

Demonstrate understanding of the properties of selected organic compounds

## WORKBOOK

Working to Excellence & NCEA Questions



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All NCEA answers  
can be found on  
C2.5 ppt





## Past NCEA questions Names and Structural Formula (ONE)

2013: Question 1d: Complete the following table to show the structural formula and IUPAC (systematic) name for each compound.

Structural formula	IUPAC (systematic) name
	pentanoic acid
	3-methylbut-1-ene
$\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$	
$\begin{array}{c} \text{CH}_3\text{CHCH}_2\text{OH} \\   \\ \text{Cl} \end{array}$	
$\begin{array}{c} \text{CH}_2\text{CHCH}_2\text{CH}_2\text{CH}_3 \\   \\ \text{CH}_3\text{CH}_3 \end{array}$	

Question 1b: Identify two molecules from the table in (a) that are constitutional (structural) isomers of each other. Justify your choice.

2014: Question: 1a: Draw a primary, a secondary, and a tertiary alcohol for the molecule  $\text{C}_5\text{H}_{11}\text{OH}$ .

2013: Question: 1a: (i) The structures of some organic compounds containing chlorine are shown below. Write the letter of the molecule that is a secondary chloroalkane. (ii) Describe why you chose the molecule

<b>A</b> $\begin{array}{c} \text{Cl} \\   \\ \text{CH}_3\text{CHCH}_2\text{CH}_3 \end{array}$	<b>B</b> $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$
<b>C</b> $\text{CH}_3\text{CH}_2\text{CHCCl}_2$	<b>D</b> $\text{CH}_3\text{CH}_2\text{CHCHCl}$
<b>E</b> $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHCl}_2$	<b>F</b> $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$

2014: Question: 2a: Complete the following table to show the structural formula and IUPAC (systematic) name for each compound.

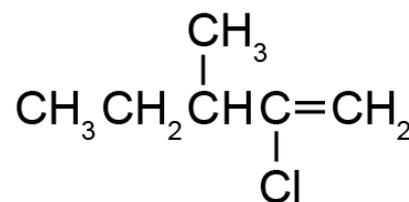
Structural formula	IUPAC (systematic) name
	But-1-yne
	2,2-dichloropentan-1-ol
$\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{NH}_2$	
$\begin{array}{c} \text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}-\text{CH}_2-\text{C}-\text{OH} \\   \qquad \qquad \qquad    \\ \text{CH}_3 \qquad \qquad \qquad \text{O} \end{array}$	
$\begin{array}{c} \text{CH}_3-\text{CH}-\text{CH}=\text{C}-\text{CH}_2-\text{CH}_3 \\   \qquad \qquad   \\ \text{Cl} \qquad \qquad \text{Cl} \end{array}$	



## Past NCEA questions Names and Structural Formula (TWO)

2015: Question: 1a: (ii) The organic compound, 4-chloro-3-methylpent-4-ene has been named incorrectly.

- Draw the implied structure and explain why it is named incorrectly.
- Give the correct IUPAC name for this structure



2015: Question: 1b: (i) Butan-1-ol has the molecular formula  $\text{C}_4\text{H}_{10}\text{O}$ . Its structural formula is:  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ . Define the term constitutional (structural) isomer.

2015: Question: 1b: (ii) Draw THREE other constitutional (structural) isomers of  $\text{C}_4\text{H}_{10}\text{O}$ .

2016: Question: 1a: (i) Complete the following table.

Structural formula	IUPAC (systematic) name
$\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\underset{\text{I}}{\text{CH}}-\text{CH}_3$	
	3-methylpentanoic acid
	but-1-yne
$\text{CH}_3-\text{CH}_2-\text{CH}_2-\underset{\text{H}}{\overset{\text{H}}{\text{N}}}$	

2016: Question: 1a: (ii) Draw and name the THREE constitutional (structural) isomers of the organic compound  $\text{C}_5\text{H}_{12}$ .

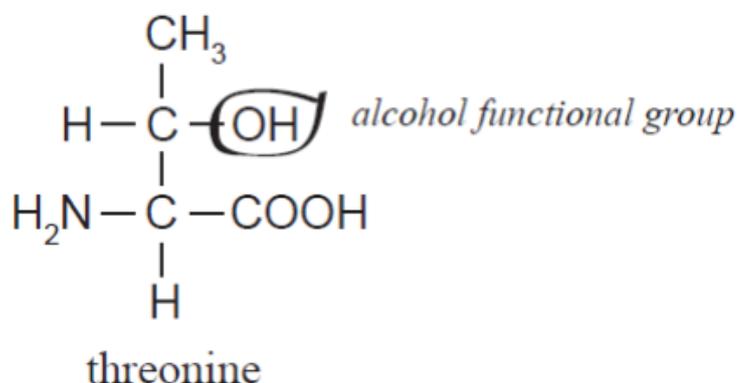
2016: Question: 1b: (i) Classify the following haloalkanes as primary, secondary or tertiary.

	Haloalkane	Classification
A	$\text{CH}_3-\text{CH}_2-\underset{\text{Cl}}{\overset{\text{CH}_3}{\text{C}}}-\text{CH}_2-\text{CH}_2-\text{CH}_3$	
B	$\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2-\underset{\text{Cl}}{\overset{\text{CH}_3}{\text{CH}}}-\text{CH}_2-\text{Cl}$	
C	$\text{CH}_3-\text{CH}_2-\underset{\text{Cl}}{\text{CH}}-\underset{\text{CH}_3}{\text{CH}}-\text{CH}_2-\text{CH}_3$	



## Past NCEA questions Names and Structural Formula (THREE)

2017: Question: 2a: The structure of a molecule of an organic compound, threonine, is shown below.



An alcohol functional group has been identified in the threonine molecule above.

- (i) Circle and name two other functional groups on the threonine molecule above.
- (ii) Classify the alcohol functional group as primary, secondary, or tertiary.
- (iii) Explain how you classified the alcohol group.

2017: Question: 2b: Name the organic compounds in the table below

Compound	IUPAC (systematic) name
$\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{C}\equiv\text{CH}$	
$\begin{array}{c} \text{CH}_3-\text{CH}-\text{CH}-\text{CH}_2-\text{CH}_2-\text{CH}_3 \\   \quad   \\ \text{Br} \quad \text{CH}_3 \end{array}$	
$\begin{array}{c} \text{OH} \quad \text{CH}_3 \\   \quad   \\ \text{CH}_3-\text{CH}_2-\text{CH}-\text{C}-\text{CH}_3 \\   \\ \text{CH}_3 \end{array}$	

2017: Question: 2c: (i) Draw four alkene isomers for the organic compound  $\text{C}_4\text{H}_8$  in a table below.

2018: Question: 1a: Complete the following table.

Compound	IUPAC (systematic name)
$\text{CH}_2=\text{CH}-\text{CH}_2-\text{CH}_2-\text{CH}_3$	
$\begin{array}{c} \text{CH}_3-\text{CH}-\text{CH}-\text{CH}_3 \\   \quad   \\ \text{CH}_3 \quad \text{OH} \end{array}$	
	2-hydroxypropanoic acid

2018: Question: 1b: Draw structural formulae for primary, secondary, and tertiary chloroalkane molecules that are constitutional (structural) isomers with the molecular formula  $\text{C}_4\text{H}_9\text{Cl}$ .



## Writing Excellence answers to Cis-Trans Isomers questions

## Cis-Trans Isomers QUESTION

Question: Molecule D can exist as geometric (*cis* and *trans*) isomers, with both isomers having the same molecular formula.

Draw the geometric (*cis* and *trans*) isomers for molecule D in the boxes below. Justify why molecule D can exist as geometric (*cis* and *trans*) isomers.

Your answer should include:

- an explanation of the requirements for *cis* and *trans* isomers
- reference to the structure of molecule D.

A	$\begin{array}{c} \text{Cl} \\   \\ \text{CH}_3\text{CHCH}_2\text{CH}_3 \end{array}$	B	$\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$
C	$\text{CH}_3\text{CH}_2\text{CHClCl}_2$	D	$\text{CH}_3\text{CH}_2\text{CHCHCl}$
E	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CHCl}_2$	F	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$

## ANSWER

	Cis	Trans
1. Draw the <i>cis</i> and <i>trans</i> isomers  If you need to select the molecule make sure that it has both: a C=C double bond and 2 different groups of each C		
	Name:	Name:
2. link the presence of a double C=C bond to lack of rotation		
3. link the requirement of two different groups of each of the C on the double		
4. link the requirements above to your specific molecule (D)		
5. Explain how two geometric isomers can have the same molecular formula		

NOTE: The white column is how your answer would appear on your test paper so make sure you write out complete sentences. The grey area is just to help you structure your answer and would not appear in the question.



## Past NCEA questions Cis-Trans Isomers (ONE)

2013: Question 1c: Molecule D can exist as geometric (*cis* and *trans*) isomers.

Draw the geometric (*cis* and *trans*) isomers for molecule D in the boxes below. Justify why molecule D can exist as geometric (*cis* and *trans*) isomers.

Your answer should include:

- an explanation of the requirements for *cis* and *trans* isomers
- reference to the structure of molecule D.

<b>A</b> $\begin{array}{c} \text{Cl} \\   \\ \text{CH}_3\text{CHCH}_2\text{CH}_3 \end{array}$	<b>B</b> $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$
<b>C</b> $\text{CH}_3\text{CH}_2\text{CHCl}_2$	<b>D</b> $\text{CH}_3\text{CH}_2\text{CHCHCl}$
<b>E</b> $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHCl}_2$	<b>F</b> $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$

2014: Question: 2b: The structures of three organic compounds are shown below. Explain why compound A can exist as geometric (*cis* and *trans*) isomers, but compounds B and C cannot.

