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KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

Level 2 Chemistry, 2015

91165 Demonstrate understanding of the properties of selected organic compounds

9.30 a.m. Monday 23 November 2015
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of the properties of selected organic compounds.	Demonstrate in-depth understanding of the properties of selected organic compounds.	Demonstrate comprehensive understanding of the properties of selected organic compounds.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

A periodic table is provided on the Resource Sheet L2–CHEMR.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–11 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Low Achievement

TOTAL 9

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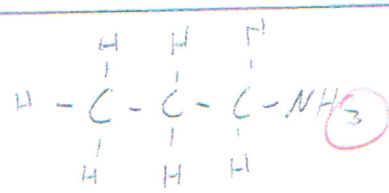
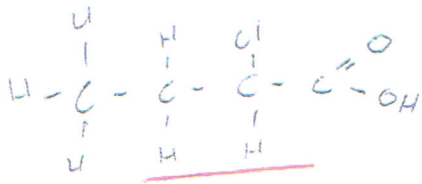
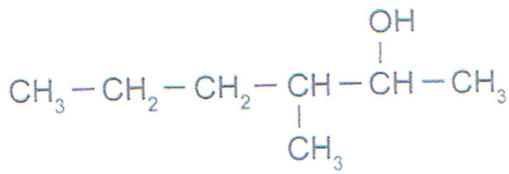
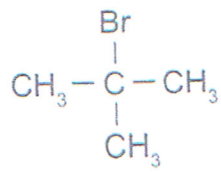
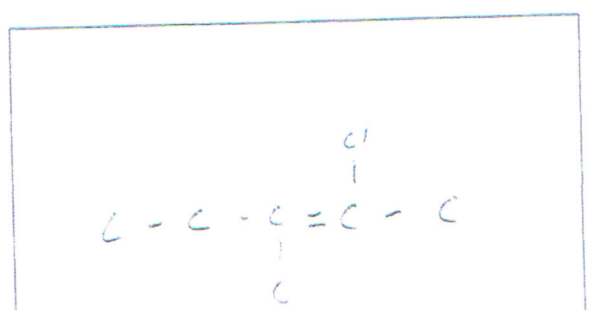
QUESTION ONE

(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
	3-methyl hexan-2-ol
	2-methyl 2-bromopropane.

(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.



It has been named incorrectly as the double bond between C atoms should be counted from the side that makes it the lowest number

The correct IUPAC name for this structure is:

2-chloro-3-methylpent-2-ene

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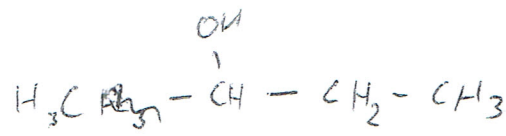
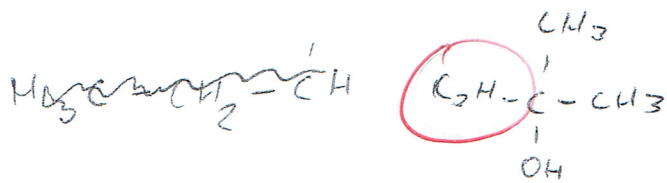
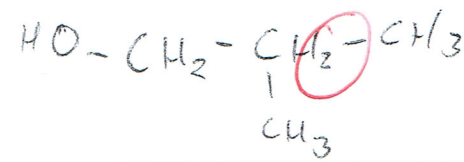
(b) Butan-1-ol has the molecular formula $C_4H_{10}O$. Its structural formula is:

$$CH_3-CH_2-CH_2-CH_2-OH$$

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

An isomer is a compound with the same number of molecular atoms but different ways they are arranged.

(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.

Letter: (A) B C (circle your choice)

Reason:

The -OH group is bonded to a carbon atom which has two more carbon atoms bonded to it.

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

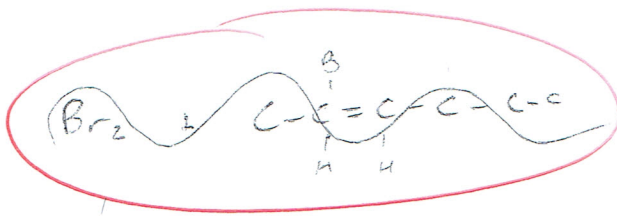
In your answer, you should:

- 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.

