

## Haloalkane Substitution

Subject &amp; topics

Chemistry | Organic | Reactions

Status

Not started

Stage &amp; difficulty

A Level Practice 1



### Part A

#### 2-Iodobutane and sodium ethoxide

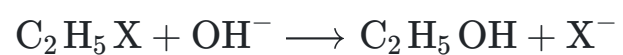
What is the product of a nucleophilic substitution reaction between 2-iodobutane and sodium ethoxide ( $\text{NaOC}_2\text{H}_5$ )?

- ☐  $\text{CH}_3\text{CH}=\text{CHCH}_3$
- ☐  $\text{CH}_3\text{CH}_2\text{CH}(\text{OCH}_3)\text{CH}_2\text{CH}_3$
- ☐  $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{OCH}_2\text{CH}_3$
- ☐  $(\text{CH}_3)_2\text{CHCH}_2\text{OCH}_2\text{CH}_3$

**Part B**



Why does the reaction



take place more rapidly in aqueous solution when X is I than when X is Br?

- ☐ The  $\text{I}^-$  ion is a stronger nucleophile than the  $\text{Br}^-$  ion.
- ☐ The  $\text{I}^-$  ion is less hydrated in solution than the  $\text{Br}^-$  ion.
- ☐ The C–Br bond is weaker than the C–I bond.
- ☐ The C–Br bond is stronger than the C–I bond.

Part A adapted with permission from UCLES, A-Level Chemistry, June 1994, Paper 4, Question 22;

Part B adapted with permission from UCLES, A-Level Chemistry, June 1995, Paper 4, Question 20

## Haloalkane Substitution Mechanism

Subject & topics

[Chemistry](#) | [Organic](#) | [Reactions](#)

Status

Not started

Stage & difficulty

A Level Practice 1



Part A

Energy profile

Halogenoalkanes react with aqueous alkali. One mechanism of this reaction has the energy profile shown below.

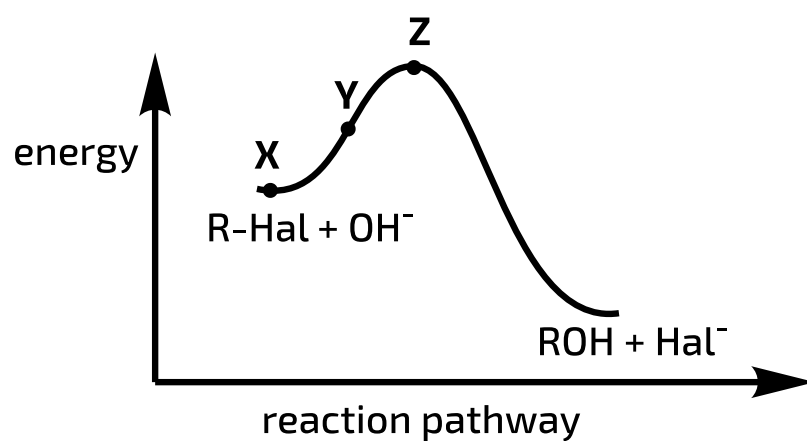


Figure 1: Energy profile for haloalkane with aqueous alkali

Which of the following statements are correct?

1. The reaction is an example of nucleophilic substitution.
2. Between **X** and **Z** the  $\text{C-Hal}$  bond will be lengthening.
3. The energy difference between **X** and **Y** represents the activation energy.

- ☐ 1, 2 and 3 are correct
- ☐ 1 and 2 only are correct
- ☐ 1 and 3 only are correct
- ☐ 2 and 3 only are correct
- ☐ 1 only is correct
- ☐ 2 only is correct
- ☐ 3 only is correct

Part B

Curly arrow mechanism

Which diagram correctly represents the transfer of electrons when ammonia reacts with a chloroalkane (alkyl chloride)?

