

# Alkenes

## Question Paper 2

<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 2

**Time Allowed:** 74 minutes

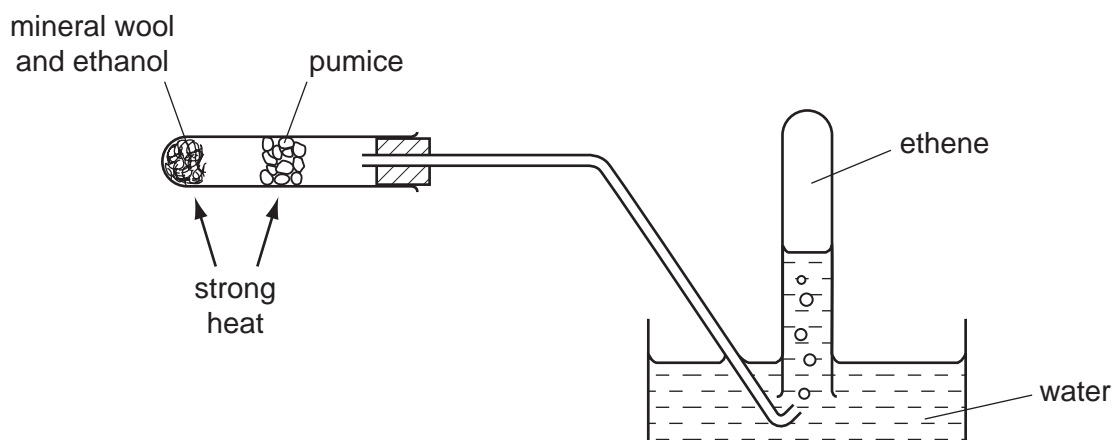
**Score:** /61

**Percentage:** /100

**Grade Boundaries:**

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

- 1 One method of preparing ethene in a school or college laboratory is from ethanol by using the apparatus shown below.



- (a) Write a balanced equation for this reaction.

.....

- (ii) What *type of reaction* is this?

.....

- (iii) Give the chemical name of a reagent other than pumice that could be used to carry out this reaction. It is not necessary to use the same apparatus.

.....

[3]

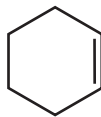
- (b) Ethene is bubbled into two separate test-tubes, one containing aqueous hydrogen bromide and the other containing cold, dilute acidified potassium manganate(VII).

In **each** case, describe any colour changes you would see and give the structural formula of the organic product.

	aqueous hydrogen bromide	cold, dilute acidified potassium manganate(VII)
colour at start		
colour after reaction		
structural formula of organic product		

[4]

(c) Cyclohexene has the following structural formula.



(i) What is the molecular formula of cyclohexene?

.....

(ii) Draw the structural formula of the compound formed when cyclohexene is reacted with bromine.

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

.....

(iv) Draw the structural formula of the compound formed when cyclohexene is reacted with hot concentrated acidified potassium manganate(VII).

[5]

[Total: 12]

- 2 But-2-ene,  $\text{CH}_3\text{CH}=\text{CHCH}_3$ , is an important compound which is obtained from the cracking of hydrocarbons present in crude oil.

(a) Give **two** different conditions under which long chain hydrocarbons may be cracked.

