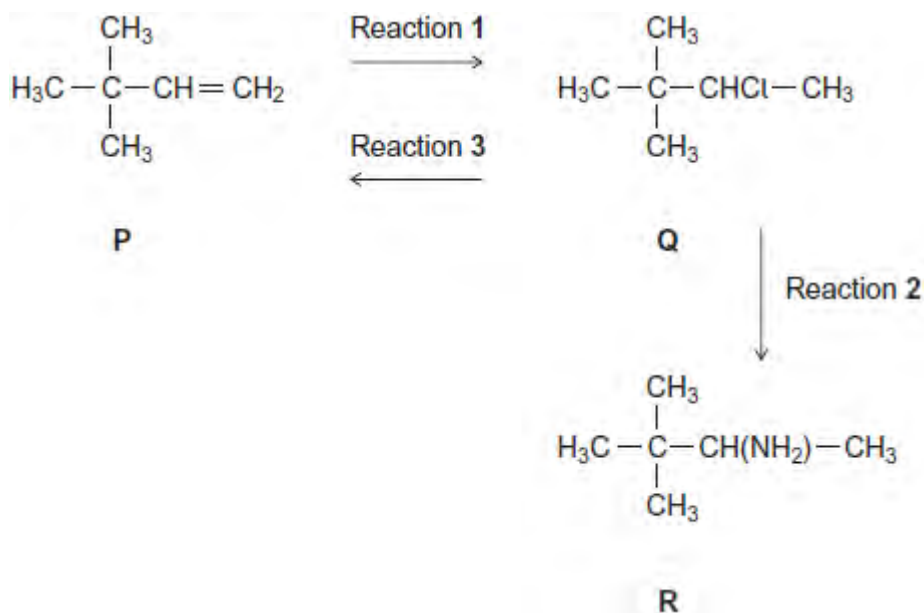


Q1. Consider the following scheme of reactions.



- (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 NH₃

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**.

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

(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 H_3PO_4 to produce HBr and Na_3PO_4 only.

Identify **two** toxic gases that are formed, together with HBr, when NaBr reacts with concentrated H_2SO_4

State the role of H_2SO_4 in the formation of these two toxic gases.

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.....

(4)

(Total 19 marks)

Q2. In each of the following questions, you should draw the structure of the compound in the space provided.

- (a) Draw the structure of the alkene that would form 1,2-dibromo-3-methylbutane when reacted with bromine.

(1)

- (b) Draw the structure of the alcohol with molecular formula $C_4H_{10}O$ that is resistant to oxidation by acidified potassium dichromate(VI).

(1)

- (c) Draw the structure of the alkene that has a peak, due to its molecular ion, at $m/z = 42$ in its mass spectrum.

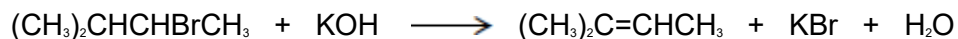
(1)

- (d) Draw the structure of the organic product with $M_r = 73$, made from the reaction between 2-bromobutane and ammonia.

(1)
(Total 4 marks)

Q3. Haloalkanes are used in the synthesis of other organic compounds.

- (a) Hot concentrated ethanolic potassium hydroxide reacts with 2-bromo-3-methylbutane to form two alkenes that are structural isomers of each other. The major product is 2-methylbut-2-ene.
- (i) Name and outline a mechanism for the conversion of 2-bromo-3-methylbutane into 2-methylbut-2-ene according to the equation.



Name of mechanism

Mechanism

(4)

- (ii) Draw the **displayed formula** for the other isomer that is formed.

(1)

- (iii) State the type of structural isomerism shown by these two alkenes.

.....

(1)

- (b) A small amount of another organic compound, **X**, can be detected in the reaction mixture formed when hot concentrated ethanolic potassium hydroxide reacts with 2-bromo-3-methylbutane.
Compound **X** has the molecular formula $\text{C}_5\text{H}_{12}\text{O}$ and is a secondary alcohol.

- (i) Draw the **displayed formula** for **X**.

(1)

- (ii) Suggest **one** change to the reaction conditions that would increase the yield of **X**.

.....

.....