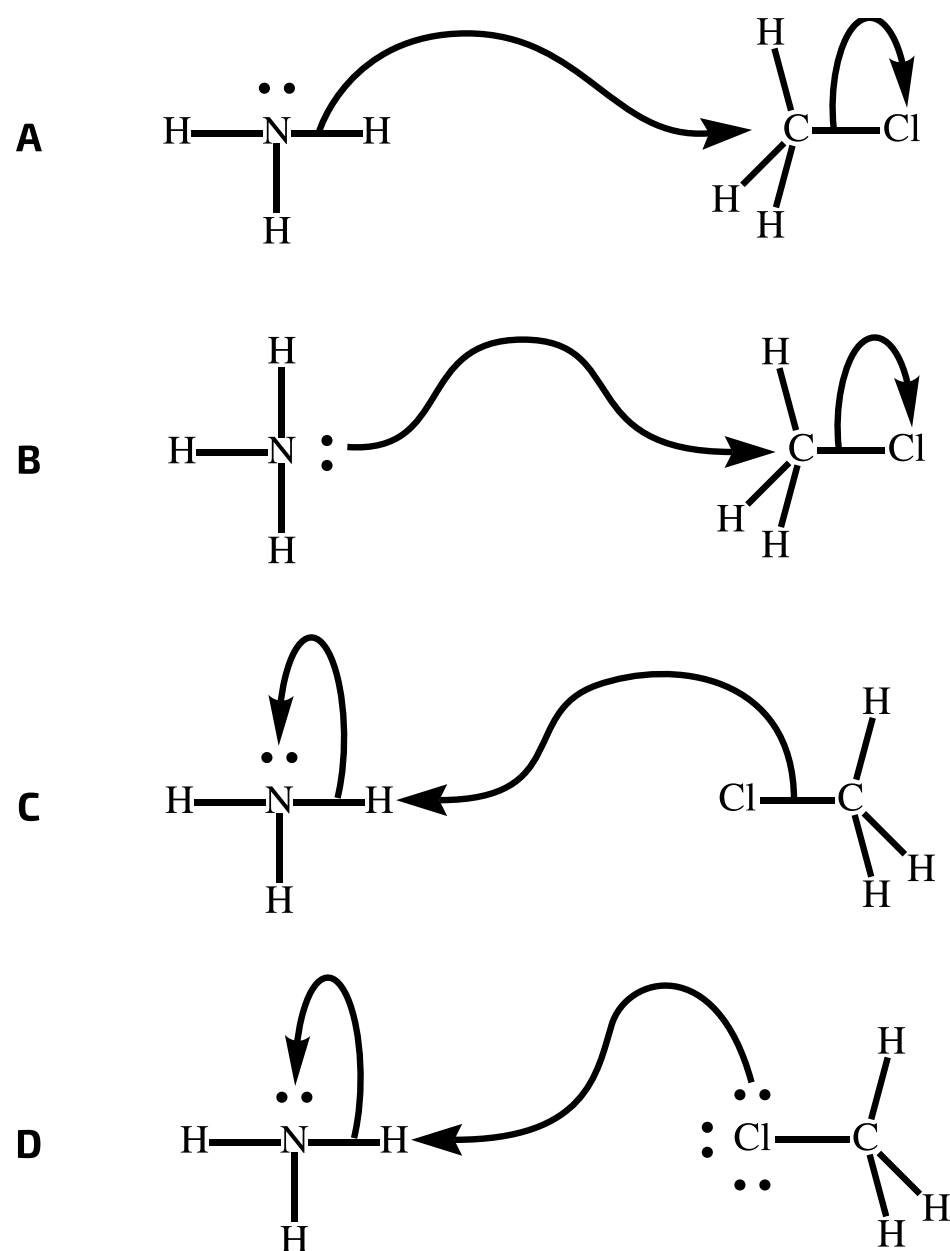


Figure 2: Possible mechanisms for ammonia with chloroalkane

- ☐ A
- ☐ B
- ☐ C
- ☐ D

Part A adapted with permission from UCLES, A-Level Chemistry, June 1993, Paper 4, Question 37;

Part B adapted with permission from UCLES, A-Level Chemistry, June 1994, Paper 4, Question 26

Question deck:



## Alkene Bromination

Subject & topics

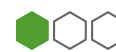
[Chemistry](#) | [Organic](#) | [Reactions](#)

Status

Not started

Stage & difficulty

A Level Practice 1



Part A

Bromination of  $C_4H_8$

Which of the following compounds could be formed by the action of bromine on an alkene of formula  $C_4H_8$ ?