The ethanol can be identified by using the $Cr_2O_7^{2-}/H^+(aq)$ solution as when mixed together the orange CrO_7^{2-} will change to green Cr^{3+}. This reaction will convert the ~~eth~~ ethanol to ethanoic acid. This reaction is Oxidisation. The ethanoic acid can be identified when reacted with the Na_2CO_3 (aq). As the reaction occurs fizzing will be visible as CO_2 is released. When combined the ethanoic acid will be converted to sodium ethanoate. This is an acid & base reaction. The hex-2-ene can be identified by ~~reacting~~ reacting it with bromine water. As the reaction occurs the bromine water will change from brown

to colourless. The product formed by the reaction will be a halo alkane, (2-bromohexane) this reaction is an addition reaction. The remaining liquid will be hexan-1-amine and it will not react with the other reagents.



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QUESTION TWO

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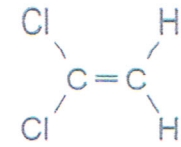
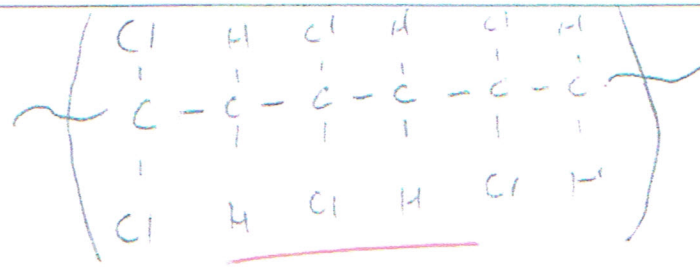
Cling Wrap is a polymer that can be made from the monomer 1,1-dichloroethene.

http://savingcentswithcoupons.com/money-maker-deal-on-glad-cling-wrap-at-shoprite/



1,1-dichloroethene

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



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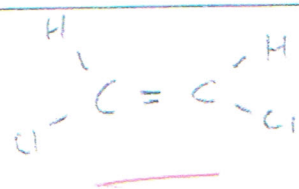
(ii) Explain why 1,1-dichloroethene cannot exist as a *cis-trans* isomer.

because regardless of which atoms are on top of the other (x:C=C or x:C=C:y) both atoms are the same.

(iii) A structural isomer of 1,1-dichloroethene **can** exist as *cis-trans* isomers.

Draw and name the *cis-trans* isomers.

Structure		
Name	cis 1,2-dichloroethene	trans 1,2-dichloroethene

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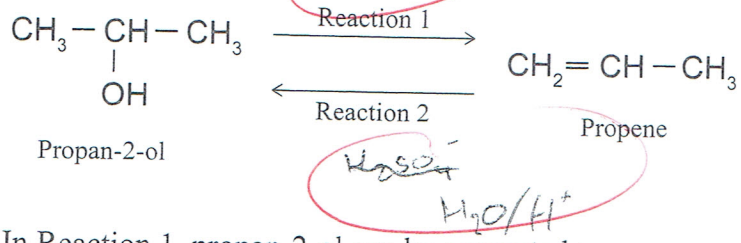
(b)



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.

In Order for reaction one to occur particles must have sufficient energy. The reagent used in reaction 1 is H_2SO_4 and is an elimination reaction as it removes the OH group to form an alkene. Reaction 1 forms only one product as an alcohol mixed with H_2SO_4 can only produce an alkene. In order for reaction 2 to occur particles must to have sufficient energy, the reagent in reactor 2 is H_2O/H^+ and is an Oxidation reaction as it is adding oxygen an OH group into the compound. Reaction 2 can form a mixture of compounds due to Zayt zeffs rule 'the poor get poorer' it will produce isomers of the propan-2-ol and the reaction can also form other organic compounds that are not alcohols