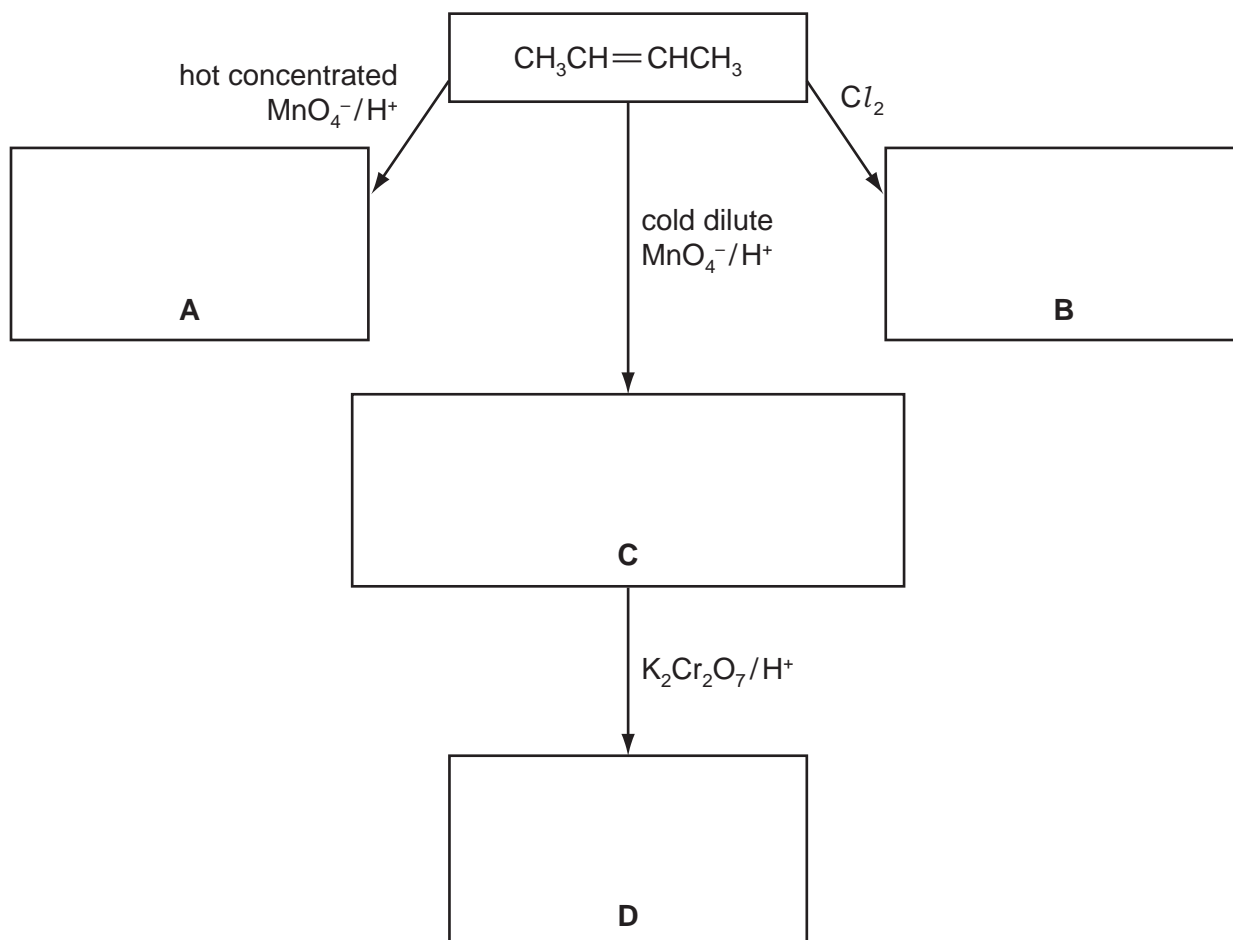
.....  
 .....  
 ..... [2]

(b) Dodecane,  $\text{C}_{12}\text{H}_{26}$ , is a long chain hydrocarbon which is present in crude oil and which can be cracked to form but-2-ene and an alkane.

Write a balanced equation for this reaction.

..... [1]

(c) Some reactions of but-2-ene are shown below.  
 In the boxes below, give the **structural** formulae of the organic compounds **A** to **D**.



(d) Draw the **skeletal** formula of compound **D**.

(ii) By using the letters **A** to **D** as appropriate, identify those compounds which are chiral. If there are none, write 'none'.

.....

[3]

(e) But-2-ene can be polymerised to give poly(butene).

Draw the **structural** formula of a portion of the polymer chain in poly(butene) showing **two** repeat units.