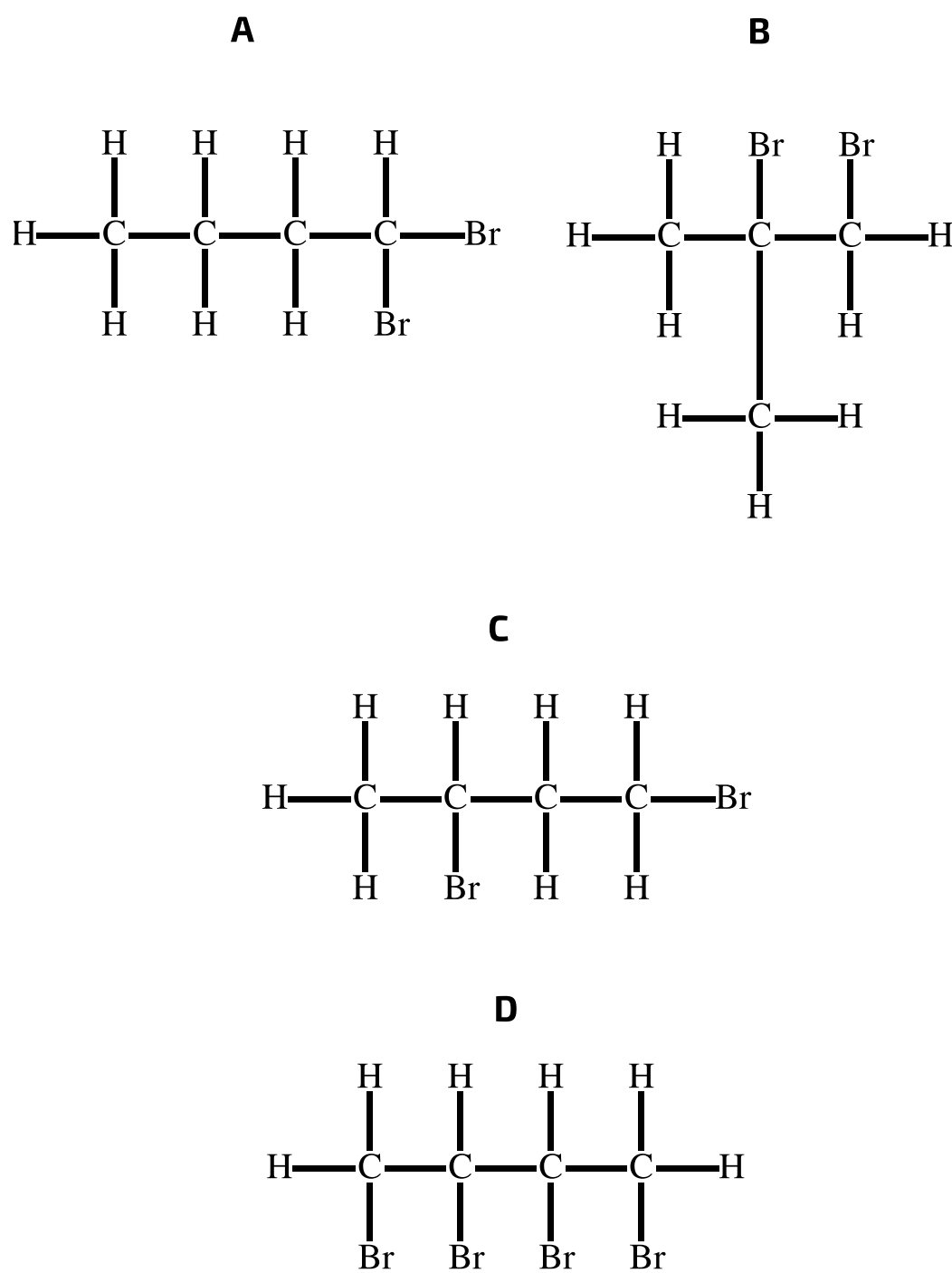


Figure 1: Possible products of  $C_4H_8$  with bromine

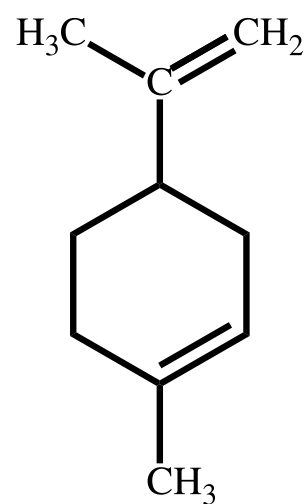
- ☐ A
- ☐ B
- ☐ C
- ☐ D



Part B

Bromination of limonene

Limonene is an oil formed in the peel of citrus fruits.

