

Formula, naming, structures, isomers, unknowns, reactions

2018

Question one

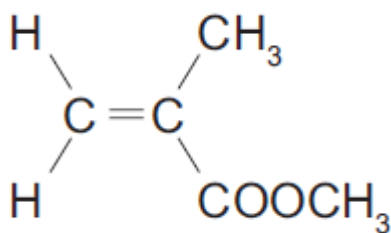
a) Complete the following table.

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

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

Classification of chloroalkane	Structural formula
Primary	
Secondary	
Tertiary	

c) 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.



(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.



d) When but-1-ene is reacted to form bromobutane, C₄H₉Br, two organic products are formed.

Analyse this reaction by:

- stating the reagent required
- identifying the type of reaction and justifying your choice
- explaining why there is a mixture of organic products

Support your answer by drawing structural formulae for but-1-ene and the organic products.



Structural formulae

Question two

- a) 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, CH_3COOH .

(i) Explain how you could identify these two bottles using only solid hydrogen carbonate, NaHCO_3

(ii) Give the structural formula and name for the product of the reaction between propan-1-amine, $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$, and ethanoic acid, CH_3COOH , to form a salt.



Name: _____

- b) 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, $\text{H}_2\text{O}(l)$.

In your answer you should explain any observations that would be made.

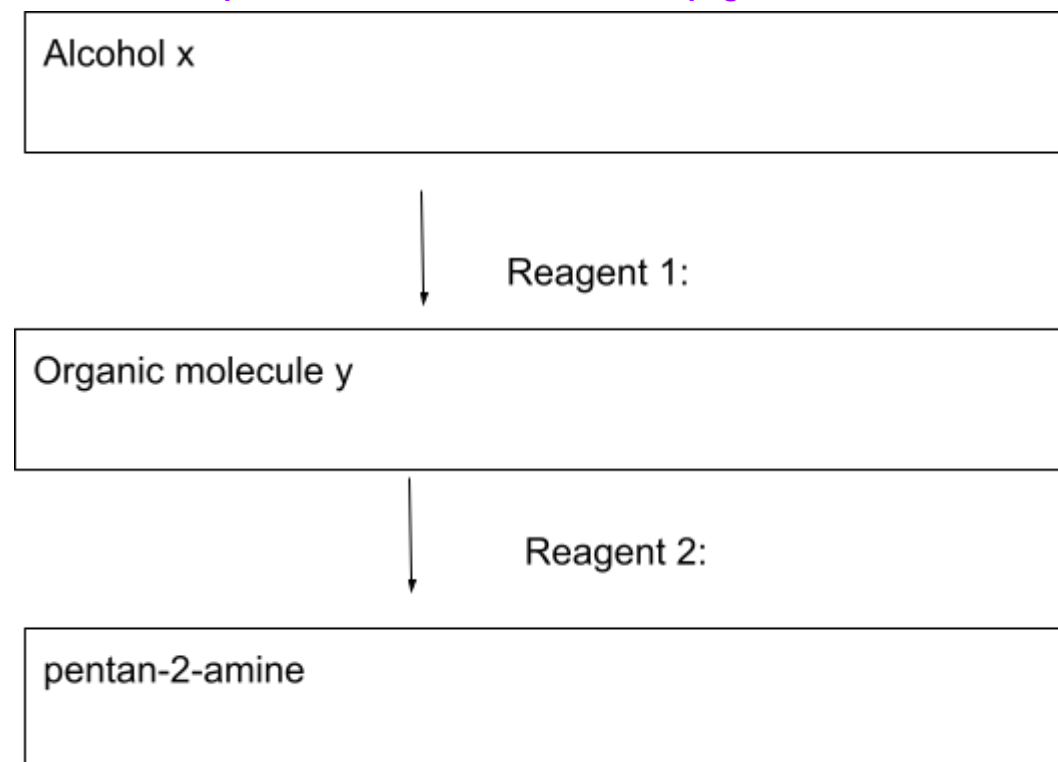
You do not need to include equations in your answer.

c) 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 in the boxes on the next page.



(ii) Elaborate on the reactions in the scheme above.

In your answer you should identify:

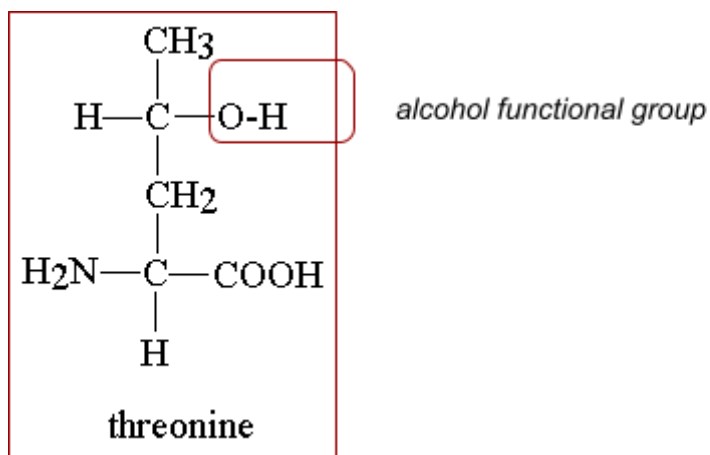
- any conditions needed for each step of the conversion
- The names of alcohol X and organic molecule Y
- the type of reaction that is occurring for each step of the conversion

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2017

Question two

(a) 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.