[1]

(f) Compound **C** is a liquid which can be reacted with concentrated sulfuric acid to give a gas, **E**, which will decolourise aqueous bromine when passed through it.

(i) Suggest the **structural** formula of **E**.

(ii) Suggest the **structural** formula of the product of the reaction between **E** and an excess of bromine.

(iii) What *type of reaction* occurs between **E** and an excess of bromine?

.....

[3]

[Total: 14]

- 3 Some of the most commonly used polymers are formed by the polymerisation of ethene,  $C_2H_4$ . The presence of side-chains affects the bulk properties of an addition polymer. Unbranched polymers pack closer together than polymers with several side-chains.

Poly(ethene) exists in two different forms LDPE (low density poly(ethene)) which has lots of side-chains, and HDPE (high density poly(ethene)) in which there are fewer and shorter side-chains.

- (a) Explain with the aid of sketches why the presence of side-chains causes a difference in density in poly(ethene).

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

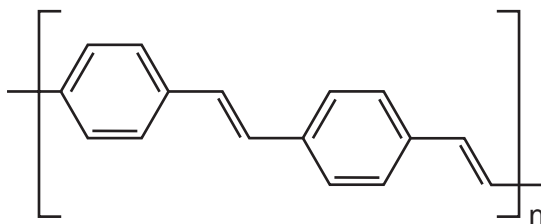
- (b) By reference to the type of bonding between the poly(ethene) chains, explain why LDPE has a lower melting point than HDPE.

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

- (c) Polymerisation can take place by two different methods depending on the monomers involved. The two methods are addition and condensation. Give **two** differences between the methods.

1. ....  
.....  
2. ....  
.....  
[2]

- (d) There has been a great deal of commercial interest in the development of polymers that can conduct electricity and/or emit light. A length of one such polymer is shown.



- (i) Suggest how this polymer conducts electricity.

.....

- (ii) Suggest the molecular geometry required for this molecule to conduct.

Explain your answer.

.....

.....

- (iii) What is the empirical formula of this polymer?

.....

[4]

[Total: 10]

- 4 The molecular formula  $C_4H_8O$  can represent a number of compounds which have different functional groups and which show different types of isomerism. Compounds **H**, **J** and **K** each have the molecular formula  $C_4H_8O$ . In **each** of the molecules of **H**, **J** and **K**,

- the carbon chain is unbranched and the molecule is not cyclic,
- no oxygen atom is attached to any carbon atom which is involved in  $\pi$  bonding.

When compound **H** is reacted with sodium metal, a colourless flammable gas is produced.

Both **J** and **K** give an orange-red precipitate when reacted with 2,4-dinitrophenylhydrazine reagent but only **K** reacts with Fehling's solution.

- (a) Suggest possible structural formulae for **H**, **J** and **K**.  
Three structural formulae are possible for **H** but only one for **J** and one for **K**.

<b>H</b>	<b>J</b>	



In addition to being structural isomers of each other, some of the possible structures for **H**, **J** or **K** show *cis-trans* isomerism or are chiral.

**(ii)** Draw the displayed formulae of those isomers which show *cis-trans* isomerism.

**(iii)** Draw the displayed formulae of those isomers which are chiral, indicating in each case the chiral carbon atom with an asterisk (\*).