In your answer you should: (i) draw the geometric (*cis* and *trans*) isomers of compound A

Compound A	$\text{CH}_3 - \text{CH}_2 - \text{CH} = \text{CH} - \text{CH}_3$
Compound B	$\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH} = \text{CH}_2$
Compound C	$\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$

2014: Question: 2b: (ii) explain the requirements for geometric (*cis* and *trans*) isomers by referring to compounds A, B, and C above

2015: Question: 2a: (ii) Explain why 1,1-dichloroethene cannot exist as a *cis-trans* isomer.

2015: Question: 2a: (iii) A structural isomer of 1,1-dichloroethene can exist as *cis-trans* isomers. Draw and name the *cis-trans* isomers.



## Past NCEA questions Cis-Trans Isomers (TWO)

2016: Question: 1c: Some alkenes are able to form *cis* and *trans* (geometric) isomers.

(i) Complete the names of structures A and B in the table below.

A	B
_____ 1,2-dibromoethene	_____ 1,2-dibromoethene

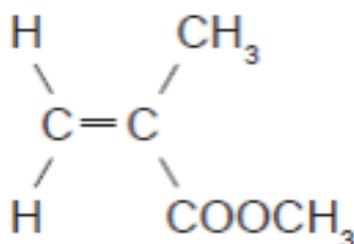
2016: Question: 1c: (ii) Elaborate on the structure of the organic compound 1,2-dibromoethene to explain why it is able to form *cis* and *trans* (geometric) isomers.

2017: Question: 2c: (ii) Identify the compounds that are *cis* and *trans* (geometric) isomers from the table above.

Justify your choices, and explain why only these two compounds are *cis* and *trans* (geometric) isomers.

	<b>cis</b>	<b>trans</b>
<b>Number</b>		

2018: Question: 1c: (ii) Justify whether or not the monomer used to produce Perspex® is a geometric (cis-trans) isomer by explaining the features required for this type of isomerism





## Writing Excellence answers to Physical Properties of Organic Compounds questions

## Solubility - Physical Properties of Organic Compounds QUESTION

Question: Explain why two layers form in Reaction One. Hexane reacts with bromine water

## ANSWER

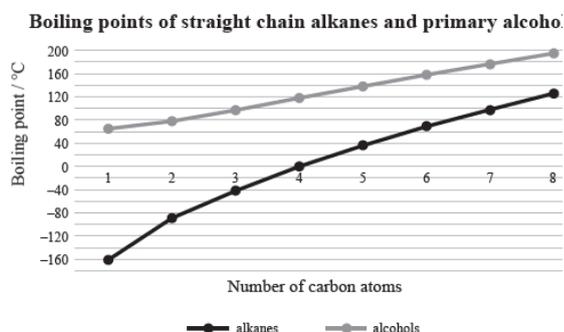
1. Identify the functional group of your substance (hexane) and name the product formed.

2. link observation (layers forming) to the polarity of the substance

3. identify the polarity of the bromine water and link to the substances being immiscible (forming 2 layers)

## Melting point - Physical Properties of Organic Compounds QUESTION

Question: Identify the trends shown on the graph. Identify which alkanes will be gases at room temperature (20°C) according to the graph beside.



## ANSWER

1. link the boiling point trend to number of carbons in both groups (when explaining trends on a line graph always relate one variable to the other)

2. Identify which alkanes (number of carbons) are gases at room temp. (will have boiling point below 20°C)

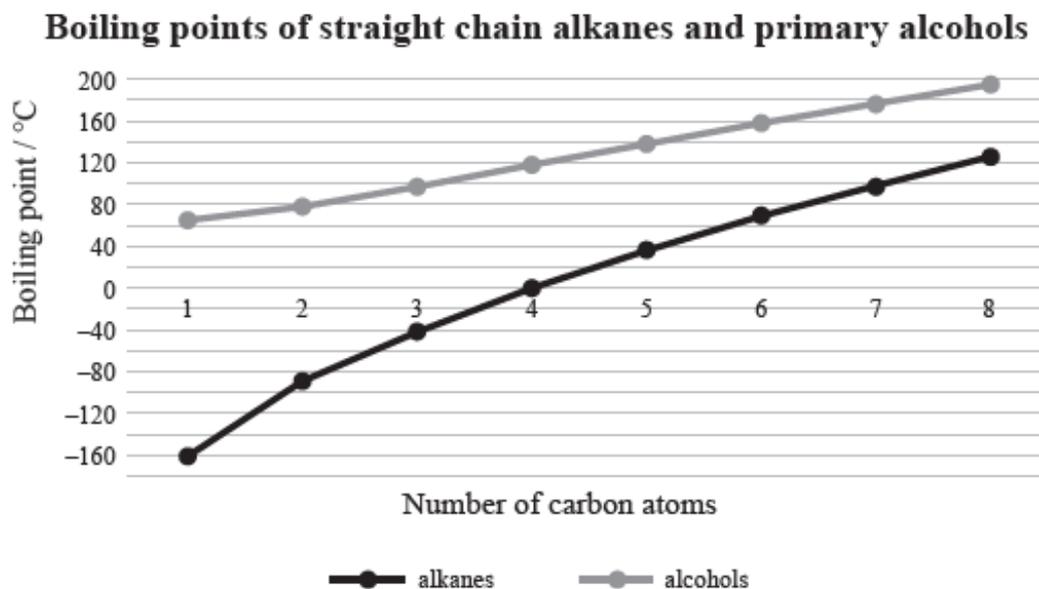
NOTE: The white column is how your answer would appear on your test paper so make sure you write out complete sentences. The grey area is just to help you structure your answer and would not appear in the question.



## Past NCEA questions Physical Properties of Organic Compounds

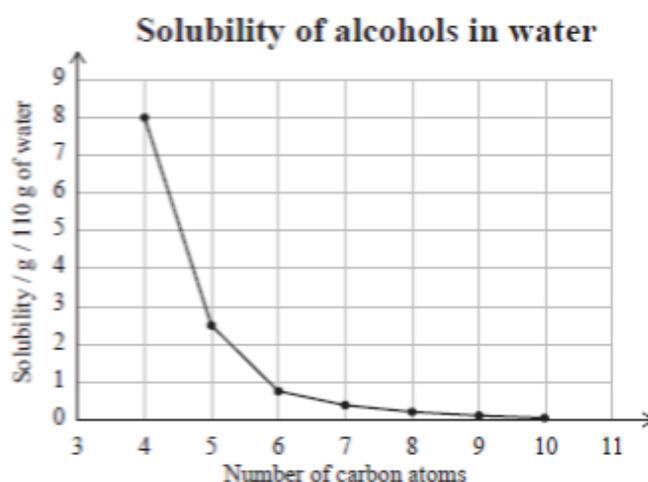
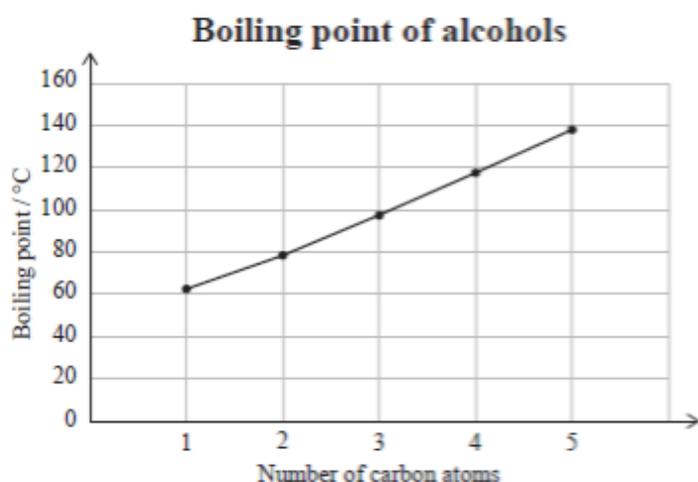
2014: Question 1c: Explain why two layers form in Reaction One. Hexane reacts with bromine water

2016: Question 2a (i): Identify the trends shown on the graph



2016: Question 2a (ii) Identify which alkanes will be gases at room temperature (20°C) according to the graph above.

2018: Question: 3a: The graphs below show trends in two physical properties of alcohols. Identify the trends shown on the graphs below





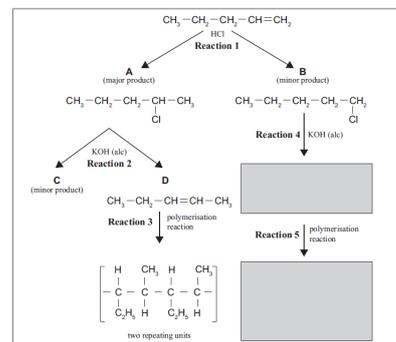
## Writing Excellence answers to Polymers questions

### Polymers QUESTION

Question: Draw TWO repeating units of the polymer formed in Reaction 1. Explain why the formation of the polymer from its monomer is classified as an addition polymerisation reaction.

Compare and contrast the polymer formed in Reaction 5 to the polymer formed in Reaction 3.

In your answer you should explain why the polymers formed in these two reactions are different.