- (b) Name the organic compounds in the table below.

Compound	IUPAC name
$\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{C} \equiv \text{CH}$	
$\text{CH}_3 - \text{CHBr} - \text{CH}(\text{CH}_3) - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$	
$\text{CH}_3 - \text{CH}_2 - \text{CHOH} - \text{C}(\text{CH}_3)_2 - \text{CH}_3$	

- (c)

- (i) Draw the four alkene isomers for the organic compound C_4H_8 in the table below.

1.	2.
3.	4.

(ii) Identify the compounds that are *cis* and *trans* (geometric) isomers from the table above.

	cis	trans
Number		

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

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(d) Alkanes and alkenes can be identified by their reactions with a solution of bromine water, Br₂(aq).

Contrast the types of reactions an alkane and an alkene will undergo with an orange solution of bromine water.

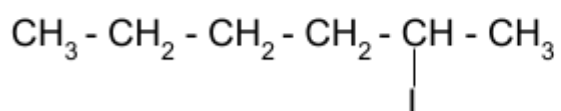
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2016

1) a) (i) Complete the following table.

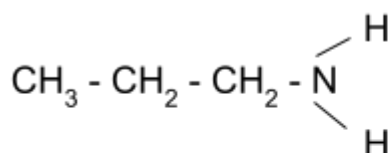
Structural formula

IUPAC name



3-methylpentanoic acid

But-1-yne



(ii) Draw and name **three** constitutional (structural) isomers of the organic compound C_5H_{12} .

1.

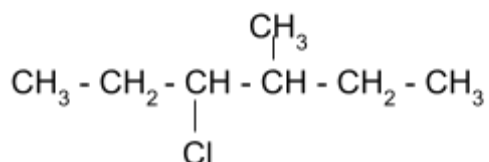
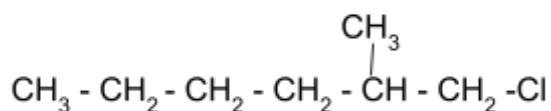
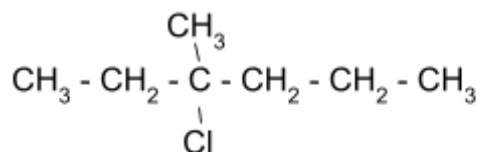
2.

3.

b) (i) Classify the following haloalkanes as primary, secondary or tertiary.

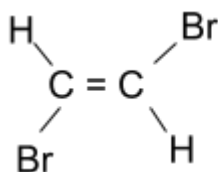
Haloalkane

Classification

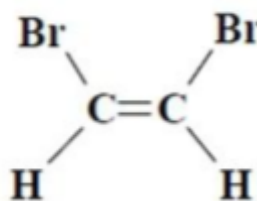


- (ii) Explain your choice for haloalkane **A**.

- c) Some alkenes are able to form *cis* and *trans* (geometric) isomers.
(i) Complete the names of structures **A** and **B** in the diagram below.

A

_____ 1,2-dibromoethene

B

_____ 1,2-dibromoethene

- (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.

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

Structural formula	IUPAC (systematic) name
	propan-1-amine
	2-chlorobutanoic acid
$ \begin{array}{ccccccc} & & & & \text{OH} & & \\ & & & & & & \\ \text{CH}_3 & - & \text{CH}_2 & - & \text{CH} & - & \text{CH} & - & \text{CH}_3 \\ & & & & & & \\ & & & & \text{CH}_3 & & \end{array} $	
$ \begin{array}{c} \text{Br} \\ \\ \text{CH}_3 - \text{C} - \text{CH}_3 \\ \\ \text{CH}_3 \end{array} $	

(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.



The correct IUPAC name for this structure is:

b) Butan-1-ol has the molecular formula $C_4H_{10}O$. Its structural formula is: $CH_3CH_2CH_2OH$

(i) Define the term constitutional (structural) isomer.

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(ii) Draw THREE other constitutional (structural) isomers of $C_4H_{10}O$

Alcohol	Structural formula
A	
B	
C	

(iii) Choose a secondary alcohol from the structures above and give a reason for your choice.

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c) Four separate colourless organic liquids are known to be: ethanol, ethanoic acid, hex-2-ene, and hexan-1-amine (1-aminohexane).

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

- acidified dichromate solution, $Cr_2O_7^{2-}/H^+$
- bromine water, $Br_2(aq)$
- sodium carbonate solution, $Na_2CO_3(aq)$

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

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3) (i) Explain why 1,1-dichloroethene cannot exist as a cis-trans isomer.

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(ii) A structural isomer of 1,1-dichloroethene can exist as cis-trans isomers. Draw and name the cis-trans isomers.

Structure		
Name		

2014

1) (a) In the boxes below, draw a primary, a secondary, and a tertiary alcohol for the molecule $C_5H_{11}OH$.

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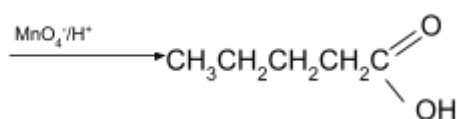
Primary

Secondary

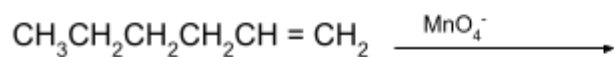
Tertiary

(b) (i) When primary alcohols are oxidised by acidified permanganate, MnO_4^-/H^+ , they form carboxylic acids. In the box below, draw the primary alcohol that was oxidised to form the carboxylic acid shown.

