 mark)

_____

_____

_____

c. State the purpose of H_2SO_4 in this reaction. (1 mark)

_____

d. State the IUPAC name of the ester being hydrolysed. (1 mark)

_____

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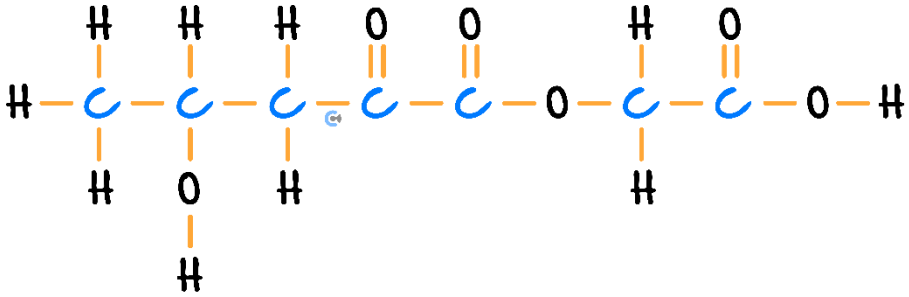
Sub-Section [2.7.3]: Apply IUPAC Conventions to Identify, Draw & Write IUPAC Names of Straight-Chained Esters

Question 20 (3 marks)

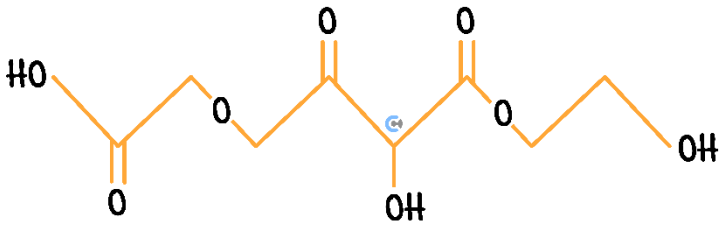
Circle the ester group in each of the following organic compounds.

a. (1 mark)



b. (1 mark)

c. (1 mark)



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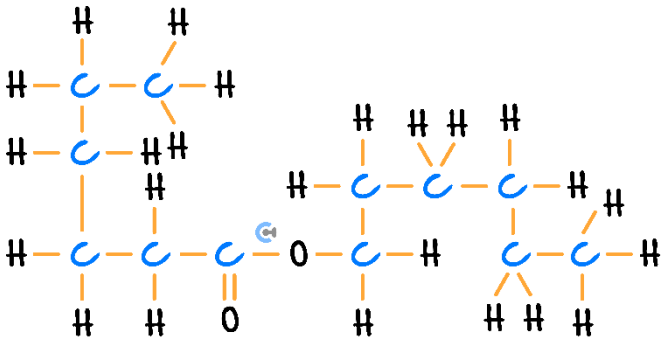
Question 21 (4 marks)

Identify the carboxylic acid and the alcohol that are reacted to form the following esters.

a. (1 mark)



b. $CH_3CH_2CH_2CH_2CH_2COOCH_3$. (1 mark)

c. (1 mark)

d. Propyl pentanoate. (1 mark)

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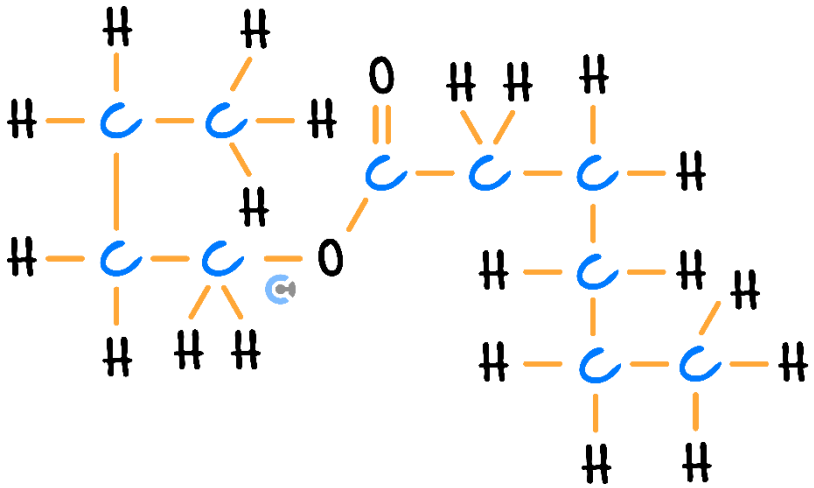
Question 22 (3 marks)

State the IUPAC names for the following organic compounds.

a. (1 mark)



b. $CH_3CH_2CH_2OCOCH_2CH_2CH_2CH_3$. (1 mark)

c. (1 mark)

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Question 23 (3 marks)

Methyl methanoate is also known as methyl formate. It is a colourless liquid and has an ethereal odour.

a. Draw the skeletal structure of methyl methanoate. (1 mark)

b. Draw the semi-structural formula for methyl methanoate. (1 mark)

_____

_____

c. Draw the structural formula for methyl methanoate. (1 mark)

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