### ANSWER

1. Identify the monomer, then draw the polymer  (identify C 1 and C2 in monomer either side of the double bond then draw a chain of C (4 for 2 repeating units) and add on groups of each one removing double bond)	monomer	polymer
2. explain the definition of addition polymerisation		
3. molecule 1 (reaction 5) – describe the 2 groups of each end of the double bonded carbons		
4. molecule 2 (reaction 3) – describe the 2 groups of each end of the double bonded carbons		
5. Explain that molecule 1 and 2 are structural isomers but have the same molecular formula		

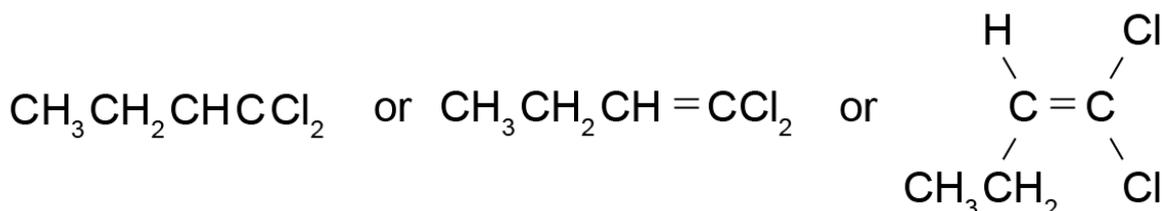


## Past NCEA questions Polymers (ONE)

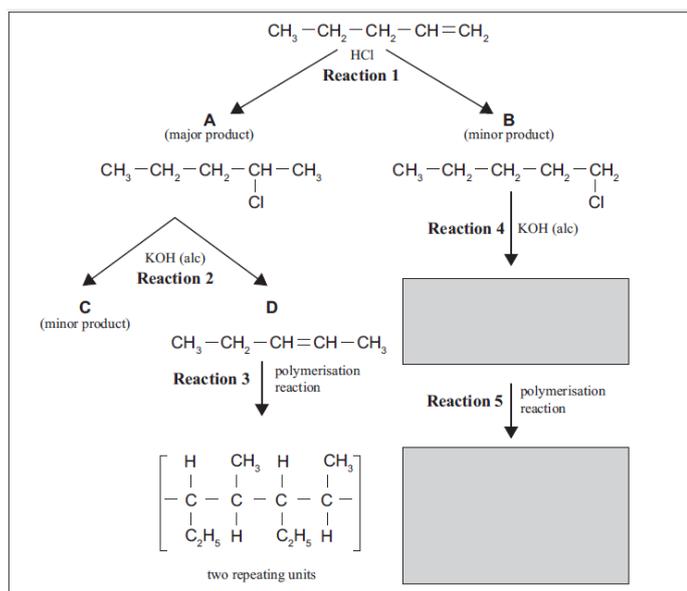
2013: Question: 2a: (i) The molecule tetrafluoroethene, shown below, is the monomer for the polymer commonly known as Teflon.  $\text{CF}_2=\text{CF}_2$

□ Draw TWO repeating units of the polymer formed.

2013: Question: 2a: (ii) The following diagram shows three repeating sections of another polymer. Draw the structural formula of the monomer molecule used to make this polymer.



2014: Question: 3c: (i) Draw TWO repeating units of the polymer formed in Reaction 5.



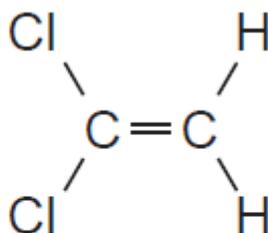
2014: Question: 3c: (ii) Compare and contrast the polymer formed in Reaction 5 to the polymer formed in Reaction 3.

In your answer you should explain why the polymers formed in these two reactions are different.

2014: Question: 3c: (ii) Compare and contrast the polymer formed in Reaction 5 to the polymer formed in Reaction 3. In your answer you should explain why the polymers formed in these two reactions are different.

2015: Question: 2a: (i) Cling Wrap is a polymer that can be made from the monomer 1,1-dichloroethene.

□ Draw THREE repeating units of the polymer formed.

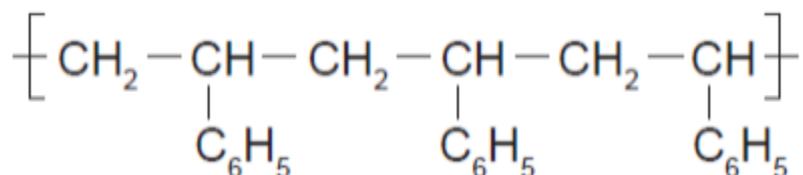


1,1-dichloroethene



## Past NCEA questions Polymers (TWO)

2016: Question 3b: Polystyrene is a polymer with the structure:

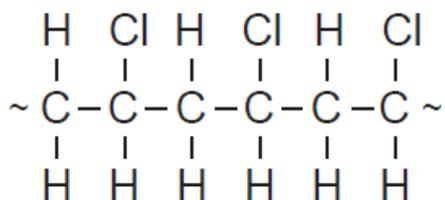


(i) Draw the monomer used to make the polymer polystyrene.

2016: Question 3b: (ii) Explain why the formation of polystyrene from its monomer is classified as an addition polymerisation reaction.

2017: Question 1a: Polyvinyl chloride (polychloroethene) is often used to make artificial leather. This can then be used to cover chairs, cover car seats, and make clothing.

A section of a polyvinyl chloride molecule is shown below.



(i) Draw the monomer from which the polymer polyvinyl chloride would be made.

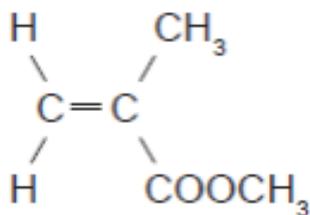
2017: Question 1a: (ii) Explain the difference in the structures and chemical reactivity of the monomer and polymer, and why the difference is important for the uses of the polymer.

2017: Question 1a (iii): Making polyvinyl chloride (polychloroethene) from its monomer is called 'addition polymerisation'.

Explain the term 'addition polymerisation' using polyvinyl chloride as an example.

Include an equation in your answer.

2018: Question: 1c: Perspex® is a polymer used as an alternative to glass as it is transparent, lightweight, and shatter resistant. It can be made from the monomer shown below.



(i) In the box below, draw THREE repeating units of the polymer formed.



## Writing Excellence answers to Haloalkane Reactions questions

## Haloalkane Reactions QUESTION

Question: Chloroethane,  $\text{CH}_3\text{CH}_2\text{Cl}$ , reacts with aqueous KOH, alcoholic KOH, and with  $\text{NH}_3$ . Compare and contrast the reactions of chloroethane with the three reagents.

In your answer you should include:

- the type of reaction occurring and the reason why it is classified as that type
- the type of functional group formed
- equations showing structural formulae for reactions occurring.

## ANSWER

Reaction 1 Chloroethane reacts with $\text{KOH}_{(\text{aq})}$	Product formed
	Reaction type
	Condensed Structural Formula equation
	Structural Formula equation
Reaction 2 Chloroethane reacts with $\text{KOH}_{(\text{alc})}$	Product formed
	Reaction type
	Condensed Structural Formula equation
	Structural Formula equation
Reaction 3 Chloroethane reacts with $\text{NH}_3_{(\text{alc})}$	Product formed
	Reaction type
	Condensed Structural Formula equation
	Structural Formula equation

NOTE: The white column is how your answer would appear on your test paper so make sure you write out complete sentences. The grey area is just to help you structure your answer and would not appear in the question.



## Writing Excellence answers to Alcohol Reactions questions

## Alcohol Reactions QUESTION

Question: Butan-1-ol can react separately with each of  $\text{PCl}_5$ ,  $\text{Cr}_2\text{O}_7^{2-} / \text{H}^+$ , and concentrated  $\text{H}_2\text{SO}_4$ . Elaborate on the reactions of butan-1-ol with each of the three reagents.

For each reaction, your answer should include:

- the type of reaction occurring and the reason why it is classified as that type
- the name of the functional group formed in each product
- the structural formula of the organic product.

## ANSWER

Reaction 1 Butan-1-ol reacts with $\text{PCl}_5$	Product formed
	Reaction type
	Condensed Structural Formula equation
	Structural Formula equation
Reaction 2 Butan-1-ol reacts with $\text{Cr}_2\text{O}_7^{2-} / \text{H}^+$	Product formed
	Reaction type
	Condensed Structural Formula equation
	Structural Formula equation
Reaction 3 Butan-1-ol reacts with concentrated $\text{H}_2\text{SO}_4$	Product formed
	Reaction type
	Condensed Structural Formula equation
	Structural Formula equation

NOTE: The white column is how your answer would appear on your test paper so make sure you write out complete sentences. The grey area is just to help you structure your answer and would not appear in the question.



## Writing Excellence answers to Alkene Reactions questions

## Alkene Reactions QUESTION

Question: Ethene,  $C_2H_4(g)$ , reacts with aqueous potassium permanganate solution,  $KMnO_4(aq)$ , dilute acid,  $H_2O / H^+$ , and hydrogen bromide,  $HBr$ .

Compare and contrast the reactions of ethene gas with each of these three reagents.

In your answer, you should:

- describe any observations that can be made
- identify, with reasons, the type of reaction ethene undergoes with each reagent
- describe the functional group of the products formed
- include equations showing the structural formulae for the organic compounds for each reaction.

## ANSWER

Reaction 1 Ethene, $C_2H_4(g)$ reacts with aqueous potassium permanganate solution, $KMnO_4(aq)$ ,	Observations
	Reaction type
	Functional group of products
	Structural Formula equation
Reaction 2 Ethene, $C_2H_4(g)$ reacts with dilute acid, $H_2O / H^+$	Observations
	Reaction type
	Functional group of products
	Structural Formula equation
Reaction 3 Ethene, $C_2H_4(g)$ reacts with hydrogen bromide, $HBr$ .	Observations
	Reaction type
	Functional group of products
	Structural Formula equation
Summary of the three reactions	



## Past NCEA questions Comparing Reactions (ONE)

2012: Question 2d: Chloroethane,  $\text{CH}_3\text{CH}_2\text{Cl}$ , reacts with aqueous KOH, alcoholic KOH, and with  $\text{NH}_3$ . Compare and contrast the reactions of chloroethane with the three reagents.