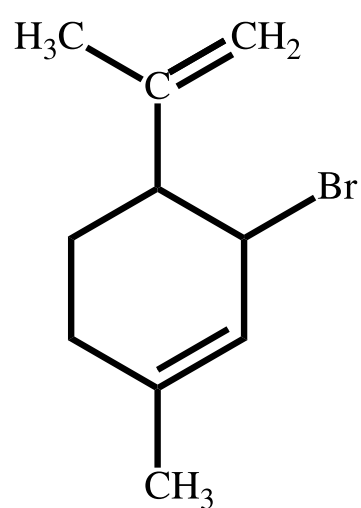


Limonene

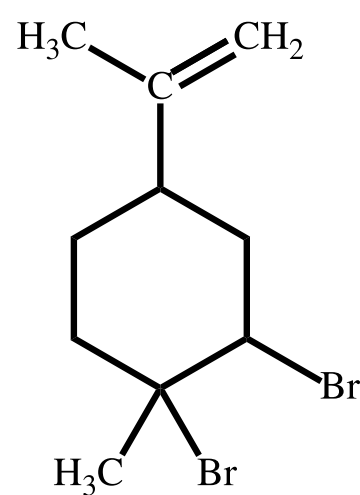
Figure 2: Structure of limonene

Which product is formed when limonene reacts with excess molecular bromine at room temperature in the dark?

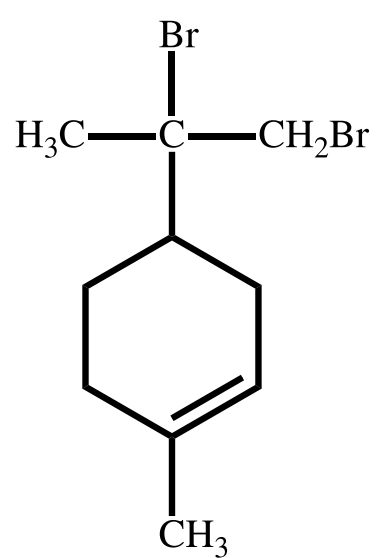
A



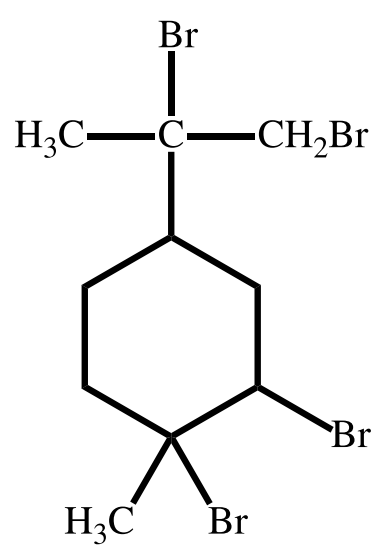
B



C



D



**Figure 3:** Possible products of limonene bromination

- ☐ A
- ☐ B
- ☐ C
- ☐ D

Part A adapted with permission from UCLES, A-Level Chemistry, November 1994, Paper 4, Question 22;

Part B adapted with permission from UCLES, A-Level Chemistry, November 1996, Paper 4, Question 22

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**STEM SMART Chemistry Week 25**

## Alkene Bromination Mechanism

Subject & topics

Chemistry | Organic | Reactions

Status

Not started

Stage & difficulty

A Level Practice 1



### Part A

#### Curly arrows

What is the sequence of curly arrows denoting movement of electrons in the first step of the reaction between ethene and bromine (below)?

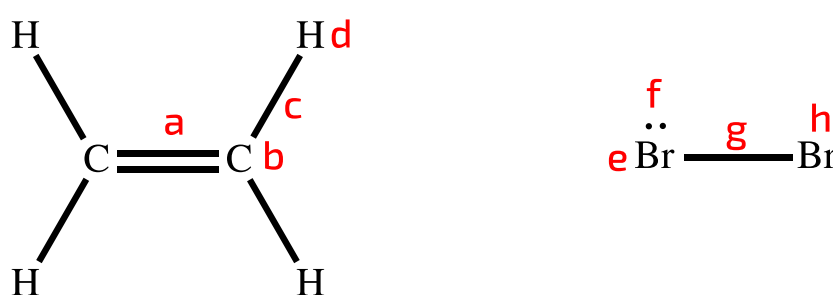


Figure 1: Bromination mechanism

For example in the reaction below, if you think the mechanism is as shown, your answer would be **cdef**.

