

## EXAM-STYLE QUESTIONS – AS Organic Reaction Mechanisms

**Preface**

The questions in this resource are based on past exam questions, and are designed to be challenging. The purpose of this resource is as a self-assessment exercise, which you can then look back over using specially made talking mark schemes, explaining the answers to the problems, the process in answering them, and the chemistry theory. If there are questions that you don't feel you know the answer to, or cover material you don't think you have studied, please try to apply your knowledge to come up with an answer. This exercise is not about getting everything right, but learning from mistakes, and will allow you to understand the fundamental principles behind mechanistic organic chemistry ready for your exams and future studies.

1 Both ethane and ethene can be used to produce chloroethane,  $C_2H_5Cl$ .

(a) (i) State the reagent and condition that can be used to make chloroethane from **ethane**.

Reagent:.....

Condition:.....

(2 marks)

(ii) What type of reaction mechanism does this occur by?

.....

(2 marks)

(b) (i) State the reagent used to make chloroethane from **ethene**.

.....

(1 mark)

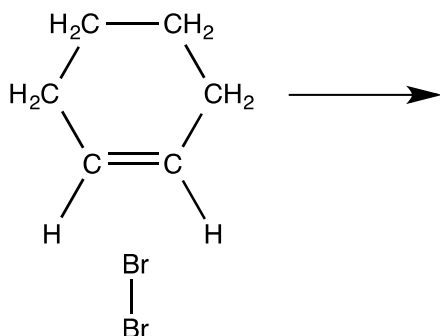
(ii) Draw a mechanism showing how chloroethane is formed from **ethene**.

Show relevant dipoles and charges.

(3 marks)

2 Cyclohexene can react with bromine, Br<sub>2</sub>, to form a halogenoalkane.

Draw and name the mechanism for this reaction, showing relevant dipoles and charges.



Name of mechanism: .....

(5 marks)

3 Halogenoalkanes are important compounds in several reactions. The list below shows the formulae of some halogenoalkanes.

<b>A</b>	CH <sub>3</sub> Cl	<b>E</b>	(CH <sub>3</sub> ) <sub>3</sub> CI
<b>B</b>	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> I	<b>F</b>	CH <sub>3</sub> CHC/CH <sub>2</sub> CHICH <sub>3</sub>
<b>C</b>	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> Br	<b>G</b>	CH <sub>3</sub> CH <sub>2</sub> CHC/CH <sub>3</sub>
<b>D</b>	CH <sub>3</sub> CH <sub>2</sub> F		

(a) Give the letter of the halogenoalkane that is highly **unreactive**.

.....

(1 mark)

(b) Halogenoalkanes can form alcohols by reacting with hot potassium hydroxide, KOH(aq).

(i) Which of the above halogenoalkanes will react to form a **diol** (a molecule with two OH groups)?

.....

(1 mark)

- (ii) Draw the mechanism of the reaction between  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$  and hot  $\text{KOH}(\text{aq})$  using the curly arrow model. State the name of the mechanism, and include any relevant dipoles.

Name of mechanism: .....(4 marks)

- (iii) A student reacts these halogenoalkanes with hot  $\text{KOH}(\text{aq})$ , and measures the rate of reaction. She observes that the reaction of **C** with hot  $\text{KOH}(\text{aq})$  is **slower** than the reaction of **B** with hot  $\text{KOH}(\text{aq})$ . Give a reason for this observation.

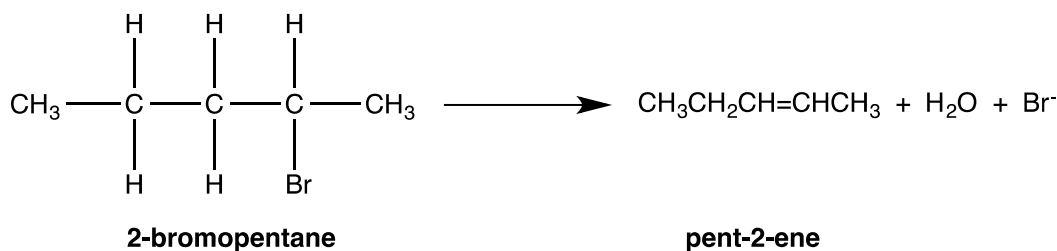
.....  
.....  
.....

(1 mark)

- 4 Alkenes are unsaturated compounds that can be used in organic synthesis. They can be formed in **elimination** reactions of halogenoalkanes. An example of this is the reaction between 2-bromopentane and hot ethanolic  $\text{KOH}$ .

Using your knowledge of reaction mechanisms, draw appropriate curly arrows to complete the elimination mechanism for this reaction, forming the major product pent-2-ene.

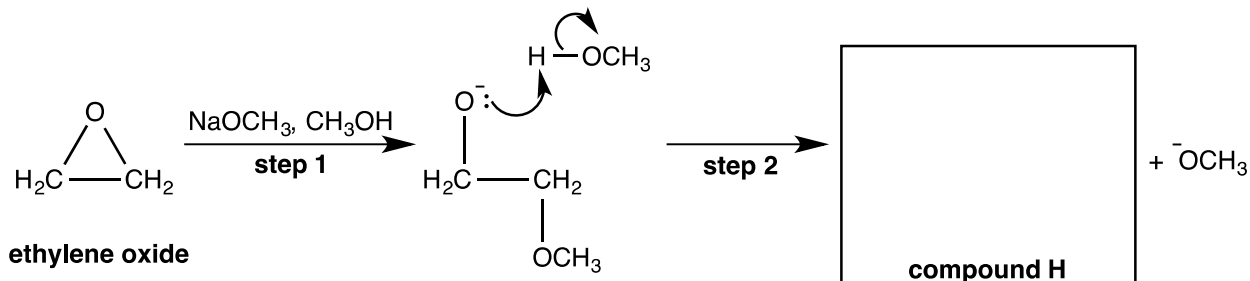
$\text{HO}^-$



(3 marks)

## EXTENSION QUESTION

- 5 Ethylene oxide is commonly used in many organic reactions, and falls into a class of compounds known as epoxides. The reaction scheme below shows how ethylene oxide can react with a nucleophilic species under basic conditions to form an alcohol.



- (a) Define the term **nucleophile**.

.....

(1 mark)

- (b) Draw the structure of compound **H**, the product of the reaction.

(1 mark)

- (c) Draw a mechanism to show how **step 1** of this reaction proceeds. Use  $\text{:OCH}_3^-$  as the nucleophile, and include relevant dipoles.

(3 marks)

**TOTAL MARKS: 28**