

Alkenes

Question Paper 5

Level	International A Level
Subject	Chemistry
Exam Board	CIE
Topic	Hydrocarbons
Sub-Topic	Alkenes
Paper Type	Theory
Booklet	Question Paper 5

Time Allowed: 68 minutes

Score: /56

Percentage: /100

Grade Boundaries:

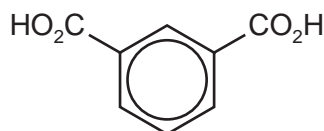
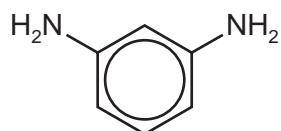
A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

- 1 (a) Polymers can be formed by addition or condensation polymerisation. Complete the table.

polymer	method of polymerisation
nylon	
PVC (polychloroethene)	
<i>Terylene</i>	

[1]

- (b) *Nomex* is a polymeric material with excellent flame-resistant properties. It contains a polymer made from the two monomers shown below.



Draw the structure of the polymer showing **two** repeat units. The linkages between monomer units should be shown fully displayed.

[2]

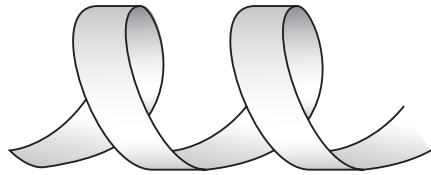
- (c) Proteins are natural polymers. Explain what is meant by the *primary structure* of a protein.

.....

.....

..... [1]

- (d) Use the diagram to show an example of how the α -helix secondary structure in proteins is stabilised.



.....
..... [2]

- (e) The tertiary structure of a protein is destroyed during the process of denaturation. Explain how this can occur by

(i) the addition of alkali,

.....
.....

(ii) the addition of Hg^{2+} ions,

.....
.....

(iii) heating to 70°C .

.....
.....

[3]

[Total: 9]

2 Crotonaldehyde, $\text{CH}_3\text{CH}=\text{CHCHO}$, occurs in soybean oils.

- (a) In the boxes below, write the **structural formula** of the organic compound formed when crotonaldehyde is reacted separately with each reagent under suitable conditions. If you think no reaction occurs, write 'NO REACTION' in the box.

reaction	reagent	product
A	Br_2 in an inert organic solvent	
B	PCl_3	
C	H_2 and Ni catalyst	
D	NaBH_4	
E	$\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+$	

[5]

- (b) Crotonaldehyde exists in more than one stereoisomeric form. Draw the **displayed formulae** of the **stereoisomers** of crotonaldehyde. Label **each** isomer.

[3]

(c) Draw the **skeletal formula** of crotonaldehyde.

[1]

(d) The product of reaction E in the table opposite will react with a solution containing acidified manganate(VII) ions.
Draw the **structural formulae** of the organic products when the reagent is

(i) cold, dilute;

(ii) hot, concentrated.

[3]

[Total: 12]

3 Compounds containing the allyl group, $\text{CH}_2=\text{CHCH}_2-$, have pungent smells and are found in onions and garlic.

Allyl alcohol, $\text{CH}_2=\text{CHCH}_2\text{OH}$, is a colourless liquid which is soluble in water.

(a) Allyl alcohol behaves as a primary alcohol and as an alkene.

Give the structural formula of the organic compound formed when allyl alcohol is reacted separately with each of the following reagents.

(i) acidified potassium dichromate(VI), heating under reflux

(ii) bromine in an inert organic solvent

(iii) cold, dilute, acidified potassium manganate(VII)

(iv) hot, concentrated, acidified potassium manganate(VII)

[5]

(b) Allyl alcohol undergoes the following reactions.

(i) When reacted with concentrated HCl at 100°C , $\text{CH}_2=\text{CHCH}_2\text{Cl}$ is formed.

State as fully as you can what *type of reaction* this is.

.....

