

Q1. Which one of the following pairs of reagents reacts to form an organic product that shows only 2 peaks in its proton n.m.r. spectrum?

- A** butan-2-ol and acidified potassium dichromate(VI)
- B** ethanoyl chloride and methanol
- C** propanoic acid and ethanol in the presence of concentrated sulphuric acid
- D** ethene and hydrogen in the presence of nickel

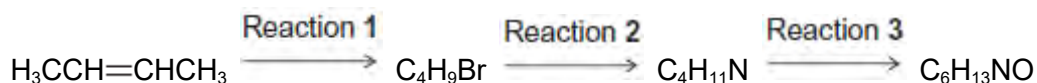
(Total 1 mark)

Q2. Which one of the following pairs reacts to form an organic product with only 2 singlets in its proton n.m.r. spectrum?

- A** ethene and bromine
- B** propan-2-ol and acidified potassium dichromate(VI)
- C** ethanol and concentrated sulphuric acid
- D** epoxyethane and water in the presence of dilute sulphuric acid

(Total 1 mark)

Q3. The N-substituted amide $C_6H_{13}NO$ can be formed from but-2-ene in a three-step synthesis.



For each reaction

- state a reagent
- give the structure of the product
- name the mechanism of the reaction.

Detailed mechanisms are **not** required.

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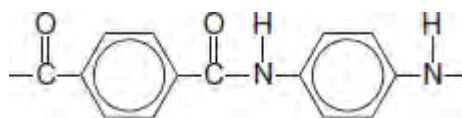
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(Total 9 marks)

Q4. Kevlar is a polymer used in protective clothing.

The repeating unit within the polymer chains of Kevlar is shown.

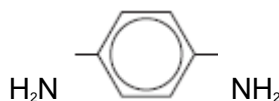


(a) Name the strongest type of interaction between polymer chains of Kevlar.

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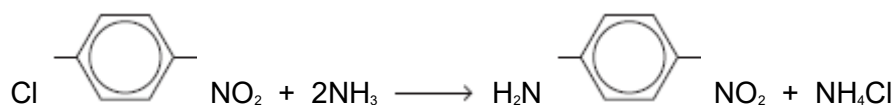
(1)

(b) One of the monomers used in the synthesis of Kevlar is



An industrial synthesis of this monomer uses the following two-stage process starting from compound **X**.

Stage 1



X

Stage 2



(i) Suggest why the reaction of ammonia with **X** in Stage 1 might be considered

unexpected.

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(2)

(ii) Suggest a combination of reagents for the reaction in Stage 2.

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(1)

(iii) Compound **X** can be produced by nitration of chlorobenzene.

Give the combination of reagents for this nitration of chlorobenzene.
Write an equation or equations to show the formation of a reactive
intermediate from these reagents.

Reagents

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Equation(s)

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(3)

(iv) Name and outline a mechanism for the formation of **X** from chlorobenzene and
the reactive intermediate in part (iii).

Name of mechanism

Mechanism

(4)
(Total 11 marks)

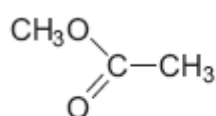
Q5. Organic chemists use a variety of methods to distinguish between compounds. These methods include analytical and spectroscopic techniques.

(a) The following compounds can be distinguished by observing what happens in test-tube reactions.

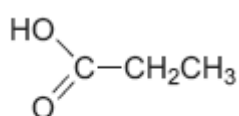
For each pair, suggest a suitable reagent or reagents that could be added separately to each compound in order to distinguish them.

Describe what you would observe with each compound.

(i)



E



F

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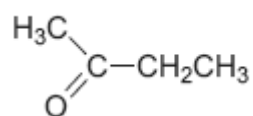
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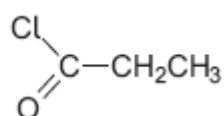
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(3)

(ii)



G



H

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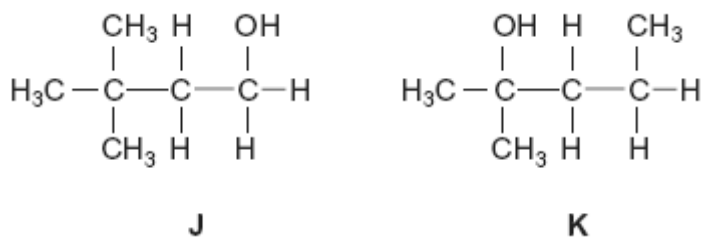
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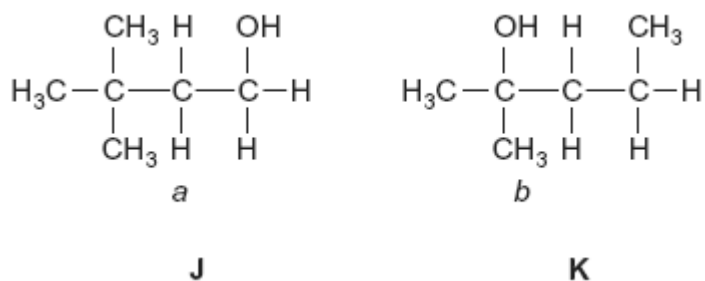
(iii)



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(3)

(b) Compounds **J** and **K** can also be distinguished using spectroscopic techniques such as ^1H n.m.r.



(i) Name compound **J**.

Give the total number of peaks in the ^1H n.m.r. spectrum of **J**.

State the splitting pattern, if any, of the peak for the protons labelled *a*.

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(3)

(ii) Name compound **K**.

Give the total number of peaks in the ¹H n.m.r. spectrum of **K**.

State the splitting pattern, if any, of the peak for the protons labelled *b*.

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(3)

(Total 15 marks)

Q6. A chemist has discovered that the labels have fallen off four bottles each of which contains a different organic liquid. These liquids are known to be propan-2-ol, propanal, hexene and 1-bromopropane.

Suggest a series of test-tube reactions which a chemist could use to confirm the identities of the four compounds. State the reagents used and the observations expected.

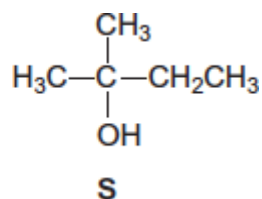
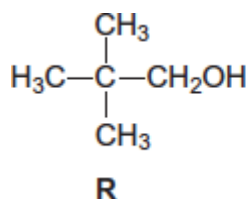
(Total 10 marks)

Q7. Describe how you could distinguish between the compounds in the following pairs using **one**

simple test-tube reaction in each case.

For each pair, identify a reagent and state what you would observe when both compounds are tested separately with this reagent.

(a)



Reagent

Observation with **R**.....

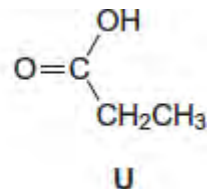
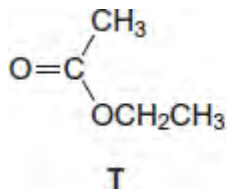
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Observation with **S**.....

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(3)

(b)



Reagent

Observation with **T**.....

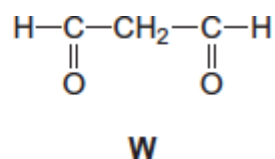
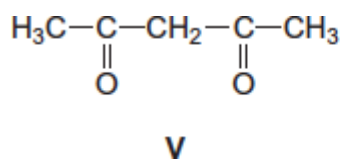
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Observation with **U**.....

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(3)

(c)



Reagent

Observation with **V**.....

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Observation with **W**.....

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(3)
(Total 9 marks)