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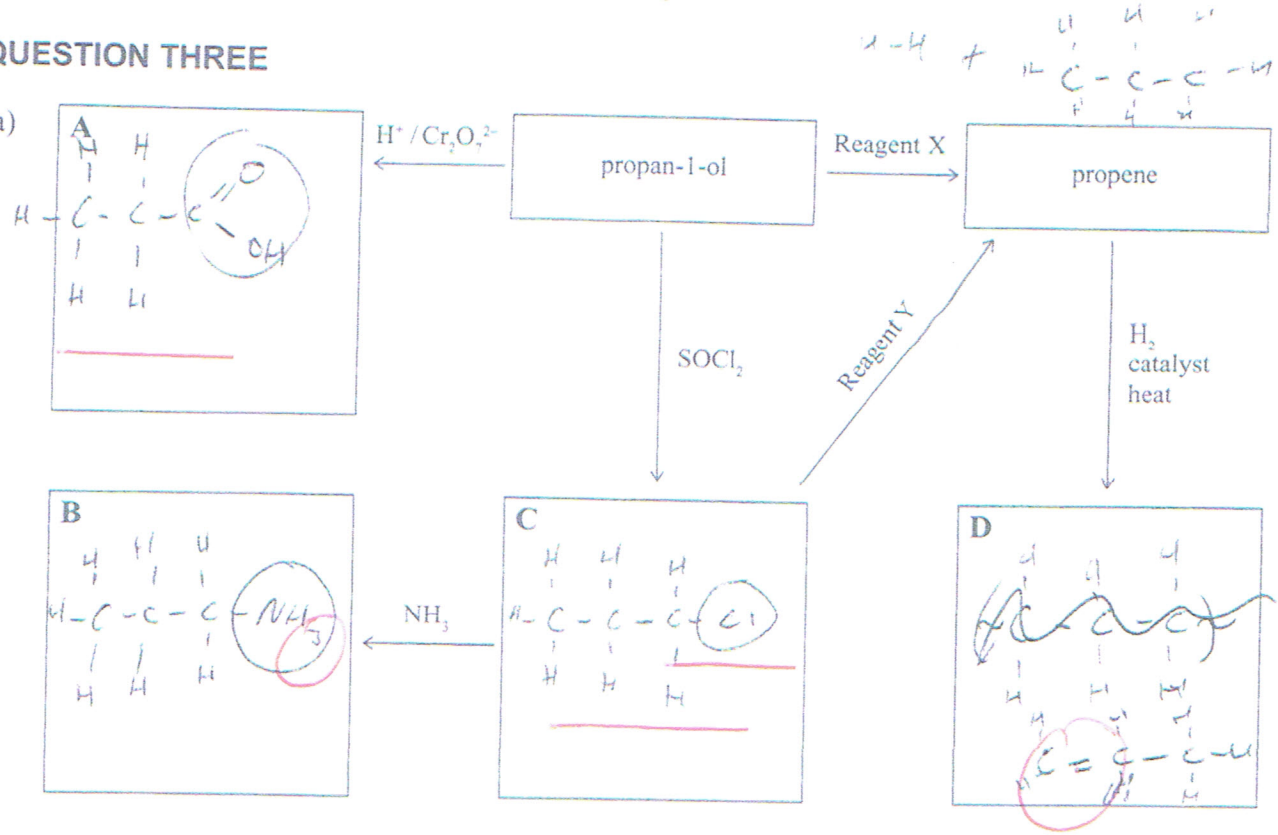
QUESTION THREE

(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: PCl_5

Reagent Y: H_2O / H^+

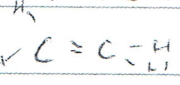
(b) Ethene, $C_2H_4(g)$, reacts with aqueous potassium permanganate solution, $KMnO_4(aq)$, dilute acid, H_2O/H^+, and hydrogen bromide, HBr.

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

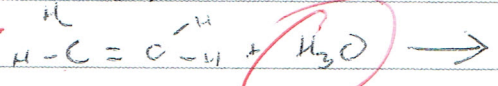
In your answer, you should:

- 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.