In your answer you should include:

- the type of reaction occurring and the reason why it is classified as that type
- the type of functional group formed
- equations showing structural formulae for reactions occurring.

2013: Question 3a: Butan-1-ol can react separately with each of  $\text{PCl}_5$ ,  $\text{Cr}_2\text{O}_7^{2-} / \text{H}^+$ , and concentrated  $\text{H}_2\text{SO}_4$ .

Elaborate on the reactions of butan-1-ol with each of the three reagents.

For each reaction, your answer should include:

- the type of reaction occurring and the reason why it is classified as that type
- the name of the functional group formed in each product
- the structural formula of the organic product.

2014: Question: 1c: The reactions shown below are all classified as being the same type of reaction. Compare and contrast these reactions.

In your answer you should:

- state whether any conditions are required
- describe the type of reaction occurring and explain why all three reactions are classified as this type of reaction
- explain why two layers form in Reaction One.

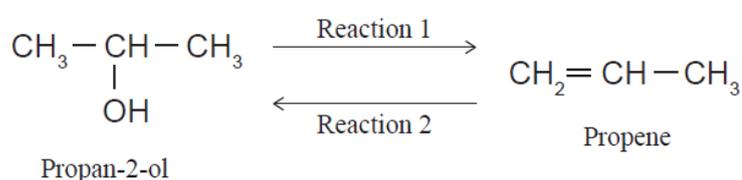
<b>Reaction One</b>	hexane, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ , reacts with bromine water, $\text{Br}_2(\text{aq})$
<b>Reaction Two</b>	hexan-1-ol, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ , reacts with $\text{PCl}_3$
<b>Reaction Three</b>	1-chlorohexane, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$ , reacts with conc $\text{NH}_3$ (alc)

2015: Question: 2b: In Reaction 1, propan-2-ol can be converted to propene.

In Reaction 2, propene can be converted back to propan-2-ol.

Analyse BOTH of these reactions by:

- describing the reagents and conditions needed for each reaction to occur
- identifying each type of reaction and explaining your choice
- explaining why Reaction 1 forms only a single organic product, but Reaction 2 forms a mixture of organic products.





## Past NCEA questions Comparing Reactions (TWO)

2015: Question: 3b: Ethene,  $C_2H_4(g)$ , reacts with aqueous potassium permanganate solution,  $KMnO_4(aq)$ , dilute acid,  $H_2O / H^+$ , and hydrogen bromide,  $HBr$ .

Compare and contrast the reactions of ethene gas with each of these three reagents.

In your answer, you should:

- describe any observations that can be made
- identify, with reasons, the type of reaction ethene undergoes with each reagent
- describe the functional group of the products formed
- include equations showing the structural formulae for the organic compounds for each reaction.

2016: Question 2c: Ethane gas,  $C_2H_6(g)$ , and ethene gas,  $C_2H_4(g)$ , will both react with bromine water,  $Br_2(aq)$ .

Compare and contrast these two reactions.

In your answer you should refer to:

- any conditions required
- the observations made
- the types of reactions occurring
- structural formulae of the organic products formed.

2018: Question: 3b: Reacting 2-chloropropane with potassium hydroxide,  $KOH$ , can produce different products due to different reactions occurring.

(i) Elaborate on the reactions of 2-chloropropane with potassium hydroxide,  $KOH$ .

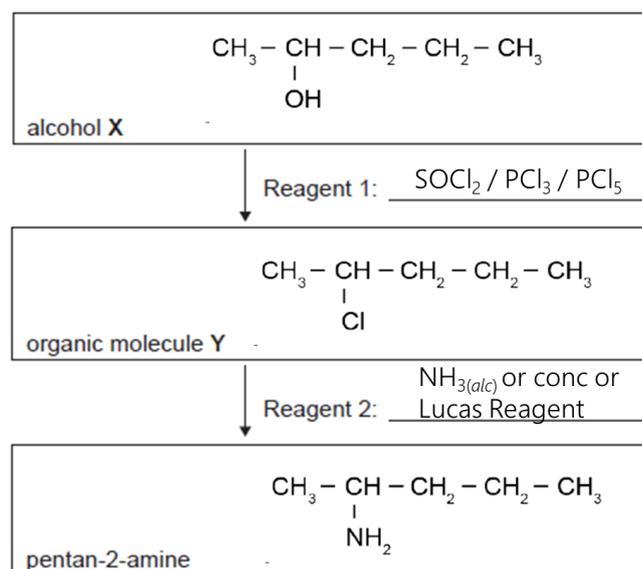
In your answer you should:

- identify the conditions of the reagent  $KOH$
- explain the types of reaction that occur with the reagent in each condition
- draw structural formulae of the organic products.

2018: Question: 2c: (ii) Elaborate on the reactions in the scheme below.

In your answer you should identify:

- any conditions needed for each step of the conversion
- the names of alcohol X and organic molecule Y
- the type of reaction that is occurring for each step of the conversion.





## Writing Excellence answers to Major and Minor products questions

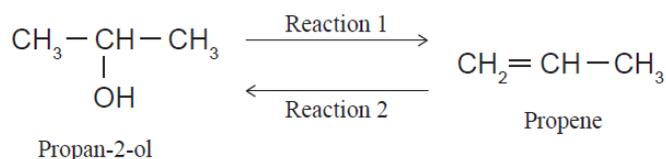
## Major and Minor Products QUESTION

Question: In Reaction 1, propan-2-ol can be converted to propene.

In Reaction 2, propene can be converted back to propan-2-ol.

Analyse BOTH of these reactions by:

- describing the reagents and conditions needed for each reaction to occur
- identifying each type of reaction and explaining your choice
- explaining why Reaction 1 forms only a single organic product, but Reaction 2 forms a mixture of organic products.



## ANSWER

1. Reaction 1 Propan – 2-ol forms propene	Reagent and conditions	
	Reaction type	
	Structural Formula	
2. Reaction 2 Propene forms propanol  Label each structure with name and whether it is major or minor	Reagent type and conditions	
	Reaction type	
	Structural Formula	
	Product type: Name:	Product type: Name:
3. Explain why <u>reaction one</u> forms only one product linked to symmetry		
4. State Markovnikov's rule AND Explain the reason <u>reaction two</u> produces two products linked to Markovnikov's rule and asymmetry, including which is major and which is minor.		

NOTE: The white column is how your answer would appear on your test paper so make sure you write out complete sentences. The grey area is just to help you structure your answer and would not appear in the question.





## Writing Excellence answers to Acid-Base Reactions questions

## Acid-Base Reactions QUESTION

Question: Question 3c: Compounds B ( $\text{CH}_3\text{COOH}$ ) and E ( $\text{CH}_3\text{CH}_2\text{NH}_2$ ) react together.

(i) Write a balanced equation for the reaction that occurs between compounds B and E.

(ii) Identify the type of reaction that occurs between compounds B and E.

Justify your answer.

## ANSWER

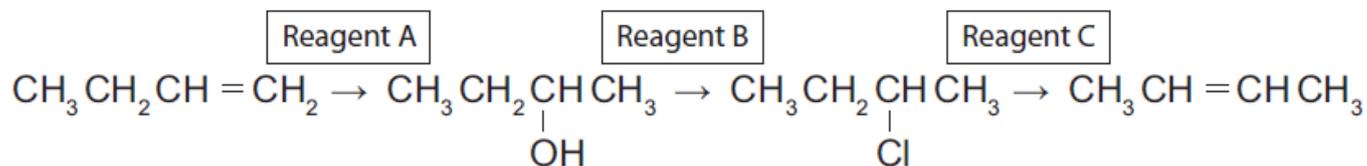
1. Draw the structural formula of the acid and base  Identify which hydrogen ion will be donated in the acid (-COOH end) and which part of the base will accept the hydrogen ion (-NH <sub>2</sub> end)	Acid (carboxylic acid)	Base (amine)
2. Write a balanced equation		
3. Name the type of reaction		
4. Explain what occurs in the reaction generally		
5. Explain in detail what occurs in the acid – and the product formed		
5. Explain in detail what occurs in the base – and the product formed		

**NOTE:** The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.



## Past NCEA questions Reaction Schemes (ONE)

2013: Question 3a: The flow diagram below shows a reaction scheme for the conversion of but-1-ene into but-2-ene.



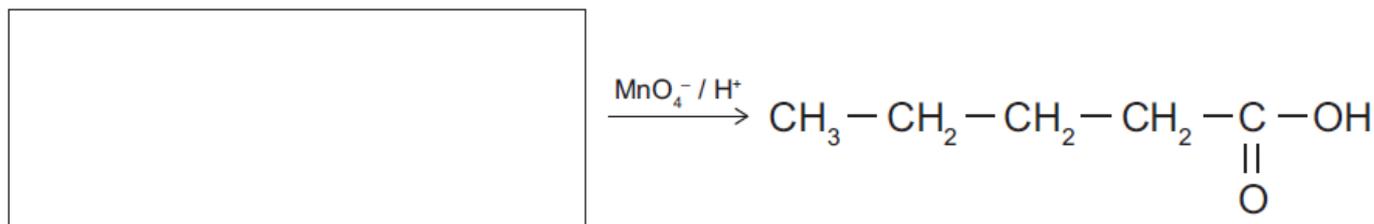
Use the reaction scheme above to complete the following table to show:

- the formula of each reagent, including any necessary conditions
- the type of reaction occurring.

Reagent	Formula of reagent / conditions	Type of reaction
A		
B		
C		

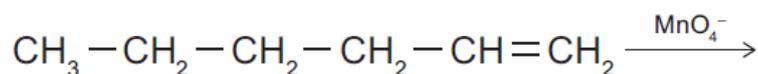
2014: Question: 1b: (i) When primary alcohols are oxidised by acidified permanganate,  $\text{MnO}_4^- / \text{H}^+$ , they form carboxylic acids.