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(ii) Permanganate ion, MnO_4^- , can be used to oxidise alkenes. Draw the product of the following reaction:



(c) The reactions shown below are all classified as being the same type of reaction.

Reaction One	hexane, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$, reacts with bromine water, $\text{Br}_2(\text{aq})$
Reaction Two	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 PCl_3
Reaction Three	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 NH_3 (alc)

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.



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

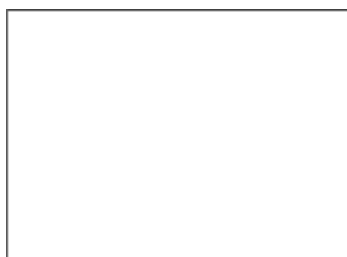
Structural formula	IUPAC name
	but-1-yne
	2,2-dichloropentan-1-ol
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$	
$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{C}(=\text{O})\text{OH}$	
$\text{CH}_3\text{CH}_2\text{CH}(\text{Cl})=\text{C}(\text{Cl})\text{CH}_2\text{CH}_3$	

(b) The structures of three organic compounds are shown below.

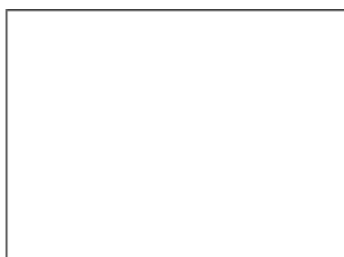
Compound A	$\text{CH}_3\text{CH}_2\text{CH}=\text{CHCH}_3$
Compound B	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}=\text{CH}_2$
Compound C	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$

Explain why compound A can exist as geometric (cis and trans) isomers, but compounds B and C cannot. In your answer you should:

- draw the geometric (cis and trans) isomers of compound A in the boxes below
- explain the requirements for geometric (cis and trans) isomers by referring to compounds A, B, and C.



Cis isomer



Trans isomer

2013

Question 1

(a) The structures of some organic compounds containing chlorine are shown below.

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

(i) Write the letter of the molecule that is a secondary chloroalkane.

11

(ii) Describe why you chose the molecule in (i).

(b) Identify two molecules from the table in (a) that are constitutional (structural) isomers of each other. Write the letters in the boxes below.

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Justify your choice.

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(c) Molecule D can exist as geometric (cis and trans) isomers.

(i) Draw the geometric (cis and trans) isomers for molecule D in the boxes below.

<i>cis isomer</i>	<i>trans isomer</i>

(ii) 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.

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

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

Question 2

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, $\text{Br}_2(\text{aq})$. Your method should allow another student to identify these liquids, and include:

- the reagent used
- any observations made.

You do not need to include equations in your answer.

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Reactions, properties

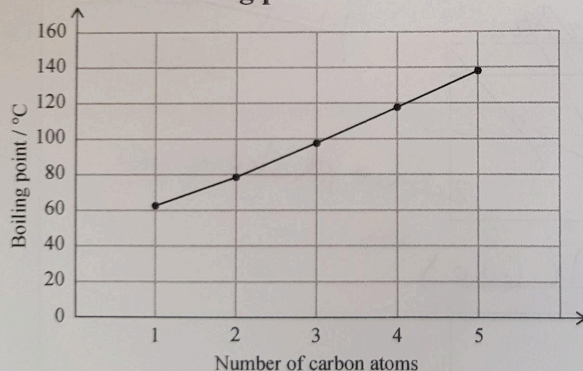
2018

Question three

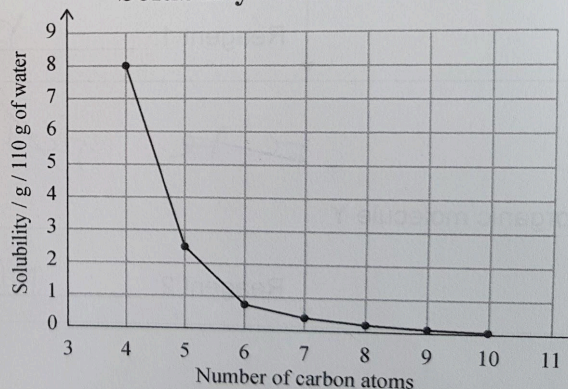
QUESTION THREE

The graphs below show trends in two physical properties of alcohols.

Boiling point of alcohols



Solubility of alcohols in water



- a) Identify the trends shown on the graphs above.

- b) 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 reactions that occur with the reagent in each condition
- draw structural formulae of the organic products

- (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:

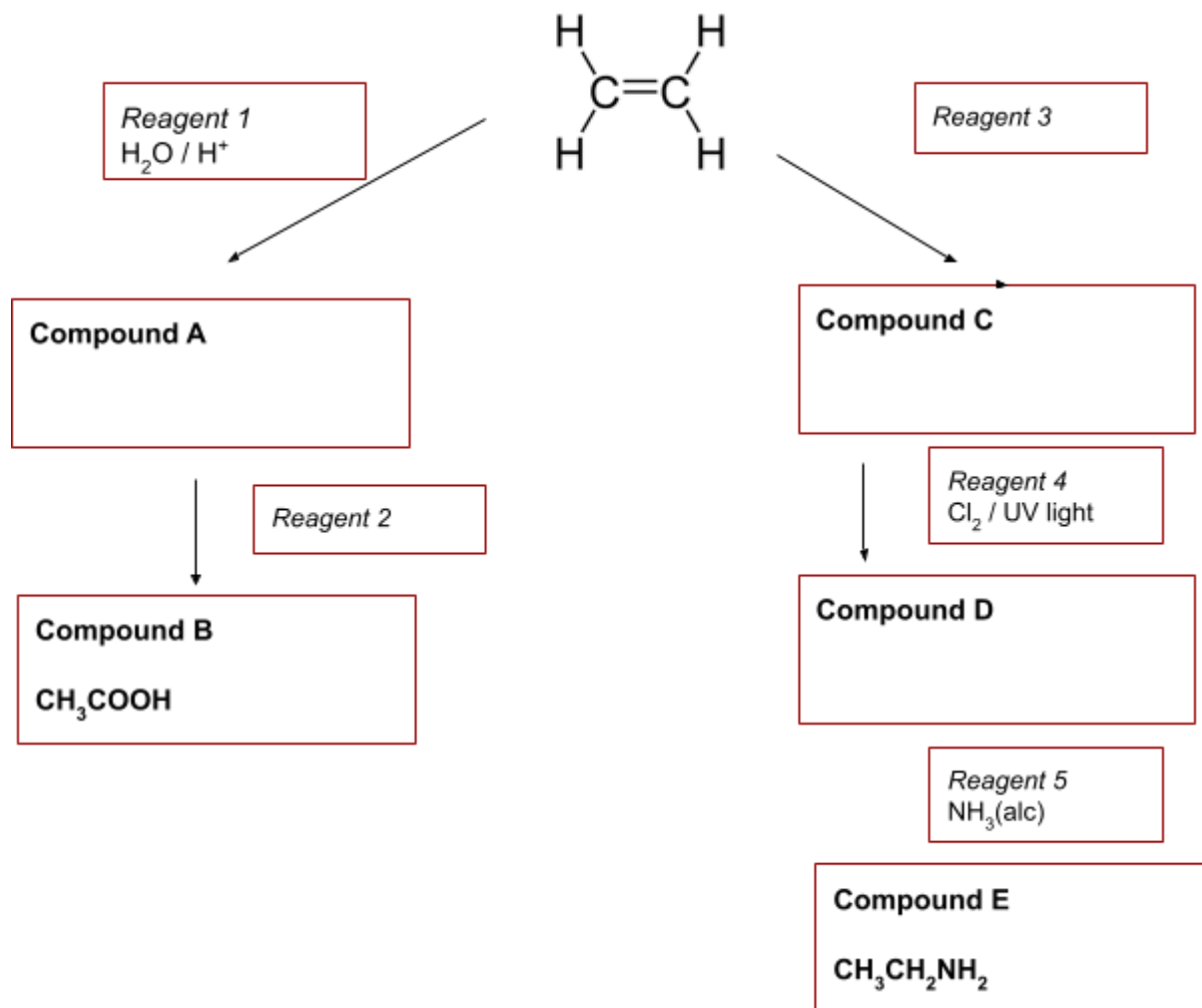
- identify chemicals and conditions required
- describe any observations
- state the type of reaction occurring
- explain why potassium permanganate, KMnO_4 (aq), cannot be used to distinguish between the organic products.

2017

Question three

(a)

(i) Complete the reaction scheme by drawing the structural formulae for the organic compounds **A**, **C**, and **D**, and identifying *reagents 2 and 3*.



(ii) Identify the type of reactions that occur to produce compounds **A**, **B**, **C**, **D**, and **E**:

A	
B	
C	
D	
E	

(b) Describe a simple test that will distinguish between solutions of the final organic compounds **B** and **E**.

(c) Compounds **B** and **E** react together.

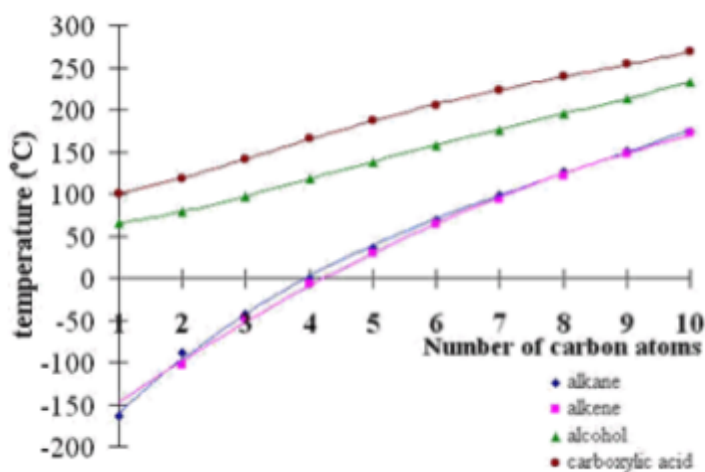
(i) Write a balanced equation for the reaction that occurs between compounds **B** and **E**.

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

(d) Explain how compound **A** from the reaction scheme can be directly converted into compound **D**.

2016

1) a) Boiling points of straight chained alkanes and primary alcohols.



This question is only looking at boiling points of straight chained alkanes and 1° alcohols.

Ignore the alkenes and carboxylic acids

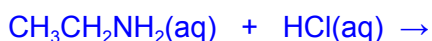
(i) Identify the trends shown on the graph above.

Remember: only the straight chained alkanes and 1° alcohols.

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

b) Solutions of amines are described as bases, and solutions of carboxylic acids are described as acids.