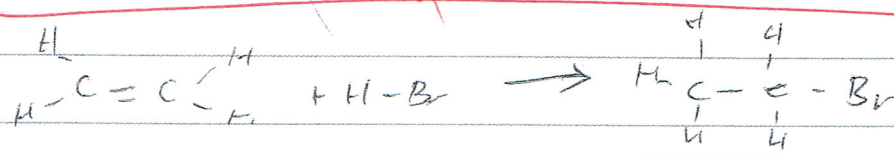
When ethene reacts with $KMnO_4$ (aq) the $KMnO_4$ solution changes from purple to colourless, this is an oxidation reaction

as MnO_4^- brings oxygen into the reaction  This will produce a diol.

When ethene reacts with H_2O/H^+ the ethene will produce ethanol This is an oxidation reaction as the H_2O/H^+ reacts to form an $-OH^-$ group. The ethanol is polar and can be dissolved in water.



When ethene reacts with HBr a haloalkane will be formed. The reaction will produce ~~water~~ hydrogen gas as it is a substitution reaction and the Br replaces an H atom The formed product is 1-bromoethane and is insoluble in water.



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Level 2 Chemistry, 2015

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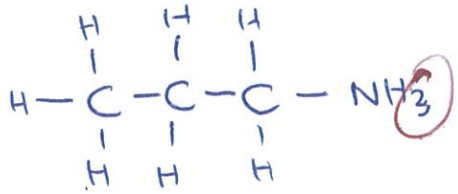
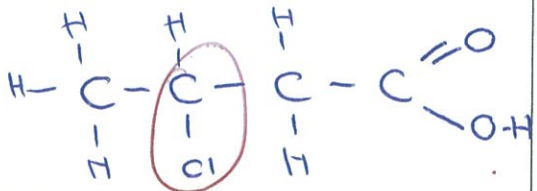
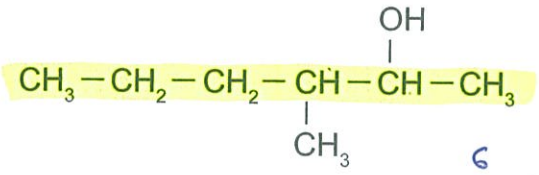
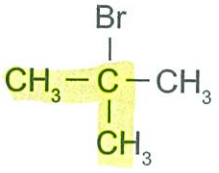
High Achievement

TOTAL 11

ASSESSOR'S USE ONLY

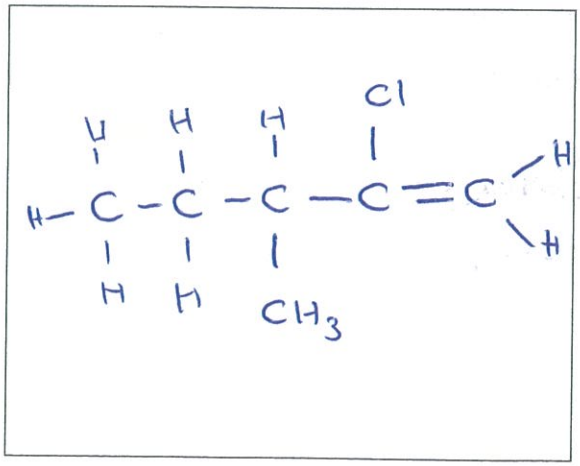
QUESTION ONE

(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
 6	3-methylhex-2-ene
 3	2-bromo-2-methylpropane

(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.



You count which carbon it is on from the shortest distance from the double bond

The correct IUPAC name for this structure is:

2-chloro-3-methylpent-1-ene

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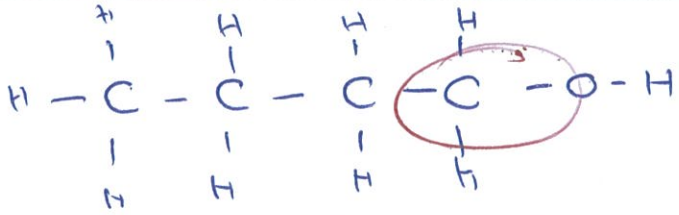
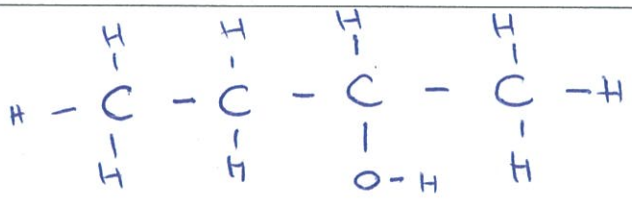
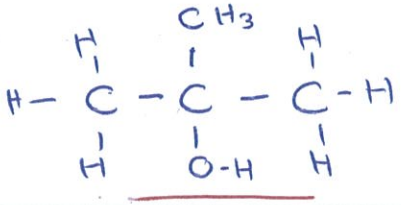
(b) Butan-1-ol has the molecular formula $C_4H_{10}O$. Its structural formula is:

$$CH_3-CH_2-CH_2-CH_2-OH$$

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

When the molecular formula remains the same but the structural formula differs. 4

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

Alcohol	Structural formula
A	
B	
C	

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

Letter: ~~A~~ **B** ~~C~~ (circle your choice)

Reason:

The 'OH' is bonded to a carbon which is bonded to 2 other carbons. 4

4

(c) Four separate colourless organic liquids are known to be:

- ethanol
- ethanoic acid
- hex-2-ene $C-C-\overset{1}{C}=\overset{1}{C}-C-$
- hexan-1-amine (1-aminohexane).

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

- acidified dichromate solution, $Cr_2O_7^{2-}/H^+(aq)$ orange → green
- bromine water, $Br_2(aq)$ orange
- 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.

Take a sample of each of the organic liquids. Pour orange bromine water in each sample. One sample will immediately turn colourless, this is an addition reaction. This liquid will be the hex-2-ene. The product would be 2-Bromohexane or 3-Bromohexane (no major or minors), a haloalkane

With the remaining 3 samples with bromine water, leave them in sunlight or under UV light. The

Take fresh samples of the remaining 3. Add acidified dichromate solution ($Cr_2O_7^{2-}/H^+(aq)$), this should be an orange colour. When paired one will react and turn green. This is an oxidation reaction and the orange $Cr_2O_7^{2-}$ will turn to a green Cr^{2+}. The solution that turns green is

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ethanol (alcohol) and will oxidise to a carboxyllic acid, the products are water and ethanoic acid.

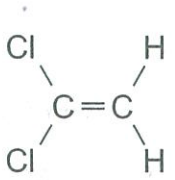
With the remaining two, take a fresh sample and smell the two, the one that smells like fish is hexan-1-amine as amines will smell like fish, the remaining is ethanoic acid.

Alternatively instead of smelling, add $Na_2CO_{3(aq)}$, which is a polar solvent. The ethanoic acid will dissolve in Na_2CO_3 as it is also polar. However hexan-1-amine will not dissolve as it is non-polar due to the carbon chain being long.

QUESTION TWO

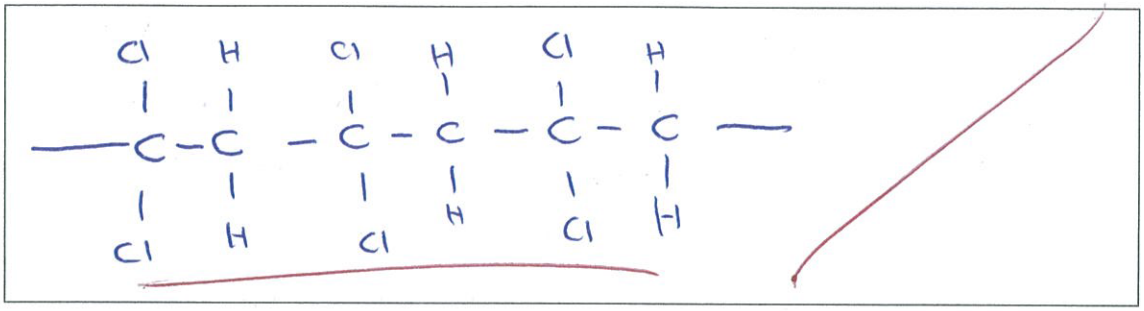
Cling Wrap is a polymer that can be made from the monomer 1,1-dichloroethene.

http://savingcentswithcoupons.com/money-maker-deal-on-glad-cling-wrap-at-shoprite/



1,1-dichloroethene

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



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

This is because both chlorine atoms are bonded on the same carbon and cannot swith places to make a trans isomer.

