



# **A-Level Chemistry**

## **Addition Reactions of Alkenes**

### **Question Paper**

**Time available: 66 minutes**

**Marks available: 62 marks**

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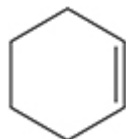
1.

Alkenes react with bromine ( $\text{Br}_2$ )

(a) Name and outline the mechanism for the reaction of cyclohexene with  $\text{Br}_2$

Name of mechanism \_\_\_\_\_

Outline of mechanism



(5)

(b) Explain why there is an attraction between a  $\text{C}=\text{C}$  double bond and  $\text{Br}_2$

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(3)

- (c) Draw the skeletal formula of the halogenoalkane formed when buta-1,3-diene ( $\text{CH}_2=\text{CHCH}=\text{CH}_2$ ) reacts with an excess of  $\text{Br}_2$

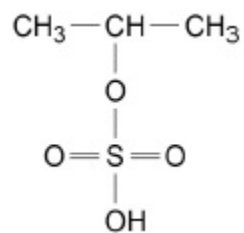
(1)

(Total 9 marks)

2.

Propene reacts with concentrated sulfuric acid to form two isomers, E and F.

The structure of **E** is shown.



(a) Name and outline the mechanism for the formation of **E** in this reaction.

Name of mechanism \_\_\_\_\_

Mechanism

(5)

(b) Draw the structure of **F**.

(1)

(c) Explain why more of isomer **E** than isomer **F** is formed in this reaction.

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(2)

(Total 8 marks)

**3.**

2-Methyl but-2-ene reacts with concentrated sulfuric acid to form two different products.

(a) Outline a mechanism for this reaction to show the formation of the major product.

(4)

(b) Draw the structure of the minor product of this reaction.

(1)

(c) Explain why the two products are formed in different amounts.

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(2)

(Total 7 marks)

4.

The alkene 3-methylpent-2-ene ( $\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)\text{CH}_2\text{CH}_3$ ) reacts with hydrogen bromide to form a mixture of 3-bromo-3-methylpentane and 2-bromo-3-methylpentane.

(a) The alkene 3-methylpent-2-ene ( $\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)\text{CH}_2\text{CH}_3$ ) exists as *E* and *Z* stereoisomers.

Draw the structure of *Z*-3-methylpent-2-ene.

(1)

(b) Name and outline the mechanism for the formation of 3-bromo-3-methylpentane from this reaction of 3-methylpent-2-ene with hydrogen bromide.

Explain why more 3-bromo-3-methylpentane is formed in this reaction than 2-bromo-3-methylpentane.

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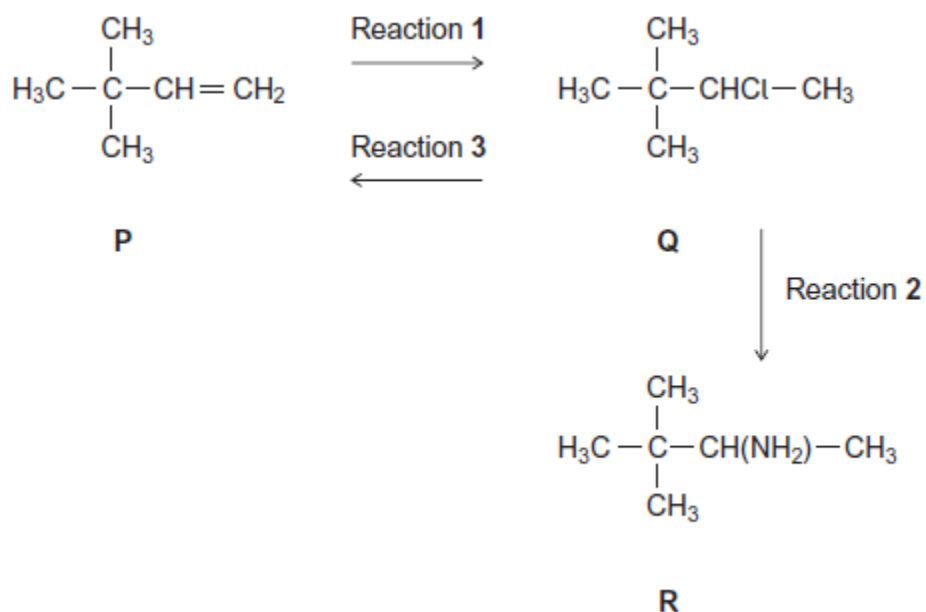
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**(7)**

**(Total 8 marks)**

**5.**

Consider the following scheme of reactions.



- (a) Give the IUPAC name for compound **P** and that for compound **Q**.

**P** \_\_\_\_\_

**Q** \_\_\_\_\_

(2)

- (b) The conversion of **P** into **Q** in Reaction 1 uses HCl

Name and outline a mechanism for this reaction.

\_\_\_\_\_

(5)

- (c) The conversion of **Q** into **R** in Reaction 2 uses NH<sub>3</sub>

Name and outline a mechanism for this reaction.

\_\_\_\_\_

(5)



(d) State the type of reaction shown by Reaction 3.

Identify a reagent for this reaction.

Give **one** condition necessary for a high yield of product when **Q** is converted into **P**.

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(3)

(e) Hydrogen bromide (HBr) could be used in the overall conversion of **P** into **R**, instead of using HCl

Hydrogen bromide is made by the reaction of NaBr with concentrated phosphoric acid.  
Concentrated sulfuric acid is **not** used to make HBr from NaBr

Write an equation for the reaction of NaBr with  $\text{H}_3\text{PO}_4$  to produce HBr and  $\text{Na}_3\text{PO}_4$  only.

Identify **two** toxic gases that are formed, together with HBr, when NaBr reacts with concentrated  $\text{H}_2\text{SO}_4$

State the role of  $\text{H}_2\text{SO}_4$  in the formation of these two toxic gases.

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(4)

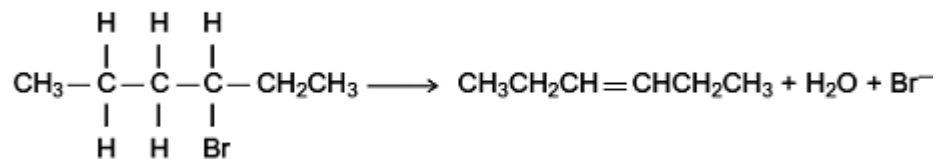
(Total 19 marks)

**6.**

Alkenes are useful intermediates in the synthesis of organic compounds.

- (a) (i) Complete the elimination mechanism by drawing appropriate curly arrows.

$\text{HO}^-$ :



3-bromohexane

hex-3-ene

(3)

- (ii) Draw structures for the E and Z stereoisomers of hex-3-ene.

E isomer of hex-3-ene

Z isomer of hex-3-ene

(2)

- (iii) State the meaning of the term *stereoisomers*.

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(2)

- (b) The equation for the first reaction in the conversion of hex-3-ene into hexan-3-ol is shown below.



Outline a mechanism for this reaction.

**(4)**

**(Total 11 marks)**