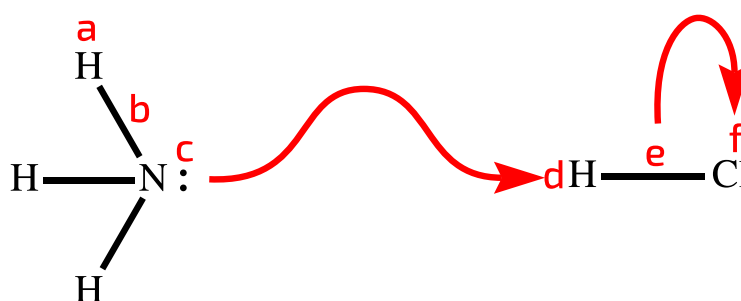


Figure 2: Sequence **cdef**

Ethene bromination sequence:

**Part B**

**Reaction type**

What type of reaction is this?

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## Alkenes With HBr

Subject & topics

[Chemistry](#) | [Organic](#) | [Reactions](#)

Status

Not started

Stage & difficulty

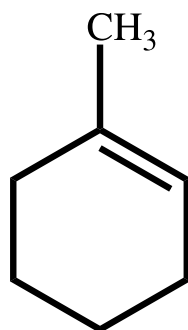
A Level Practice 2



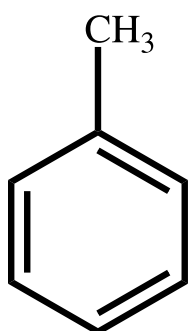
Part A

1-Methylcyclohexene with HBr

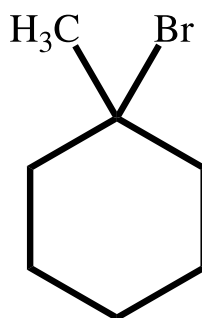
Which of the following structures represents the main organic compound produced when hydrogen bromide is added to 1-methylcyclohexene (shown below)?



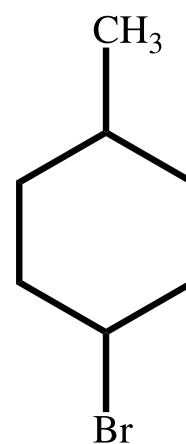
A



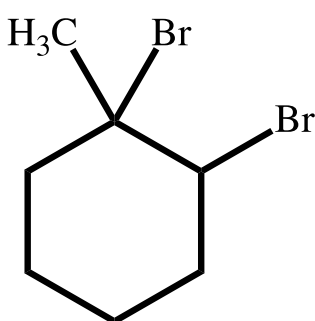
B



C



D



E

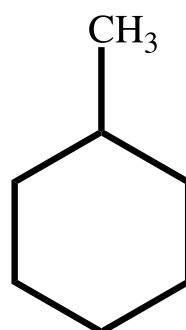


Figure 1: 1-methylcyclohexene and possible products of reaction with HBr

☐ A

☐ B

☐ C

☐ D

☐ E

## Part B

### Methylpropene with HBr

Methylpropene has the structure shown below.

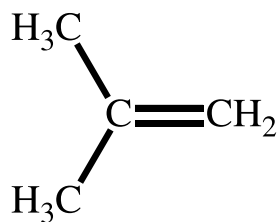


Figure 2: Structure of methylpropene

What is the **major** product formed when methylpropene reacts with HBr?

Use the [structure editor](#) to generate a SMILES string.

In the editor, after drawing your structure, click on the round, yellow smiley face to generate a SMILES string. Copy the SMILES string and paste it in the answer box.