(iii) A structural isomer of 1,1-dichloroethene **can** exist as *cis-trans* isomers.

Draw and name the *cis-trans* isomers.

Structure	C=C	C=C
Name	cis 1,1-dichloroethane	trans 1,1-dichloroethane

(b) $CH_3-CH(OH)-CH_3$ (Propan-2-ol) $\xrightarrow{\text{Reaction 1}}$ $CH_2=CH-CH_3$ (Propene)

$\xleftarrow{\text{Reaction 2}}$

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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.

Reaction 1 is an elimination reaction and ~~needs water (H-OH) as a reagent~~ and requires the presence of H_2SO_4 (as a catalyst). This is an elimination reaction as a H atom and the OH are removed from the carbon chain of propan-2-ol (an alcohol) to make propene (an alkene). This is known as dehydration as a water molecule is removed (H-OH)

4

Reaction 2 is an addition reaction and needs water (H-OH) as a reagent and requires the presence of H_2SO_4 (as a catalyst). This is an addition reaction as a H atom and OH is added to the carbon chain to form propan-2-ol from propene. This is known as hydration as a water molecule is added (H-OH).

4

In reaction 2, there are two products that can be formed. This is because when the

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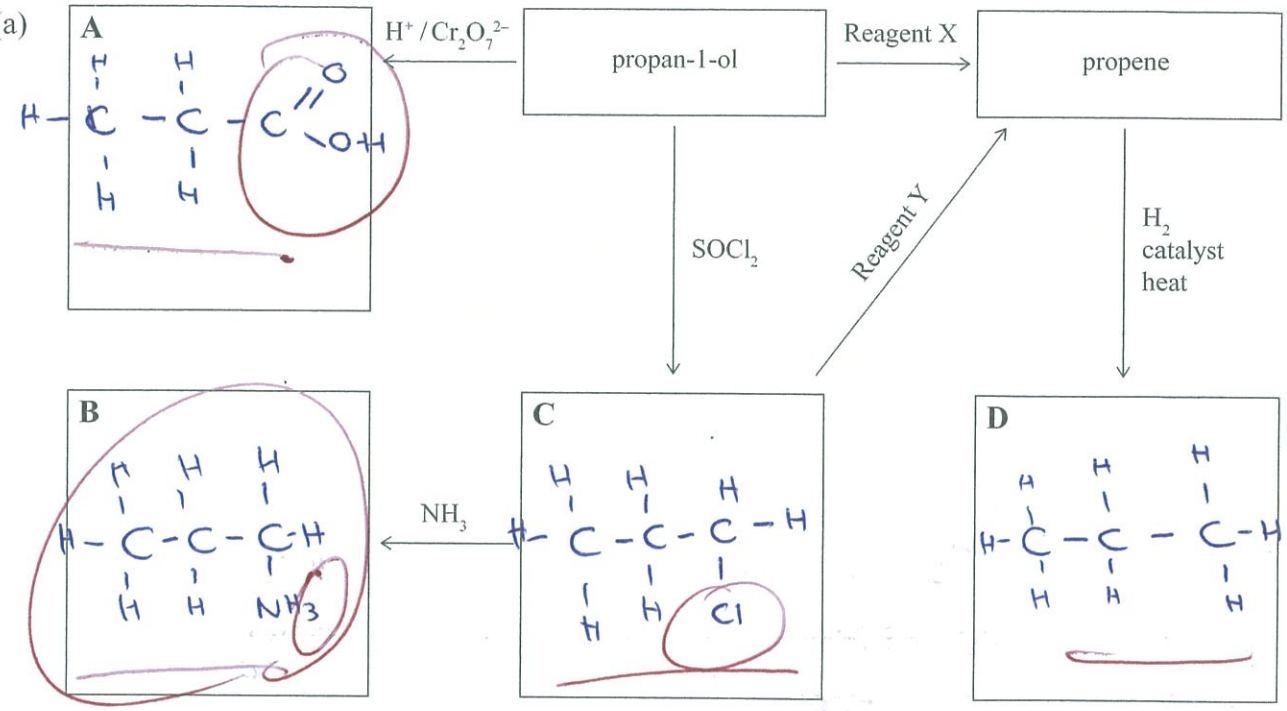
QUESTION THREE