(i) Complete the balanced equation for the reaction between solutions of ethanamine, $\text{CH}_3\text{CH}_2\text{NH}_2(\text{aq})$, and hydrochloric acid, $\text{HCl}(\text{aq})$.



(ii) Explain the statement 'carboxylic acids have acidic properties.'

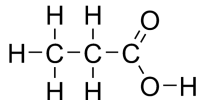
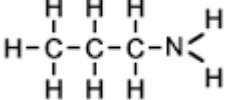
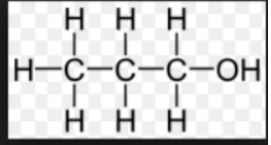
Refer to the reaction between ethanoic acid, $\text{CH}_3\text{COOH}(\text{aq})$, and water, $\text{H}_2\text{O}(\text{l})$, in your answer.

c) Ethane gas, $\text{C}_2\text{H}_6(\text{g})$, and ethene gas, $\text{C}_2\text{H}_4(\text{g})$, will both react with bromine water, $\text{Br}_2(\text{aq})$. Compare and contrast these two reactions. In your answer you should include:

- Any conditions required
- The observations made
- The types of reactions occurring
- Structural formulae of the organic products formed

2014

1) (a) Sodium carbonate, hydrochloric acid, and sulfuric acid are each added to separate samples of three organic compounds. The structures of the compounds and the products of any reactions are given in the table below.

Reagent	Organic compound		
			
Na_2CO_3	(i)	No reaction	No reaction
HCl	No reaction	(ii)	$\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$
H_2SO_4	No reaction	$\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_3^+$	$\text{CH}_3\text{CH}=\text{CH}_2$

Compare and contrast the reactions that do occur between these organic compounds, and the reagents in the table above. In your answer you should:

- give the structure of the organic products (i) and (ii)
- describe the different types of reactions occurring, and give reasons why they are classified as that type
- identify any specific conditions that are required for the reactions to occur.

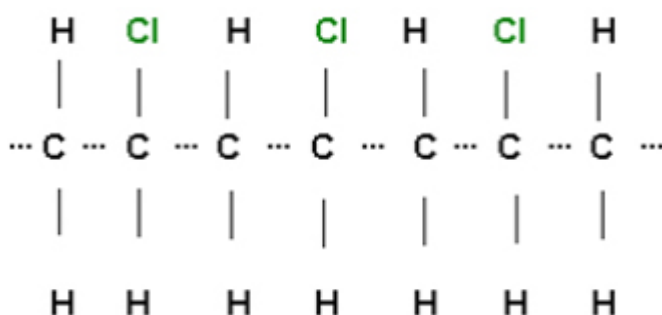
Flow charts, polymers, more reactions

2017

Question one

(a) Polyvinyl chloride (poly chloroethene) is often used to make artificial leather. This can then be used to cover chairs, car seats, and make clothing.

A section of polyvinyl chloride is shown below.



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

(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.

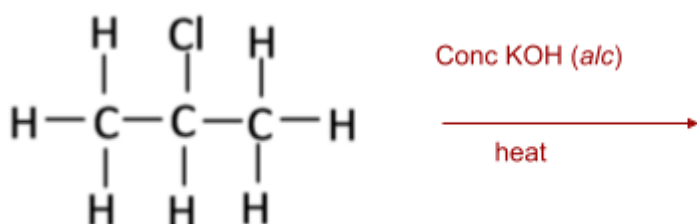
(iii) Making polyvinyl chloride (poly chloroethene) from its monomer is called 'addition polymerisation.'

Explain the term 'addition polymerisation' using polyvinyl chloride as an example. Include an equation in your answer.

Equation

(b) A chemistry class was learning about the chemistry of haloalkanes. They were researching the effect of heat and concentrated potassium hydroxide in alcohol, KOH (*alc*), on the haloalkane 2-chloropropane.

(i) Draw the organic product formed in the following reaction.