Draw the primary alcohol that was oxidised to form the carboxylic acid shown



2014: Question: 1b: (ii) Permanganate ion,  $\text{MnO}_4^-$ , can be used to oxidise alkenes.

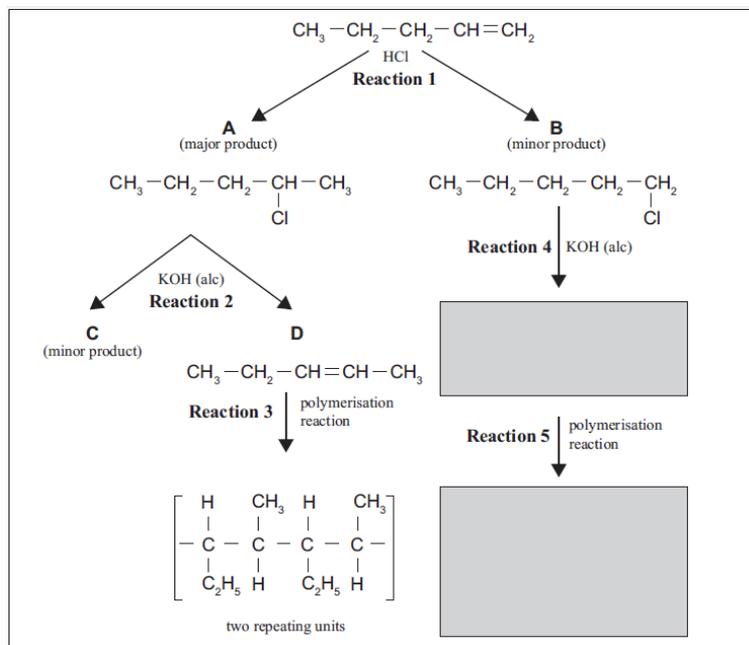
- Draw the product of the following reaction





## Past NCEA questions Reaction Schemes (TWO)

2014: Question: 3a: (i) Explain why Reaction 1 from the reaction scheme, shown again below, is classified as an addition reaction.



2014: Question: 3b: (i) Explain why Reaction 2 from the reaction scheme is classified as an elimination reaction.

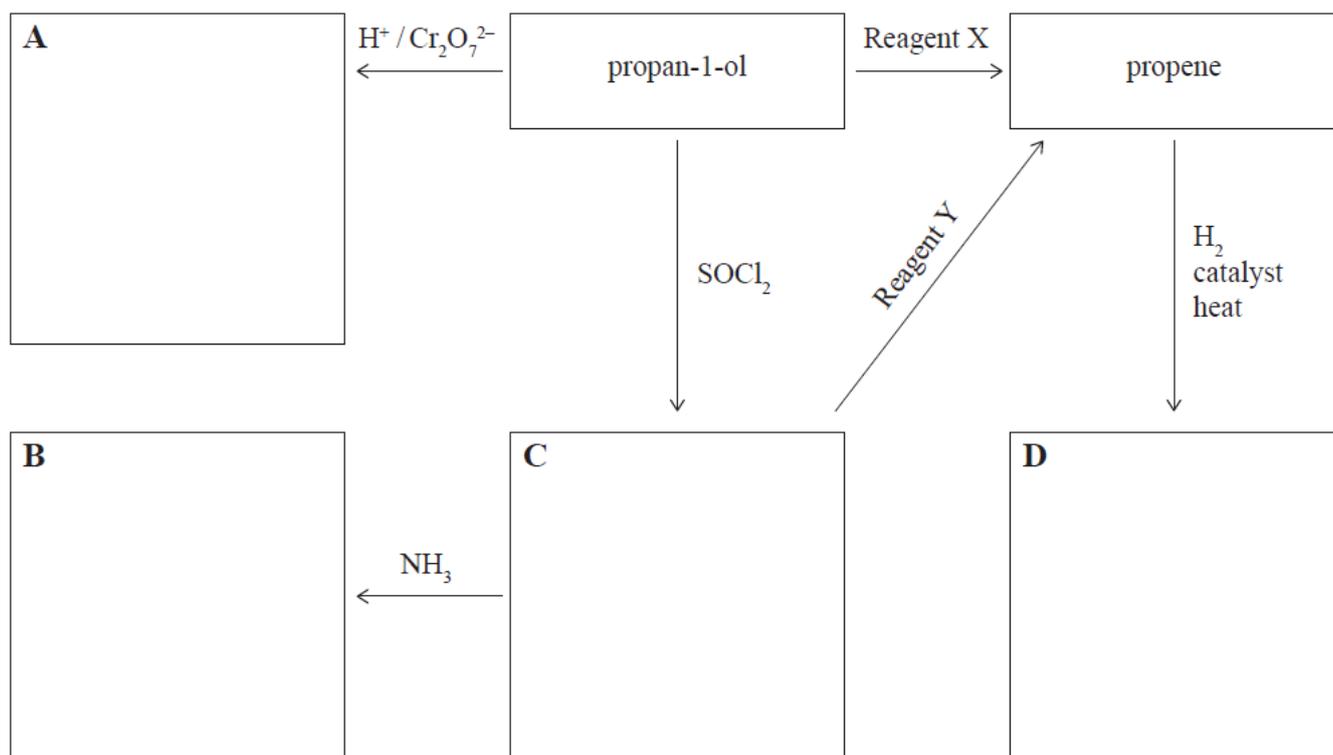
2014: Question: 3b: (ii) Reaction 4 is also an elimination reaction.

- Draw the structural formula of the product formed

2015: Question: 3a: (i) Complete the scheme above by drawing the structural formulae of the organic compounds A to D.

(ii) Circle the functional group of each of the organic compounds A, B, and C that you have drawn.

(iii) Identify reagents X and Y.

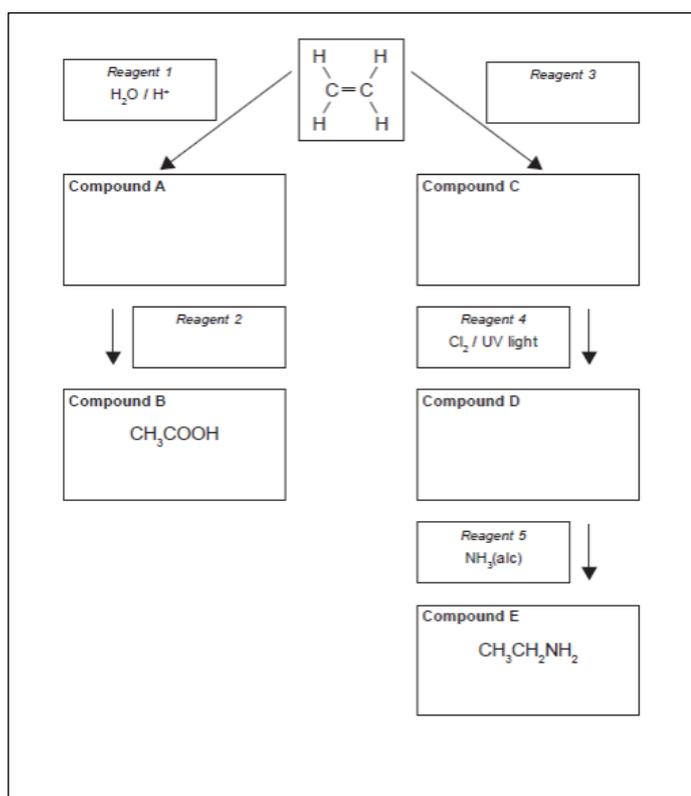
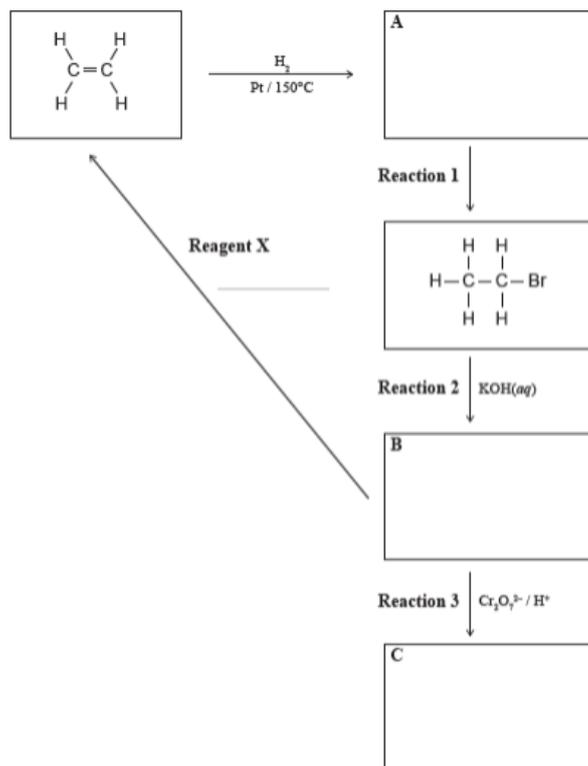




## Past NCEA questions Reaction Schemes (THREE)

2016: Question 3a (i): Complete the following chart to the right by drawing the structural formulae for the organic compounds A, B, and C and identifying reagent X.

2016: Question 3a (ii): Identify the type of organic reaction occurring in each of Reactions 1, 2, and 3.



2017: Question 3a: (i) Complete the following reaction scheme to the left by drawing the structural formulae for the organic compounds A, C, and D, and identifying *reagents 2 and 3*.