(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: H_2SO_4 as a catalyst

Reagent Y: KOH or NaOH

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

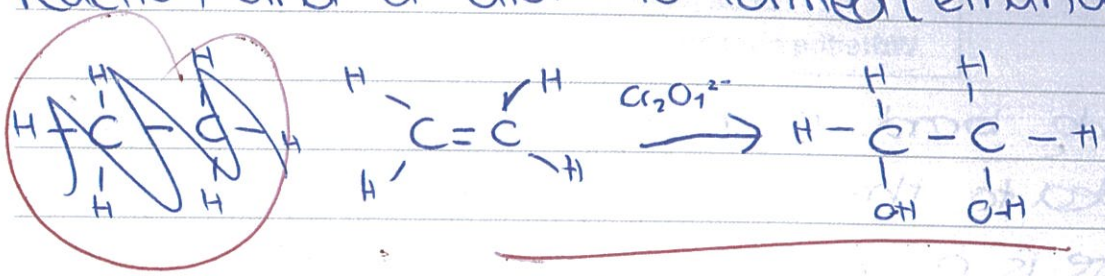
Compare and contrast the reactions of ethene gas with each of these three reagents.

In your answer, you should:

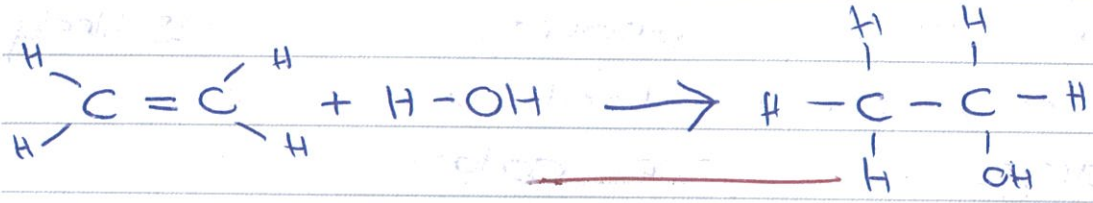
- describe any observations that can be made
- identify, with reasons, the type of reaction ethene undergoes with each reagent
- describe the functional group of the products formed
- include equations showing the structural formulae for the organic compounds for each reaction.

The $KMnO_4(aq)$ is a purple colour ~~and is acidified~~. When it reacts with ethene the solution will go colourless, this is an oxidation

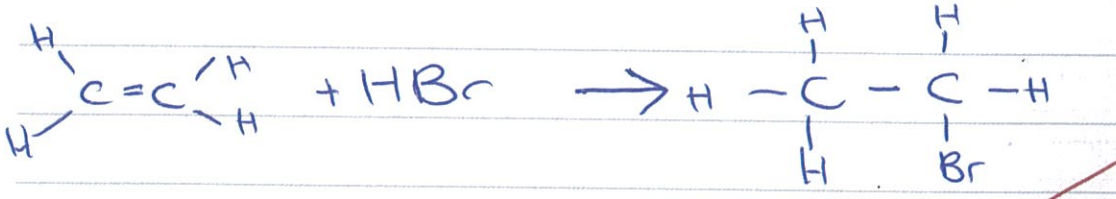
reaction and a diol is formed (ethandiol)



When it reacts with H_2O/H^+, it is an addition reaction where H_2O is a reagent. The Ethene (alkene) will become an alcohol (ethanol)



When it reacts with hydrogen bromide (which is orange), the solution will go colourless and go from ethene (alkene) to 1-bromoethane (haloalkane)



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A3

Extra paper if required.
Write the question number(s) if applicable.

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QUESTION NUMBER

2b double bond is broken, the OH can be added to the first or second carbon. There is a major or minor product that can be formed, the major is propan-2-ol as the "rich get richer", which means the hydrogen bonds will most likely bond with the carbon with the most carbons. The minor product, which a less likely product is propan-1-ol where the hydrogen bonds the carbon with the least hydrogens. // Seen