[Using the structure editor](#)

Part A adapted with permission from OCSEB, A-Level Chemistry, June 1998, Paper 1, Question 22;

Part B created for Isaac Physics by R. Less

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**STEM SMART Chemistry Week 25**

## Alkene Reactions

Subject &amp; topics

Chemistry | Organic | Reactions

Status

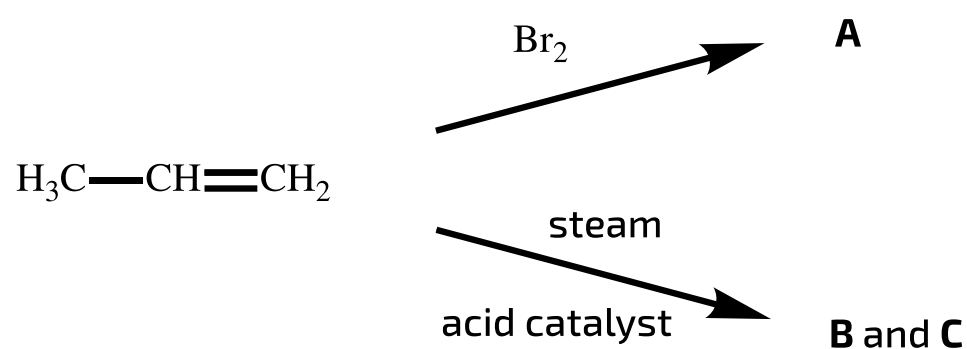
Not started

Stage &amp; difficulty

A Level Practice 2



Propene reacts under the following conditions to give compounds **A**, **B** and **C**.



**Figure 1:** Propene with bromine and steam in presence of an acid catalyst

### Part A with Br<sub>2</sub>

What is product **A**?

Use the [structure editor](#) to generate a SMILES string.

In the editor, after drawing your structure, click on the round, yellow smiley face to generate a SMILES string. Copy the SMILES string and paste it in the answer box.

[Using the structure editor](#)



**Part B**

**with steam / acid catalyst**

What are products **B** and **C**?

Use the [structure editor](#) to generate SMILES strings.

Give your answer in the format "**B, C**" (space after comma).

In the editor, after drawing your structure, click on the round, yellow smiley face to generate a SMILES string.  
Copy the SMILES string and paste it in the answer box.

[Using the structure editor](#)

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## More Alkene Bromination

Subject & topics		
Chemistry   Organic   Reactions		
Status	Stage & difficulty	
Not started	A Level Practice 1	



Compound **A** undergoes the following reactions:



### Part A

#### Bromination of compound **A**

What is compound **A**? (There are two possible isomers: give the structure of either.)

Use the [structure editor](#) to generate a SMILES string.

Click on the round, yellow smiley face to generate a SMILES string. Copy the SMILES string and paste it in the answer box.

[Using the structure editor](#)

### Part B

#### Step (II)

What type of reaction is step (II)?

**Part C**

**Ethene with aqueous bromine**

Ethene reacts with aqueous bromine to give the two products  $\text{CH}_2\text{BrCH}_2\text{Br}$  and  $\text{CH}_2\text{BrCH}_2\text{OH}$ .

Which statement is correct for these products?

- ☐ Both products are obtained in this reaction by nucleophilic addition.
- ☐ Both products can be hydrolysed to form the same diol.
- ☐ Both products possess an overall dipole.
- ☐ Reaction of ethene with aqueous  $\text{HBr}$  gives the same products.
- ☐ Both products are obtained in this reaction by electrophilic substitution.

Part A adapted with permission from UCLES, A-Level Chemistry, June 1991, Paper 3, Question 8;

Part B adapted with permission from UCLES, A-Level Chemistry, November 1993, Paper 4, Question 24

Question deck:

**STEM SMART Chemistry Week 25**

## Free Radical Reactions

Subject &amp; topics

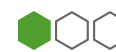
[Chemistry](#) | [Organic](#) | [Reactions](#)

Status

Not started

Stage &amp; difficulty

A Level Practice 1



### Part A

#### CFCs

In the upper atmosphere, chlorofluoroalkanes (CFCs) are broken down to give chlorine radicals but not fluorine radicals.

What is the best explanation for this?

- ☐ Fluorine has a lower atomic number.
- ☐ Chlorine has a higher molecular weight.
- ☐ The C—F bond is stronger than the C—Cl bond.
- ☐ Fluorine has a higher ionisation energy than chlorine.

**Part B**

**Chlorination of methane**

Methane reacts with chlorine in the presence of sunlight. Which statement about the intermediates is correct?

- ☐ They are more energetically stable than the reactants.
- ☐ They are positively charged ions.
- ☐ They combine to form HCl.
- ☐ They contain an odd number of electrons.