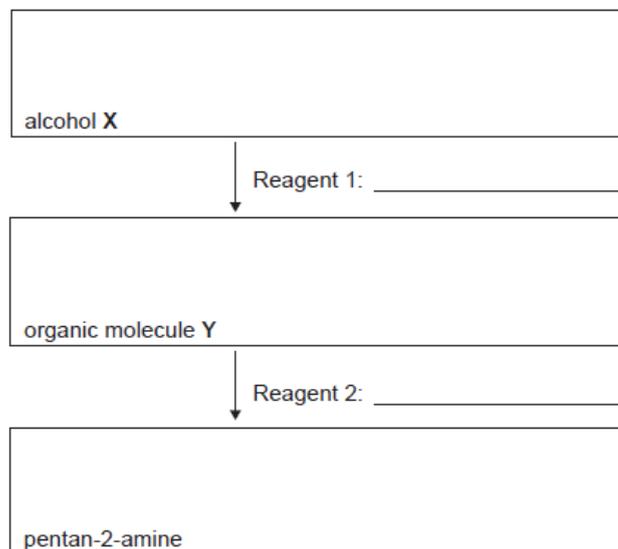
2017: Question 3a: (ii) Identify the types of reactions that occur to produce compounds A, B, C, D, and E:

2018: Question: 2c: Many organic reactions take more than one step in order to convert from one organic molecule to another.

Two steps are required to produce pentan-2-amine from an alcohol.

Use the information given to analyse the reactions.

(i) Draw the structural formulae of the compounds, and name the reagents involved in the process.





## Writing Excellence answers to Identifying Unknowns questions

## Identifying Unknowns QUESTION

Question: Question: 1c:

Four separate colourless organic liquids are known to be: • ethanol • ethanoic acid • hex-2-ene • 1-aminohexane

Write a procedure to identify each of these organic liquids using only the reagents listed below.

• acidified dichromate solution,  $\text{Cr}_2\text{O}_7^{2-} / \text{H}^+_{(aq)}$  • bromine water,  $\text{Br}_{2(aq)}$  • sodium carbonate solution,  $\text{Na}_2\text{CO}_{3(aq)}$ .

In your answer, you should:

- identify the test reagents used
- describe any observations that would be made
- identify the type of reaction that occurs
- identify the organic product of any reaction.

You do not need to include equations in your answer.

## ANSWER

Step 1	Test reagents used
	Observations
	Type of reaction that occurs
	Organic product of any reaction
Step 2	Test reagents used
	Observations
	Type of reaction that occurs
	Organic product of any reaction
Step 3.	Test reagents used
	Observations
	Type of reaction that occurs
	Organic product of any reaction
Step 4.	Test reagents used
	Observations
	Type of reaction that occurs
	Organic product of any reaction

NOTE: The white column is how your answer would appear on your test paper so make sure you write out complete sentences. The grey area is just to help you structure your answer and would not appear in the question.



## Past NCEA questions Identifying Unknowns

2013: Question 2b: Five separate colourless organic liquids are known to be:

pentan-1-ol    ethanol    pent-1-ene    pentane    ethanamine.

Write a valid method to show how each of these liquids can be identified using only water, litmus paper, and bromine water,  $\text{Br}_{2(aq)}$ . Your method should allow another student to identify these liquids, and include: the reagent used and any observations made.

2015: Question 1c: Four separate colourless organic liquids are known to be:

• ethanol • ethanoic acid • hex-2-ene • hexan-1-amine (1-aminohexane).

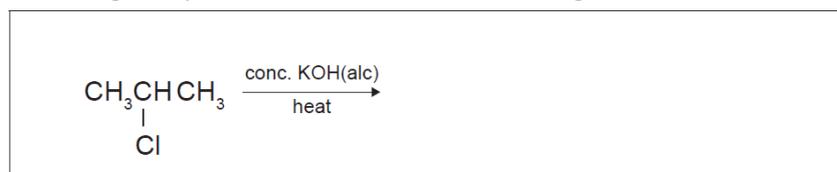
Write a procedure to identify each of these organic liquids using only the reagents listed below.

• acidified dichromate solution,  $\text{Cr}_2\text{O}_7^{2-} / \text{H}^+_{(aq)}$  • bromine water,  $\text{Br}_{2(aq)}$  • sodium carbonate solution,  $\text{Na}_2\text{CO}_{3(aq)}$ .

In your answer, you should: • identify the test reagents used • describe any observations that would be made • identify the type of reaction that occurs • identify the organic product of any reaction.

You do not need to include equations in your answer.

2017: Question 1b: A chemistry class was learning about the chemistry of haloalkanes. They were researching the effect of heat and concentrated potassium hydroxide in ethanol, conc.  $\text{KOH(alc)}$ , on the haloalkane 2-chloropropane. (i) Draw the organic product formed in the following reaction.



2017: Question 1b: (ii) Explain how the functional group of the organic product drawn above could be identified.

2018: Question: 2a: Two bottles of different colourless organic liquids are unlabelled. They are known to be propan-1-amine,  $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$ , and ethanoic acid,  $\text{CH}_3\text{COOH}$ .

(i) Explain how you could identify these two liquids using only solid sodium hydrogen carbonate,  $\text{NaHCO}_{3(s)}$ .

2018: Question: 2b: Three more unlabelled bottles of colourless organic liquids are known to contain hexane, hex-1-ene, and ethanol. Write a procedure to identify each of these liquids using only bromine water,  $\text{Br}_{2(aq)}$ , and water,  $\text{H}_2\text{O}$ . In your answer you should explain any observations that would be made.

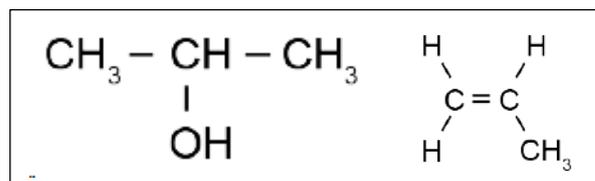
You do not need to include equations in your answer.

2018: Question: 3b: (ii) Elaborate on chemical tests that could be used to identify the functional groups of the organic products formed in part (i).

In your answer, you should:

- identify chemicals and conditions required
- describe any observations
- state the type of reaction occurring

• explain why potassium permanganate solution,  $\text{KMnO}_4(aq)$ , cannot be used to distinguish between these organic products.





## Writing Excellence answers to Cis-Trans Isomers questions

## Cis-Trans Isomers QUESTION

Question: Molecule D can exist as geometric (*cis* and *trans*) isomers, with both isomers having the same molecular formula.

Draw the geometric (*cis* and *trans*) isomers for molecule D in the boxes below. Justify why molecule D can exist as geometric (*cis* and *trans*) isomers.

Your answer should include:

- an explanation of the requirements for *cis* and *trans* isomers
- reference to the structure of molecule D.

A	$\begin{array}{c} \text{Cl} \\   \\ \text{CH}_3\text{CHCH}_2\text{CH}_3 \end{array}$	B	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$
C	$\text{CH}_3\text{CH}_2\text{CHClCl}_2$	D	$\text{CH}_3\text{CH}_2\text{CHCHCl}$
E	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CHCl}_2$	F	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$

## ANSWER

1. Draw the <i>cis</i> and <i>trans</i> isomers	<p>Cis</p> $\begin{array}{ccc} \text{H} & \text{H} & \\   &   & \\ \text{C} & = & \text{C} \\   &   & \\ \text{Cl} & & \text{CH}_2\text{CH}_3 \end{array} \quad \textit{cis}$ <p>Name: <i>cis</i> 1-chlorobut-1-ene</p>	<p>Trans</p> $\begin{array}{ccc} \text{H} & \text{CH}_2\text{CH}_3 & \\   &   & \\ \text{C} & = & \text{C} \\   &   & \\ \text{Cl} & & \text{H} \end{array} \quad \textit{trans}$ <p>Name: <i>trans</i> 1-chlorobut-1-ene</p>
2. link the presence of a double C=C bond to lack of rotation	For <i>cis</i> and <i>trans</i> isomers to occur a carbon-carbon double bond must be present as this prevents any rotation about this bond, and the atoms or groups of atoms attached to the two carbon atoms are therefore fixed in position.	
3. link the requirement of two different groups of each of the C on the double	They must also have two different groups attached to each carbon (involved in the double bond).	
4. link the requirements above to your specific molecule (D)	This molecule has a carbon-carbon double bond. One carbon of the double bond is attached to a hydrogen atom and an ethyl group. The other is attached to a hydrogen atom and a chlorine atom.	
5. Explain how two geometric isomers can have the same molecular formula	When these two requirements are met, the two haloalkenes can have the same molecular formula and the same sequence of atoms in the formula, but a different arrangement in space (a different 3D formula), hence they are <i>cis</i> and <i>trans</i> isomers.	

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.



## Writing Excellence answers to Physical Properties questions

## Solubility - Physical Properties of Organic Compounds QUESTION

Question: Explain why two layers form in Reaction One. Hexane reacts with bromine water

## ANSWER

1. Identify the functional group of your substance (hexane) and name the product formed.

Hexane is an alkane, with single bonded carbons. When reacting with bromine water it will form a haloalkane (bromohexane) during a substitution reaction

2. link observation (layers forming) to the polarity of the substance

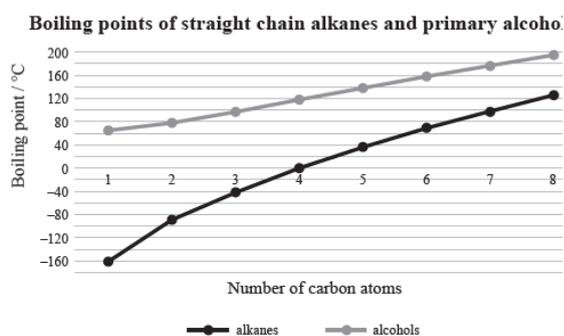
Two layers form in Reaction One as hexane is non-polar and the product (bromohexane) is effectively also non-polar.