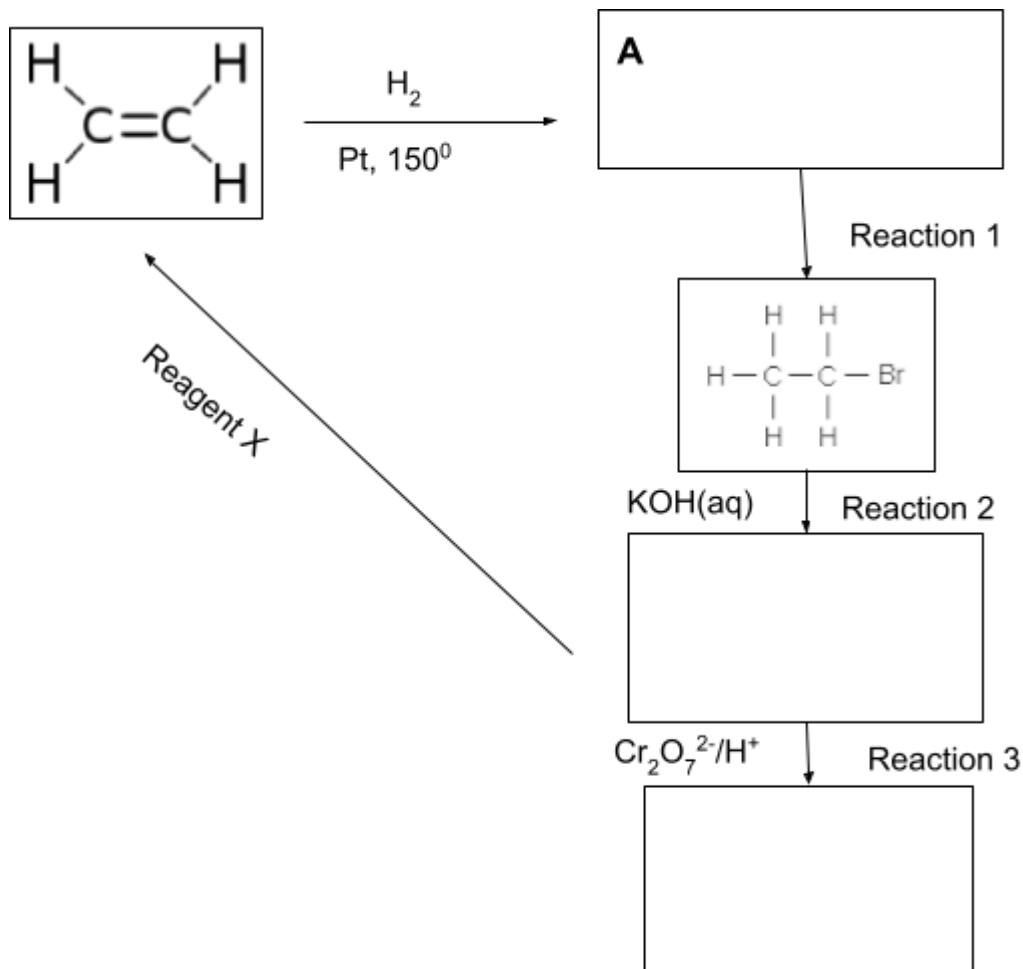
(ii) Explain how the functional group of the organic product drawn above could be identified.

(iii) 2-bromo-3-methylbutane also reacts with conc KOH (*alc*). However, in this reaction TWO organic products are formed, a major and a minor product. Give an account of the chemical processes that occur in this reaction. In your answer you should:

- write an equation for this reaction showing the organic compounds
- name the type of reaction occurring
- explain how the products form
- explain which product you would expect to be the minor product

(2016)

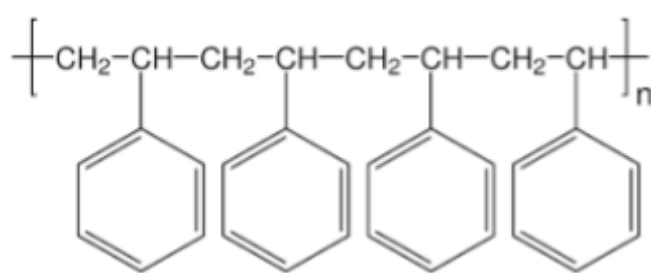
1) a) (i) Complete the following chart by drawing the structural formulae for the organic compounds **A**, **B** and **C** and identifying reagent **X**.



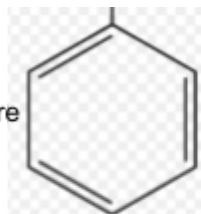
(ii) Identify the type of organic reaction occurring in each of reaction 1, 2, and 3.

Reaction 1	
Reaction 2	
Reaction 3	

b) Polystyrene is a polymer with the structure:



Where



is a benzene Ring, bonded to a C. Therefore This ring has a Formula of C_6H_5 .

An unattached benzene ring has a formula of C_6H_6

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

Styrene monomer

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

c) The reaction between propene, $C_3H_6(g)$, and hydrogen chloride, $HCl(g)$, produces a mixture of products. One of these products, the major product, is made in higher proportions than the other, the minor product.



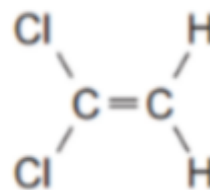
(i) Draw and name the major and minor products for this reaction.

Major product	Minor product
Name:	Name:

(ii) Elaborate on the reaction that occurs between propene and hydrogen chloride.

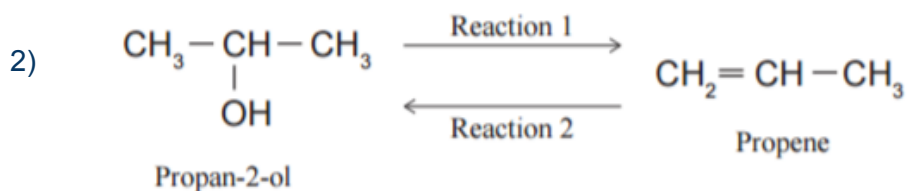
(2015)

1) Cling Wrap is a polymer that can be made from the monomer 1,1-dichloroethene.