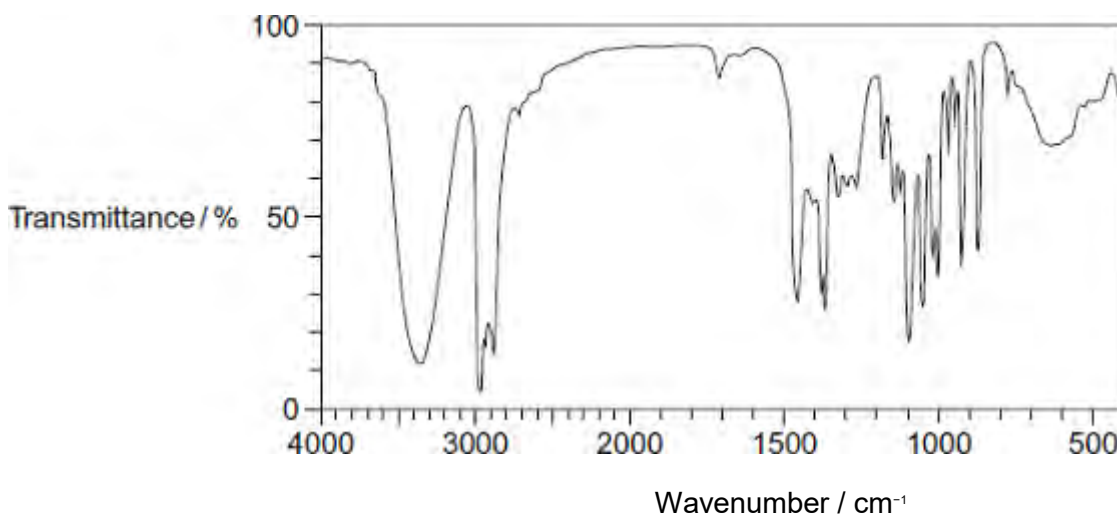
(1)

- (iii) State the type of mechanism for the conversion of 2-bromo-3-methylbutane into **X**.

.....

(1)

- (iv) Identify **one** feature of this infrared spectrum of a pure sample of **X** that may be used to confirm that **X** is an alcohol.
You may find it helpful to refer to **Table 1** on the Data Sheet.



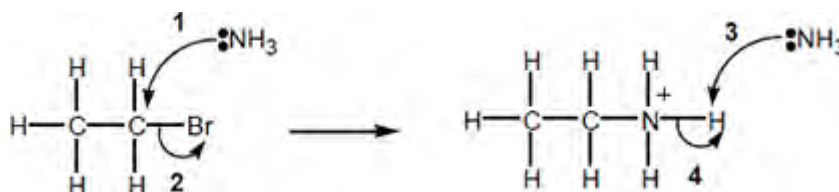
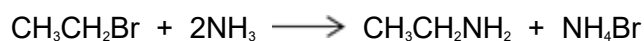
Feature

.....

(1)

(Total 10 marks)

Q4. This question is about a method that can be used to prepare ethylamine.



Which statement about the reaction is **not** correct?

- A Ethylamine is a primary amine.
- B The mechanism is a nucleophilic substitution.
- C Using an excess of bromoethane will prevent further reaction to form a mixture of amine products.
- D Ammonium bromide is an ionic compound.

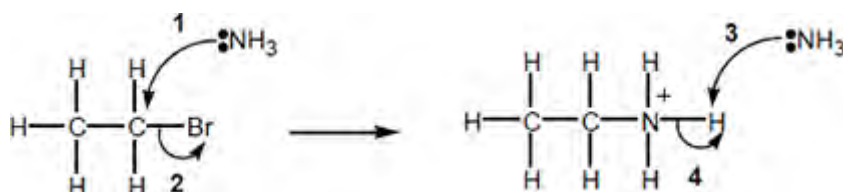
(Total 1 mark)

Q5. Why are fluoroalkanes unreactive?

- A Fluorine is highly electronegative.
- B The F⁻ ion is very stable.
- C They are polar molecules.
- D The C-F bond is very strong.

(Total 1 mark)

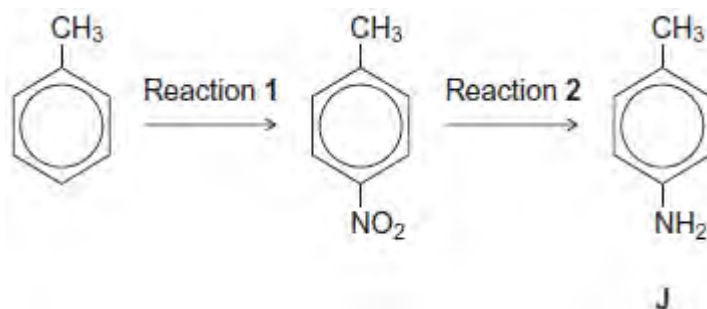
Q6. This question is about a method that can be used to prepare ethylamine.



Which of the curly arrows in the mechanism is **not** correct?

- A 1
- B 2
- C 3
- D 4

Q7. Consider the following reaction sequence starting from methylbenzene.



(a) Name the type of mechanism for reaction 1.

.....

(1)

(b) Compound J is formed by reduction in reaction 2.

(i) Give a reducing agent for this reaction.

.....

(1)

(ii) Write an equation for this reaction. Use [H] to represent the reducing agent.

.....

(1)

(iii) Give a use for J.

.....

(1)

(c) Outline a mechanism for the reaction of bromomethane with an excess of compound J.

You should represent J as RNH_2 in the mechanism.

(4)

(d) Compound **K** ($\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$) is a structural isomer of **J**.

Explain why **J** is a weaker base than **K**.

.....

.....

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.....

.....

(3)

(Total 11 marks)