3. identify the polarity of the bromine water and link to the substances being immiscible (forming 2 layers)

The water from the bromine water is polar and therefore the non-polar organic reactant and product will not dissolve in the water; because of this, two layers form as this polar and non-polar layer do not mix.

## Melting point - Physical Properties of Organic Compounds QUESTION

Question: Identify the trends shown on the graph. Identify which alkanes will be gases at room temperature (20°C) according to the graph beside.



## ANSWER

1. link the boiling point trend to number of carbons in both groups (when explaining trends on a line graph always relate one variable to the other)

The boiling points of both alkanes and alcohols increase as the number of C atoms increases. The boiling points of alcohols are always higher than the alkanes (with the same number of C atoms).

2. Identify which alkanes (number of carbons) are gases at room temp. (will have boiling point below 20°C)

Alkanes with 1, 2, 3, and 4 C atoms (methane, ethane, propane, and butane) will be gases at room temperature.



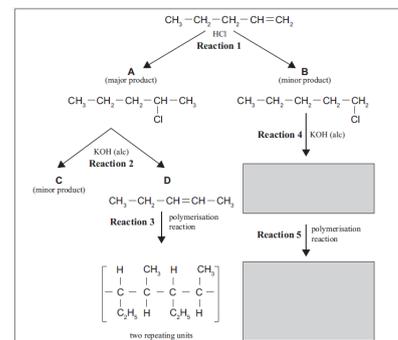
## Writing Excellence answers to Polymers questions

## Polymers QUESTION

Question: Draw TWO repeating units of the polymer formed in Reaction 1. Explain why the formation of the polymer from its monomer is classified as an addition polymerisation reaction.

Compare and contrast the polymer formed in Reaction 5 to the polymer formed in Reaction 3.

In your answer you should explain why the polymers formed in these two reactions are different.

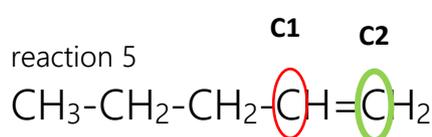


## ANSWER

1. Identify the monomer, then draw the polymer

(identify C 1 and C2 in monomer either side of the double bond then draw a chain of C (4 for 2 repeating units) and add on groups of each one removing double bond)

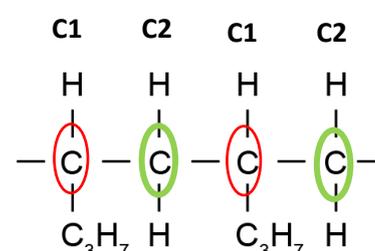
monomer



reaction 3



polymer



2. explain the definition of addition polymerisation

Since the monomer for this reaction is an alkene, when polymerisation occurs, the double bond in each alkene molecule is broken, freeing up a bonding space on each of the C atoms that was part of the double bond. This allows the monomers to join together by forming covalent bonds to make the polymer.

Since double bonds in the alkene are being broken and molecules added into the freed up bonding spaces to make the monomer, this is an addition reaction.

Polymerisation reactions occur when many monomers are chemically joined.

3. molecule 1 (reaction 5) – describe the 2 groups of each end of the double bonded carbons

In Reaction 3, the polymer formed will have a carbon with one hydrogen and a methyl group, and a carbon with one hydrogen and an ethyl group, as its repeating unit, due to the double bond being on the C2 position.

4. molecule 2 (reaction 3) – describe the 2 groups of each end of the double bonded carbons

In Reaction 5, since the double bond is in a different position (the C1 position), the polymer formed will have as its repeating unit a carbon atom with 2 hydrogen atoms attached, and a carbon atom with one hydrogen attached and a propyl group attached.

5. Explain that molecule 1 and 2 are structural isomers but have the same molecular formula

The molecular formulae of the two repeating units of both polymers are the same, but the structural formulae are different. (States repeating units are structural isomers.)



## Writing Excellence answers to Haloalkane reactions questions

## Haloalkane reactions QUESTION

Question: Chloroethane,  $\text{CH}_3\text{CH}_2\text{Cl}$ , reacts with aqueous  $\text{KOH}$ , alcoholic  $\text{KOH}$ , and with  $\text{NH}_3$ . Compare and contrast the reactions of chloroethane with the three reagents.

In your answer you should include:

- the type of reaction occurring and the reason why it is classified as that type
- the type of functional group formed
- equations showing structural formulae for reactions occurring.

## ANSWER

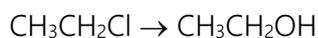
## Reaction 1

Chloroethane reacts with  $\text{KOH}_{(\text{aq})}$

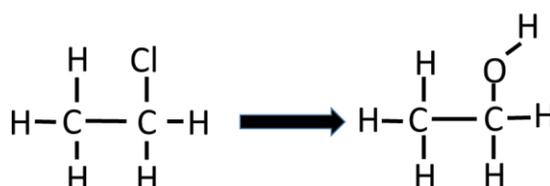
Product formed - forms an alcohol, ethanol

Reaction type - in a substitution reaction; Cl is replaced by OH.

Condensed Structural Formula equation



Structural Formula equation



## Reaction 2

Chloroethane reacts with  $\text{KOH}_{(\text{alc})}$

Product formed - forms an alkene, ethane (plus a  $\text{HCl}$  molecule)

Reaction type - in an elimination reaction; H and Cl removed /  $\text{HCl}$  formed.

Condensed Structural Formula equation



Structural Formula equation



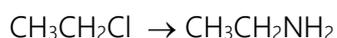
## Reaction 3

Chloroethane reacts with  $\text{NH}_3_{(\text{alc})}$

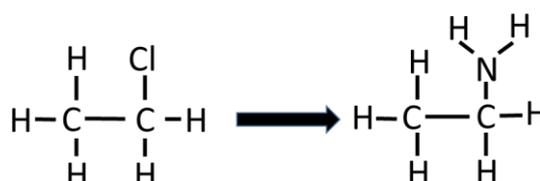
Product formed - forms an amine, aminoethane

Reaction type - in a substitution reaction; Cl is replaced by  $\text{NH}_2$

Condensed Structural Formula equation



Structural Formula equation





## Writing Excellence answers to Alcohol Reactions questions

## Alcohol Reactions QUESTION

Question: Butan-1-ol can react separately with each of  $\text{PCl}_5$ ,  $\text{Cr}_2\text{O}_7^{2-} / \text{H}^+$ , and concentrated  $\text{H}_2\text{SO}_4$ . Elaborate on the reactions of butan-1-ol with each of the three reagents.

For each reaction, your answer should include:

- the type of reaction occurring and the reason why it is classified as that type
- the name of the functional group formed in each product
- the structural formula of the organic product.

## ANSWER

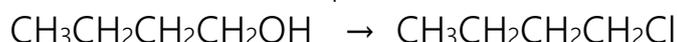
## Reaction 1

Butan-1-ol reacts with  $\text{PCl}_5$

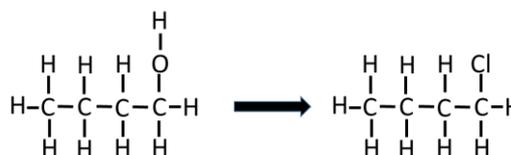
Product formed – The functional group in the product is a chloro group / chloroalkane (haloalkane) 1-chlorobutane

Reaction type - Reaction with  $\text{PCl}_5$  is a substitution reaction. The hydroxyl group ( $-\text{OH}$ ) is replaced by a chloro group ( $-\text{Cl}$ ).

Condensed Structural Formula equation



Structural Formula equation



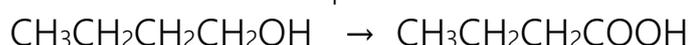
## Reaction 2

Butan-1-ol reacts with  $\text{Cr}_2\text{O}_7^{2-} / \text{H}^+$

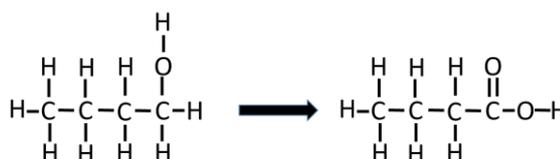
Product formed - The functional group in the product is carboxylic acid. butanoic acid

Reaction type – Reaction with acidified dichromate is oxidation as the alcohol is oxidised to a carboxylic acid.

Condensed Structural Formula equation



Structural Formula equation



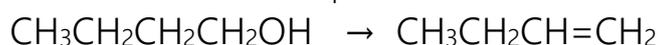
## Reaction 3

Butan-1-ol reacts with concentrated  $\text{H}_2\text{SO}_4$

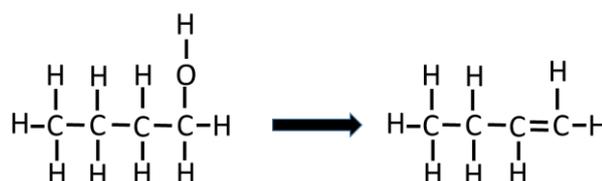
Product formed - The functional group in the product is a (carbon-to-carbon) double bond / alkene. But-1-ene

Reaction type - Reaction with concentrated  $\text{H}_2\text{SO}_4$  is an elimination reaction. A hydrogen atom and the  $-\text{OH}$  group on (adjacent) carbon atoms are removed forming a (carbon-to-carbon) double bond.

Condensed Structural Formula equation



Structural Formula equation





## Writing Excellence answers to Alkene Reactions questions

## Alkene Reactions QUESTION

Question: Ethene,  $C_2H_4(g)$ , reacts with aqueous potassium permanganate solution,  $KMnO_4(aq)$ , dilute acid,  $H_2O / H^+$ , and hydrogen bromide,  $HBr$ .

Compare and contrast the reactions of ethene gas with each of these three reagents.

