

# Alkenes

## Question Paper 1

<b>Level</b>	International A Level
<b>Subject</b>	Chemistry
<b>Exam Board</b>	CIE
<b>Topic</b>	Hydrocarbons
<b>Sub-Topic</b>	Alkenes
<b>Paper Type</b>	Theory
<b>Booklet</b>	Question Paper 1

**Time Allowed:** 70 minutes

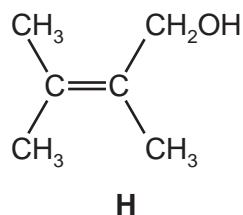
**Score:** /58

**Percentage:** /100

**Grade Boundaries:**

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

1 The structure of **H** is shown.



(a) **H** reacts with both cold, dilute, acidified potassium manganate(VII) and with hot, concentrated, acidified potassium manganate(VII).

(i) Give the structure of the organic product of the reaction of **H** with cold, dilute, acidified potassium manganate(VII).

[1]

(ii) Give the structures of the organic products of the reaction of **H** with hot, concentrated, acidified potassium manganate(VII).

[2]

(b) (i) Complete the reaction scheme to show the mechanism of the reaction of **H** with bromine to form **J**.

Include all necessary curly arrows, lone pairs and charges.



[3]

**(ii)** Explain the origin of the dipole on the bromine molecule.

.....  
..... [1]

**J** is formed as an equimolar mixture of isomers.

**(iii)** State the type of isomerism shown by **J**.

..... [1]

**(iv)** Draw the structures of the two isomers of **J**.

[2]

[Total: 10]

2 Alkanes and alkenes both react with bromine.

(a) Explain how and why bromine can be used to distinguish between an alkene and an alkane.

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

(b) The reaction of ethane with bromine forms a mixture of products.

(i) State the essential conditions for this reaction to occur.

..... [1]

(ii) Give the full name of the mechanism of this reaction.

..... [2]

(iii) Give the equation for a **termination** step that could occur, producing a **hydrocarbon**.

..... [1]

(iv) Give the equation for one **propagation** step involved in the formation of dibromoethane from bromoethane during this reaction.

..... [1]

(c) The reaction of ethene with bromine forms a single product.

(i) Give the full name of the mechanism of this reaction.

..... [2]

(ii) Complete the diagram below to illustrate this mechanism.  
 Include all relevant charges, partial charges, curly arrows and lone pairs.

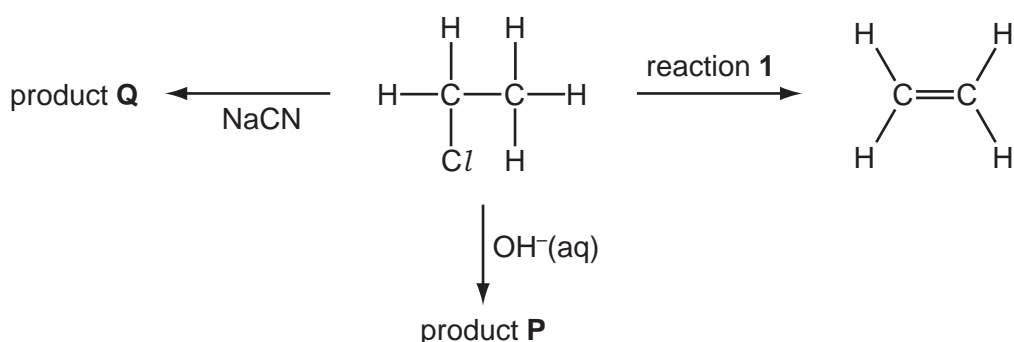


[4]

- (d) Chloroethene can be polymerised to form a polymer commonly known as PVC. Draw a diagram of the structure of PVC including **three** repeat units.

[2]

- (e) Chloroethane undergoes a series of reactions as shown in the diagram below.



- (i) Give the reagent and conditions necessary for reaction 1.

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

- (ii) Give the **skeletal** formula of product P.

[1]

- (iii) Give the **displayed** formula and the name of product Q.

..... [2]

[Total: 20]

- 3 A hydrocarbon, **P**, with the formula  $C_6H_{12}$  readily decolourises bromine.

On reaction with hot, concentrated, acidified potassium manganate(VII) solution a single organic product, **Q**, is obtained.