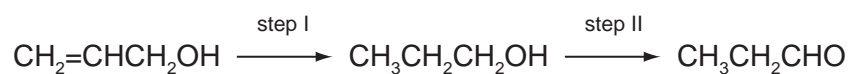
(ii) When reacted with MnO_2 at room temperature, $\text{CH}_2=\text{CHCHO}$ is formed.

What *type of reaction* is this?

.....

[2]

(c) Allyl alcohol can be converted into propanal in two steps.



(i) What reagents and conditions would be used for **each** step?

step I

reagent(s)

condition(s)

step II

reagent(s)

condition(s)

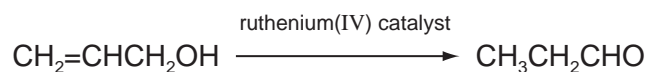
(ii) Allyl alcohol and propanal are isomers.

What form of isomerism do they display?

.....

[5]

(d) Allyl alcohol may also be converted into propanal by using a ruthenium(IV) catalyst in water.



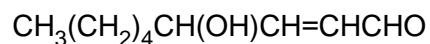
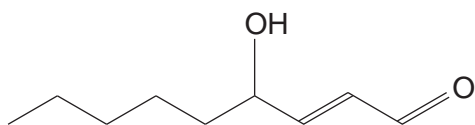
Suggest what is unusual about this single step reaction.

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..... [1]

[Total: 13]

- 4 The compound *trans*-4-hydroxy-2-nonenal (HNE) is thought to lead to infections of the lung when cigarettes are smoked.



***trans*-4-hydroxy-2-nonenal**

- (a) What is the empirical formula of *trans*-4-hydroxy-2-nonenal?

.....

[1]

- (b) (i) HNE contains an alkene group. Name as fully as you can **two** other functional groups which are present in the HNE molecule.

.....

.....

- (ii) How would you confirm the presence of the alkene group in HNE?
State the reagent used and the observation you would make.

reagent

observation

[5]

HNE is a reactive compound.

(c) Give the structural formulae of all of the carbon-containing compounds formed in each case when HNE is reacted separately with the following reagents.

(i) hot concentrated manganate(VII) ions in acid solution

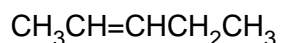
(ii) hot phosphorus trichloride, PCl_3

(iii) sodium tetrahydridoborate(III), $NaBH_4$

[4]

[Total: 10]

5 The structural formulae of six different compounds, **P – U**, are given below.



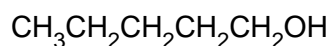
P



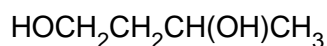
Q



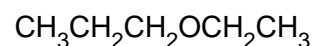
R



S



T



U

(a) (i) What is the empirical formula of compound **T**?

.....

(ii) Draw the skeletal formula of compound **S**.

[2]

(b) (i) Compounds **S** and **U** are isomers.

What type of isomerism do they show?

.....

(ii) Two of the six formulae **P – U** can **each** be drawn in two forms which are known as stereoisomers.

Which two compounds have formulae that can be drawn in two forms?

What type of stereoisomerism does each show?

Identify each compound by its letter.

compound	type of stereoisomerism

[3]

(c) Compound **S** can be converted into compound **R**.

(i) What type of reaction is this?

.....

(ii) What reagent would you use for this reaction?

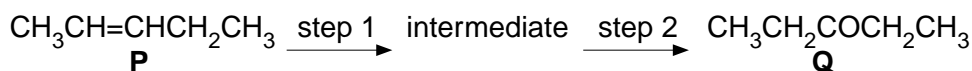
.....

(iii) Write the structural formula of the compound formed when **T** undergoes the same reaction using an excess of the reagent you have used in (c)(ii).

.....

[3]

(d) Compound **P** may be converted into compound **Q** in a two-step reaction.



(i) What is the structural formula of the intermediate compound formed in this sequence?

(ii) Outline how step 1 may be carried out to give this intermediate compound.

.....
.....
.....

(iii) What reagent would be used for step 2?

.....

[4]

[Total: 12]