Part A adapted with permission from UCLES, A-Level Chemistry, November 1997, Paper 3, Question 25;

Part B adapted with permission from UCLES, A-Level Chemistry, November 1998, Paper 3, Question 21

Question deck:

**STEM SMART Chemistry Week 25**

## Ethene Oxidation

Subject &amp; topics

Chemistry | Organic | Reactions

Status

Not started

Stage &amp; difficulty

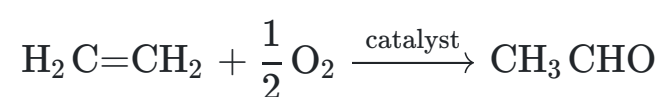
A Level Challenge 1



### Part A

#### Ethene to ethanal

Aldehydes and ketones are produced industrially by the catalytic oxidation of alkenes, e.g. ethanal is manufactured from ethene as shown below:



This process is also used industrially with but-2-ene.

Which of the following represents the structure of the compound which would be produced from but-2-ene?

- ☐  $\text{CH}_3\text{CH}_2\text{CHO}$
- ☐  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$
- ☐  $\text{CH}_3\text{COCH}_2\text{CH}_3$
- ☐  $\text{CH}_3\text{COCH}_3$
- ☐  $(\text{CH}_3)_2\text{CHCHO}$

Part B

Ethene with bromine and sodium nitrate

When ethene reacts with bromine in the presence of concentrated aqueous sodium nitrate, the product contains the following compound:

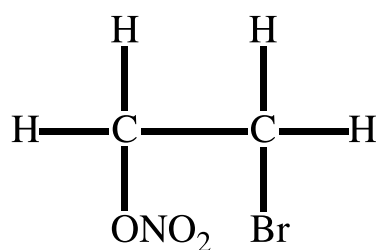


Figure 1: Reaction product

What is the intermediate formed in this reaction?