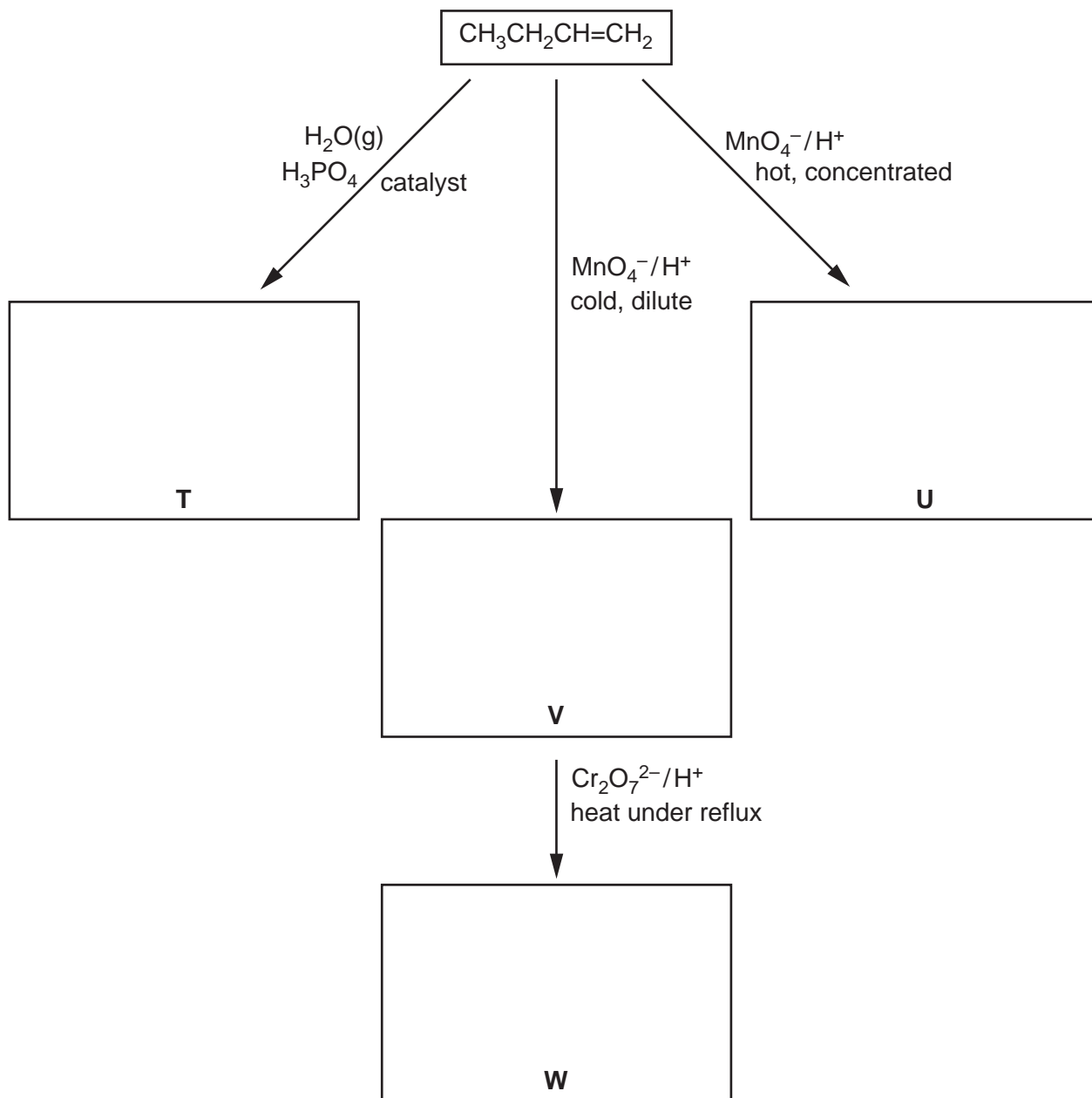
[8]

[Total: 8]

5 But-1-ene,  $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$ , is an important compound in the petrochemical industry.

(a) Some reactions of but-1-ene are given below.

In **each** empty box, draw the structural formula of the organic compound formed.