In your answer, you should:

- describe any observations that can be made
- identify, with reasons, the type of reaction ethene undergoes with each reagent
- describe the functional group of the products formed
- include equations showing the structural formulae for the organic compounds for each reaction.

## ANSWER

Reaction 1 Ethene, $C_2H_4(g)$ reacts with aqueous potassium permanganate solution, $KMnO_4(aq)$ .	Observations - The purple $KMnO_4$ turns colourless (or brown)
	Reaction type - This is an oxidation or addition reaction in which the double bond is broken and two $-OH$ groups attach to each C atom of the double bond.
	Functional group of products Ethene reacts with aqueous $KMnO_4$ to form a diol, ethan-1,2-diol.
	Structural Formula equation $CH_2 = CH_2 \xrightarrow{KMnO_4} \begin{array}{c} CH_2 - CH_2 \\   \quad   \\ OH \quad OH \end{array}$
Reaction 2 Ethene, $C_2H_4(g)$ reacts with dilute acid, $H_2O / H^+$	Observations - No colour changes are observed in this reaction. (colourless to colourless)
	Reaction type - This is an addition reaction as once again the double bond is broken. However, in this reaction one $-OH$ group and one $-H$ atom attach to each C atom of the double bond.
	Functional group of products Ethene reacts with dilute acid, $H_2O / H^+$ , to form ethanol.
	Structural Formula equation $CH_2 = CH_2 \xrightarrow{H_2O / H^+} CH_3 - CH_2 - OH$
Reaction 3 Ethene, $C_2H_4(g)$ reacts with hydrogen bromide, $HBr$ .	Observations - Again there is no colour change observed. (colourless to colourless)
	Reaction type - This reaction is an addition reaction, as the double bond is broken and two atoms are added to each C atom of the double bond. In this reaction one H and one Br atom are added.
	Functional group of products When ethene reacts with hydrogen bromide, bromoethane is formed.
	Structural Formula equation $CH_2 = CH_2 \xrightarrow{HBr} CH_3 - CH_2 - Br$
Summary of the three reactions	All three reactions involve the breaking of the double bond. All three reactions involve addition (adding atoms on) Two of these reactions are addition reactions and one is an oxidation reaction. Only one of the reactions gives a colour change that is easily observed.



## Writing Excellence answers to Major and Minor products questions

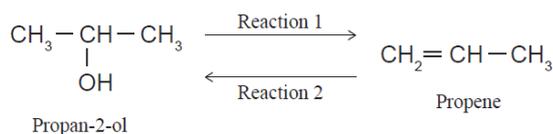
## Major and Minor Products QUESTION

Question: In Reaction 1, propan-2-ol can be converted to propene.

In Reaction 2, propene can be converted back to propan-2-ol.

Analyse BOTH of these reactions by:

- describing the reagents and conditions needed for each reaction to occur
- identifying each type of reaction and explaining your choice
- explaining why Reaction 1 forms only a single organic product, but Reaction 2 forms a mixture of organic products.



## ANSWER

1. Reaction 1 Propan – 2-ol forms propene	Reagent and conditions -To convert propan-2-ol to propene, add concentrated sulfuric acid (which is a dehydrating agent).	
	Reaction type - It is an elimination reaction because OH and H are removed from adjacent carbon atoms and a double bond is created to form an alkene.	
	Structural Formula $\begin{array}{c} \text{H} & & \text{H} \\   & &   \\ \text{H}-\text{C}-\text{C}=\text{C}-\text{H} \\   &   \\ \text{H} & \text{H} \end{array}$	
2. Reaction 2 Propene forms propanol  Label each structure with name and whether it is major or minor	Reagent type and conditions - To convert propene to propan-2-ol, add dilute (sulfuric) acid.	
	Reaction type - This is an addition reaction because the double bond is broken forming a C-C (single) bond, allowing H and OH from water to bond to the C atoms that were double bonded together.	
	Structural Formula $\begin{array}{c} \text{H} \\   \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\   \quad   \quad   \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$ Product type: Major Name: Propan-2-ol	$\begin{array}{c} \text{H} \\   \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\   \quad   \quad   \\ \text{H} \quad \text{H} \quad \text{O} \\ \quad \quad \quad   \\ \quad \quad \quad \text{H} \end{array}$ Product type: Minor Name: Propan-1-ol
3. Explain why <u>reaction one</u> forms only one product linked to symmetry	Reaction 1 forms only one product because the carbon atom from which the H is removed (C1 or C3) does not affect the structure of the product as propan-2-ol is symmetrical.	
4. State Markovnikov's rule AND Explain the reason <u>reaction two</u> produces two products linked to Markovnikov's rule and asymmetry, including which is major and which is minor.	Reaction 2 produces two products because an asymmetric reagent (H-OH) adds onto an asymmetric alkene (CH <sub>3</sub> CH=CH <sub>2</sub> ). There are two carbons that the H or OH can bond with (C1 and C2), so there are two possible combinations. We can predict which will be the major product by using <u>Markovnikov's rule</u> , which states that the carbon with the most hydrogens gains more hydrogens. This means that most of the time, C1 will get another hydrogen while C2 will get the OH in this reaction. Propan-2-ol will be the major product and propan-1-ol the minor product.	



## Writing Excellence answers to Acid-Base Reactions questions

## Acid-Base Reactions QUESTION

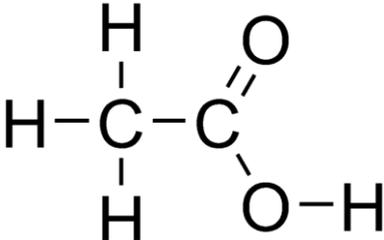
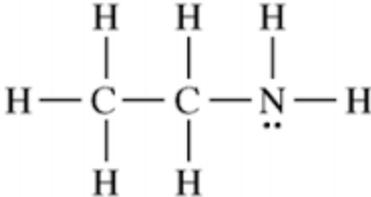
Question: Question 3c: Compounds B ( $\text{CH}_3\text{COOH}$ ) and E ( $\text{CH}_3\text{CH}_2\text{NH}_2$ ) react together.

(i) Write a balanced equation for the reaction that occurs between compounds B and E.

(ii) Identify the type of reaction that occurs between compounds B and E.

Justify your answer.

## ANSWER

<p>1. Draw the structural formula of the acid and base</p> <p>Identify which hydrogen ion will be donated in the acid (-COOH end) and which part of the base will accept the hydrogen ion (-NH<sub>2</sub> end)</p>	<p>Acid (carboxylic acid)</p> 	<p>Base (amine)</p> 
<p>2. Write a balanced equation</p>	$\text{CH}_3\text{COOH}_{(aq)} + \text{CH}_3\text{CH}_2\text{NH}_{2(aq)} \rightarrow \text{CH}_3\text{COO}^-_{(aq)} + \text{CH}_3\text{CH}_2\text{NH}_3^+_{(aq)}$	
<p>3. Name the type of reaction</p>	<p>The reaction between B and E is an acid-base (neutralisation) reaction.</p>	
<p>4. Explain what occurs in the reaction generally</p>	<p>Acid-base reactions involve a proton / <math>\text{H}^+</math> transfer.</p>	
<p>5. Explain in detail what occurs in the acid – and the product formed</p>	<p>Protons / <math>\text{H}^+</math>, are released from the carboxylic acid functional group, -COOH, resulting in a salt forming containing the -COO- group.</p>	
<p>5. Explain in detail what occurs in the base – and the product formed</p>	<p>The proton / <math>\text{H}^+</math> is accepted by the amine functional group, -NH<sub>2</sub>, this forms a salt containing the -NH<sub>3</sub><sup>+</sup> group.</p>	



## Writing Excellence answers to Identifying Unknowns questions

## Identifying Unknowns QUESTION

Question: Question: 1c:

Four separate colourless organic liquids are known to be: • ethanol • ethanoic acid • hex-2-ene • 1-aminohexane. Write a procedure to identify each of these organic liquids using only the reagents listed below.

• acidified dichromate solution,  $\text{Cr}_2\text{O}_7^{2-} / \text{H}^+_{(aq)}$  • bromine water,  $\text{Br}_{2(aq)}$  • sodium carbonate solution,  $\text{Na}_2\text{CO}_{3(aq)}$ .

In your answer, you should:

• identify the test reagents used • describe any observations that would be made • identify the type of reaction that occurs • identify the organic product of any reaction.

You do not need to include equations in your answer.

## ANSWER

Step 1	Test reagents used – start with $\text{Cr}_2\text{O}_7^{2-} / \text{H}^+$ adding a bit to each sample
	Observations - which will turn from orange to green with ethanol No change for the other 3 samples
	Type of reaction that occurs - oxidation
	Organic product of any reaction - ethanol is oxidised to ethanoic acid.
Step 2	Test reagents used - add sodium carbonate solution, $\text{Na}_2\text{CO}_{3(aq)}$ to the remaining 3 samples
	Observations - Bubbles of gas will be produced in the ethanoic acid sample No change for the other 2 samples
	Type of reaction that occurs – acid-base reaction
	Organic product of any reaction – in the acid-base reaction Sodium ethanoate / ethanoate ion is formed.
Step 3.	Test reagents used – add bromine water, $\text{Br}_{2(aq)}$ to the remaining 2 samples
	Observations - the bromine water, which turns from red / brown to colourless straightaway in the hex-2-ene sample No change for the other sample (for substitution in an alkane this reaction will be seen slowly with UV light as a catalyst)
	Type of reaction that occurs – addition reaction
	Organic product of any reaction – in the addition reaction It will form 2,3-dibromohexane is formed
Step 4.	Test reagents used - Hexan-1-amine will be the chemical left over that will not react with any of the given reagents.
	Observations (in other questions red litmus paper can be used – which will turn blue for an amine)
	Type of reaction that occurs
	Organic product of any reaction