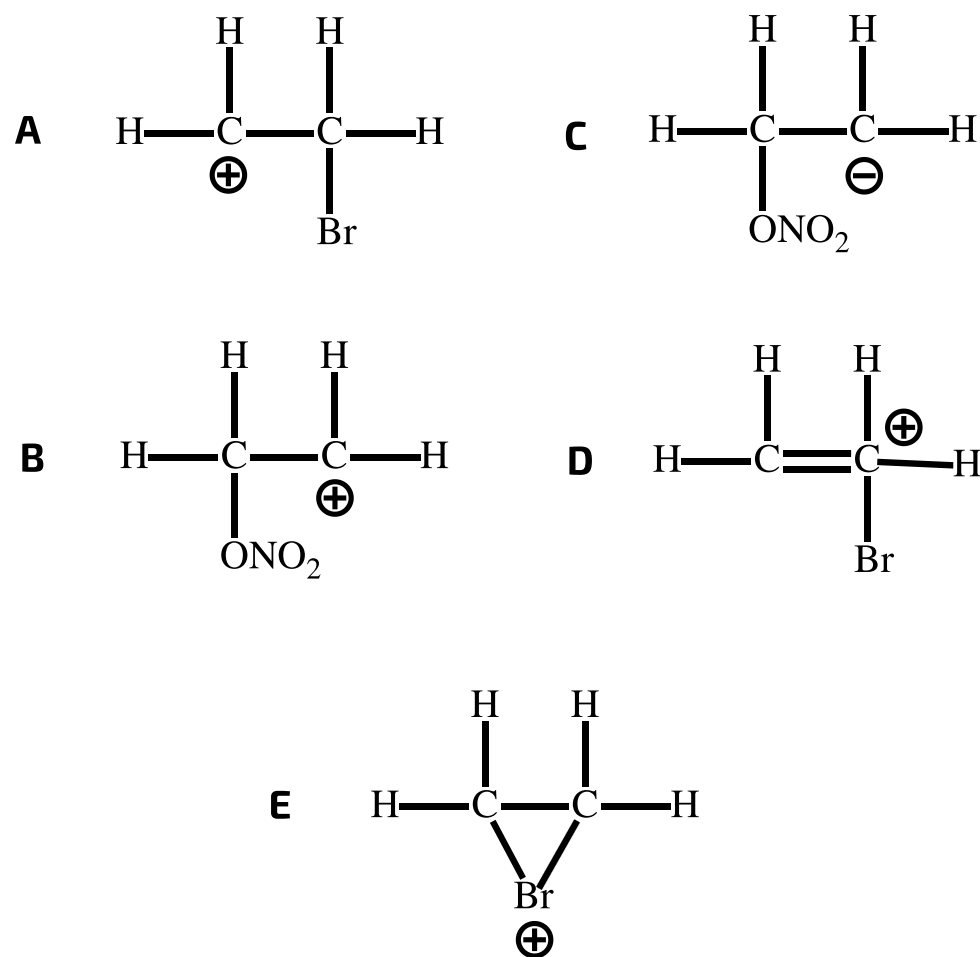


Figure 2: Possible intermediates

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E

Part A adapted with permission from UCLES, A-Level Chemistry, November 1993, Paper 4, Question 22;

Part B adapted with permission from UCLES, A-Level Chemistry, November 1995, Paper 4, Question 22

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Question deck:

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## Epoxy Precursor

Subject & topics

Chemistry | Organic | Reactions

Status

Not started

Stage & difficulty

A Level Challenge 1



Epoxy resins are polymers which are used as adhesives. One monomer used in their manufacture has the displayed formula:

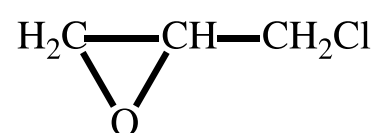


Figure 1: Epoxy resin monomer

This is manufactured from propene in three stages:

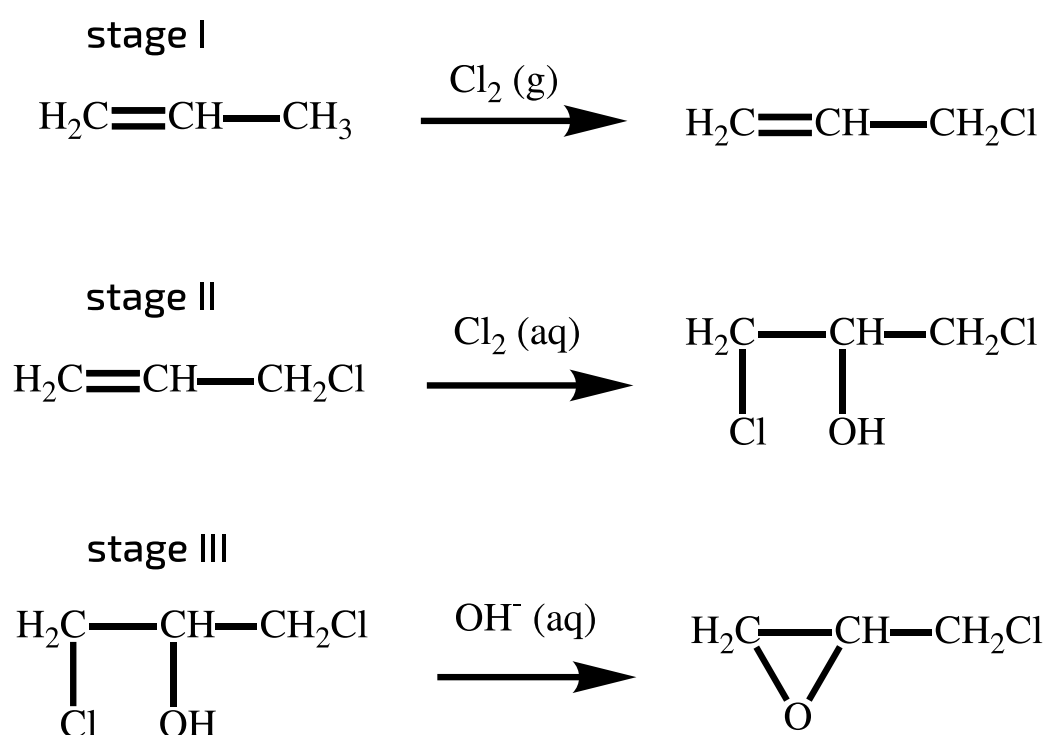


Figure 2: Three stages of epoxy monomer manufacture from propene

**Part A**  
**Stage I**

What type of reaction mechanism takes place between propene and chlorine gas in stage I?

Suggest what conditions are necessary for this reaction.

**Part B**  
**Stage II**

What type of reaction mechanism takes place when the aqueous chlorine reacts in stage II?

**Part C**  
**Stage III**

What type of organic reaction takes place in stage III?