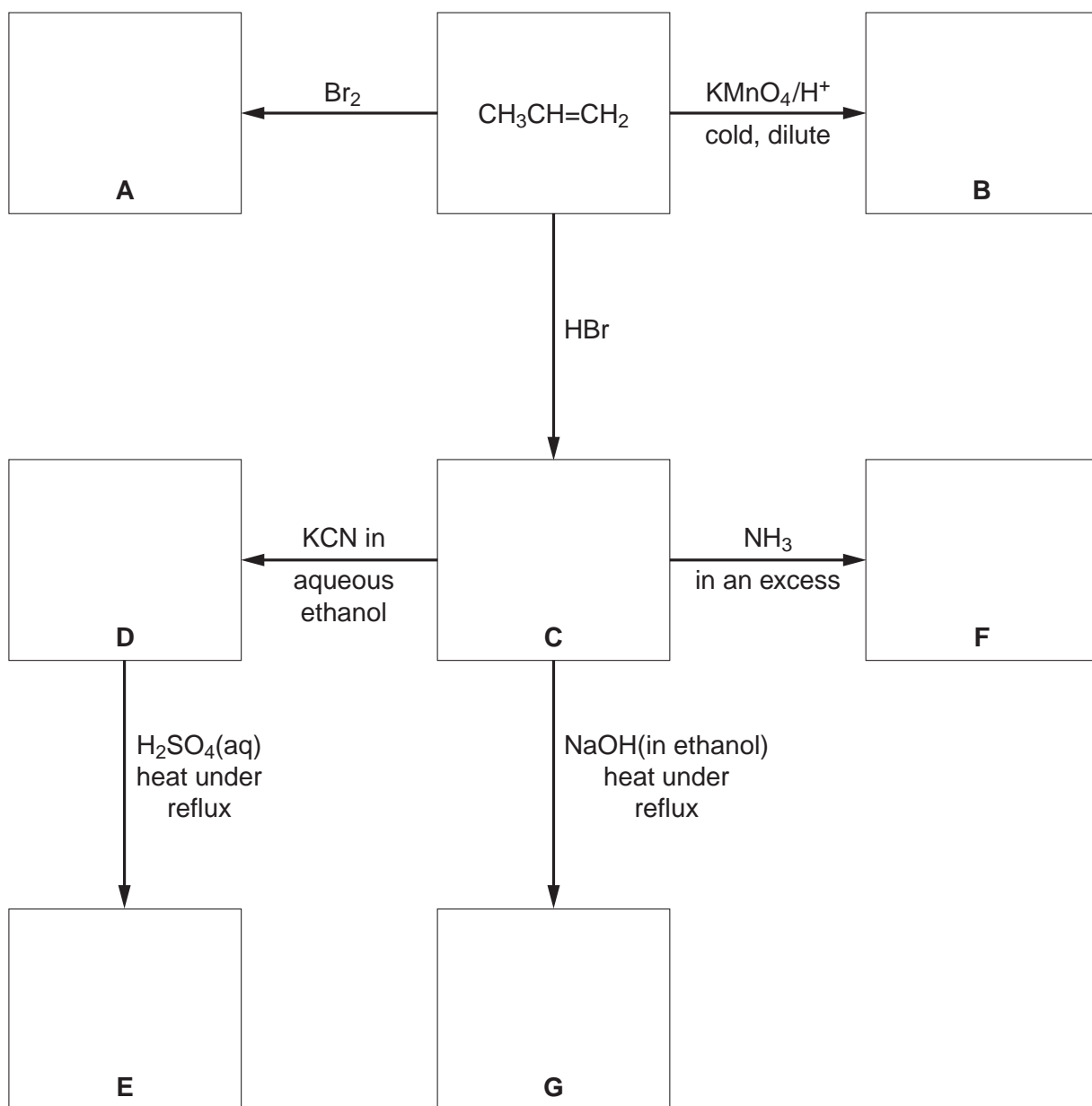
**(b)** Compound **T** reacts with compound **U**.

Draw the **displayed** formula of the organic product of this reaction.

[2]

[Total: 7]

- 6 (a) Complete the following reaction scheme which starts with propene. In **each empty** box, write the **structural formula** of the organic compound that would be formed.



**(b)** Under suitable conditions, compound **E** will react with compound **B**.

**(i)** What functional group is produced in this reaction?

.....

**(ii)** How is this reaction carried out in a school or college laboratory?

.....

.....

[3]

[Total: 10]