1,1-dichloroethene

a) In the box below, draw THREE repeating units of the polymer formed



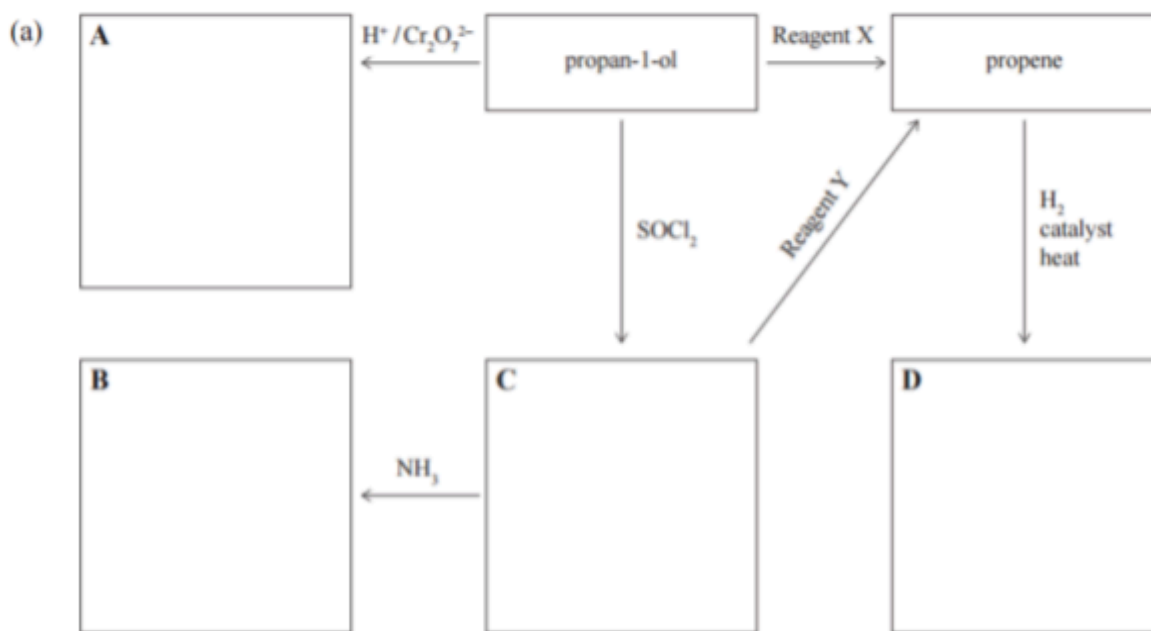
In Reaction 1, propan-2-ol can be converted to propene.

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.

3) a)



(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.

Reagent X	
Reagent y	

b) Ethene, $\text{C}_2\text{H}_4(\text{g})$, reacts with aqueous potassium permanganate solution, $\text{KMnO}_4(\text{aq})$, dilute acid, $\text{H}_2\text{O}/\text{H}^+$, 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

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2013

Question 1

Butan-1-ol can react separately with each of PCl_5 , $\text{Cr}_2\text{O}_7^{2-}/\text{H}^+$, and concentrated H_2SO_4 . Elaborate on the reactions of butan-1-ol with each of the three reagents.

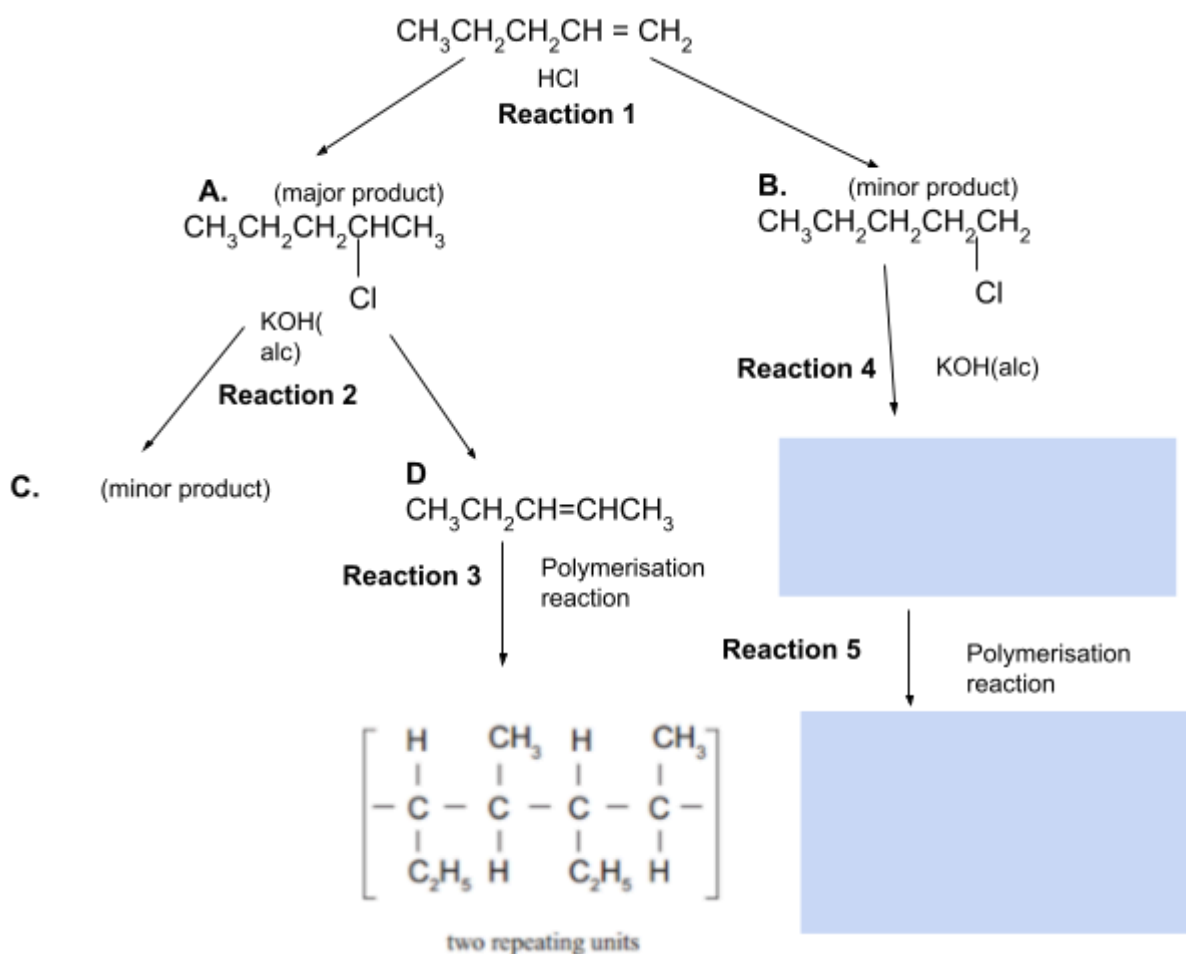
For each reaction, your answer should include:

- 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.

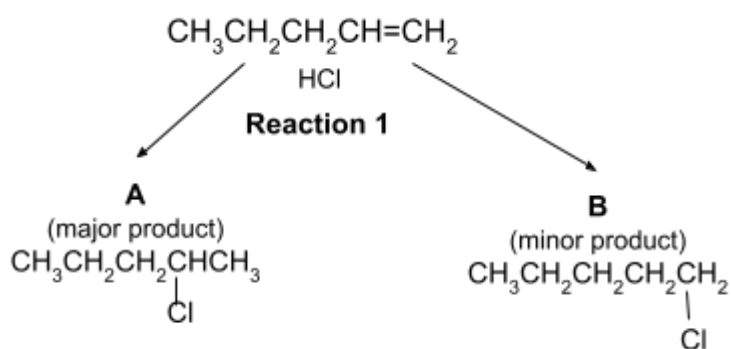
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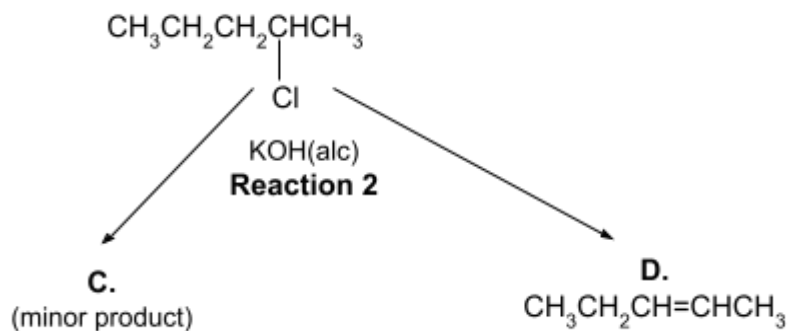
2014

1) A reaction scheme is shown below



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





(ii) Reaction 4 is also an elimination reaction.

Draw the structural formula of the product formed in Reaction 4

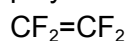
(c) (i) Draw TWO repeating units of the polymer formed in Reaction 5

(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.

2013

Question 1

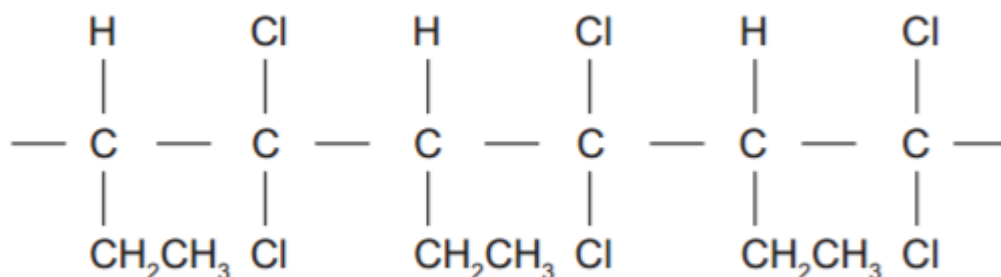
(a) (i) The molecule tetrafluoroethene, shown below, is the monomer for the polymer commonly known as Teflon.



Draw TWO repeating units for the Teflon polymer in the box below.

Teflon

(ii) The following diagram shows three repeating sections of another polymer.

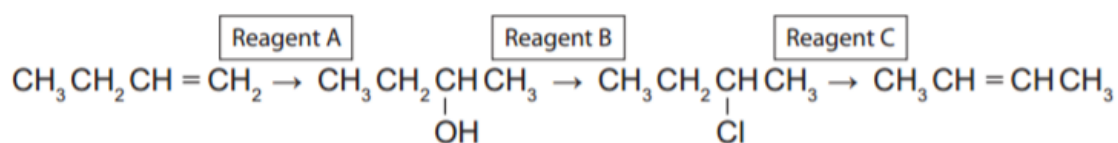


Draw the structural formula of the monomer molecule used to make this polymer.

monomer

Question 2

(a) The flow diagram below shows a reaction scheme for the conversion of but-1-ene into but-2-ene.

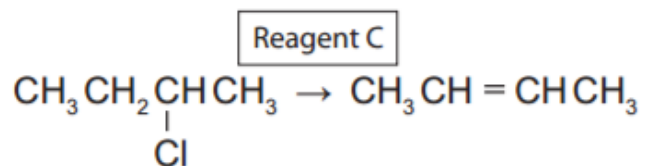


(i) Use the reaction scheme above to complete the following table to show:

- 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		

(ii) For the following reaction:



Circle the words below that describe the product formed.

major product

minor product

Explain your answer.