**Q** gives an orange precipitate when reacted with 2,4-dinitrophenylhydrazine, 2,4-DNPH reagent, but has no reaction with Tollens' reagent.

- (a) (i) Explain these observations.

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.....

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.....

.....

..... [4]

- (ii) Draw the skeletal formula of **P** and give its name.

name of **P** ..... [2]

- (iii) Draw the skeletal formula of **Q** and give its name.

name of **Q** ..... [2]

- (b) There are several structural isomers of **P** that also decolourise bromine, but only four of these structural isomers exhibit geometrical (cis-trans) isomerism.

Give the structures of any **three** structural isomers of **P** that exhibit geometrical (cis-trans) isomerism.

[3]

[Total: 11]

4 **P**, **Q**, **R** and **S** are structural isomers with the molecular formula  $C_5H_{10}$ .

All four compounds readily decolourise bromine in the dark.

**P**, **R** and **S** do not exhibit stereoisomerism but **Q** exists as a pair of geometrical (cis-trans) isomers.

All four compounds react with hot concentrated, acidified potassium manganate(VII) to produce a variety of products as shown in the table.

compound	products
<b>P</b>	$CO_2$ and $CH_3CH_2CH_2CO_2H$
<b>Q</b>	$CH_3CO_2H$ and $CH_3CH_2CO_2H$
<b>R</b>	$CO_2$ and <b>T</b> ( $C_4H_8O$ )
<b>S</b>	$CH_3CO_2H$ and $(CH_3)_2CO$

**T** reacts with 2,4-dinitrophenylhydrazine reagent, 2,4-DNPH, to form an orange crystalline product but does not react with Fehling's reagent.

(a) Give the structural formulae of **P**, **Q**, **R**, **S** and **T**.

**P** ..... **Q** .....

**R** ..... **S** .....

**T** ..... [5]

(b) (i) Explain what is meant by the term *stereoisomerism*.

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



(ii) Draw the **displayed** formulae of the geometrical isomers of **Q** and name them both.

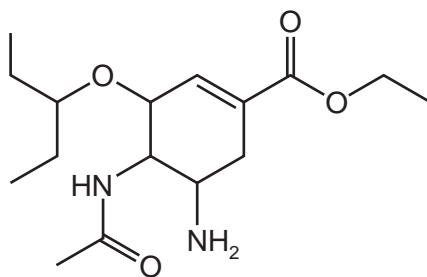
name ..... name ..... [2]

(c) Name the organic product of the reaction of **T** with sodium borohydride,  $\text{NaBH}_4$ .

..... [1]

[Total: 10]

- 5 (a) Oseltamivir is an antiviral drug that slows the spread of the influenza( flu)virus.



oseltamivir

Circle **two** bonds, each in a different functional group, that could be easily hydrolysed in the body. [2]

- (b) Oseltamivir is a chiral drug. This drug is usually taken as a single optical isomer rather than as a mixture of isomers.

Suggest **one** benefit of taking a drug in this way.

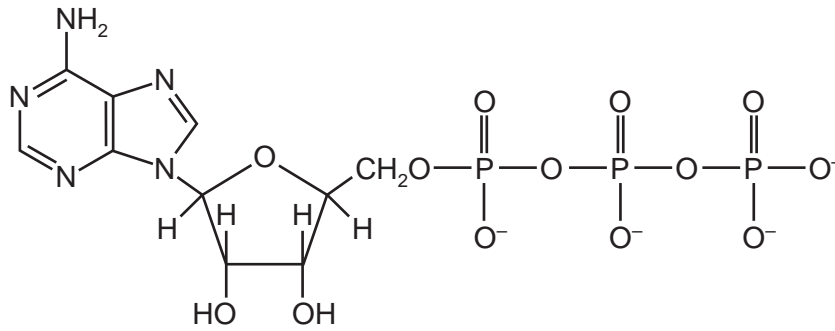
.....  
..... [1]

- (c) Oseltamivir is a competitive inhibitor of an enzyme produced by the flu virus.

Explain the meaning of the term *competitive inhibitor* and state how its action could be overcome.

.....  
.....  
..... [3]

(d) ATP plays an important role in metabolic reactions in living organisms.



ATP

What is the function of ATP in living organisms?

.....  
..... [1]

[Total: 7]