Q1. Two isomeric ketones are shown below.

(a) Name and outline a mechanism for the reaction of compound **Q** with HCN and name the product formed.

Name of mechanism …….....

Mechanism

Name of product .....

(6)

(b) Some students were asked to suggest methods to distinguish between isomers **Q** and **R**.

One student suggested testing the optical activity of the products formed when **Q** and **R** were reacted separately with HCN.

By considering the optical activity of these products formed from **Q** and **R**, explain why this method would **not** distinguish between **Q** and **R**.

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(3)
(Total 9 marks)

Q2. Which one of the following reactions will produce an organic compound that has optical isomers?

A dehydration of butan-2-ol by heating with concentrated sulphuric acid

B reduction of pentan-3-one by warming with $NaBH_4$

C addition of Br_2 to 3-bromopropene

D reduction of 2,3-dimethylpent-2-ene with H_2 in the presence of a nickel catalyst

(Total 1 mark)

Q3. Which one of the following can exhibit both geometrical and optical isomerism?

A $(CH_3)_2C=CHCH(CH_3)CH_2CH_3$

B $CH_3CH_2CH=CHCH(CH_3)CH_2CH_3$

C $(CH_3)_2C=C(CH_2CH_3)_2$

D $CH_3CH_2CH(CH_3)CH(CH_3)C=CH_2$

(Total 1 mark)

Q4. Butanone is reduced in a two-step reaction using $NaBH_4$ followed by dilute hydrochloric acid.

(a) Write an overall equation for the reduction of butanone using [H] to represent the reductant.

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(1)

(b) By considering the mechanism of the reaction, explain why the product has **no** effect on plane polarised light.

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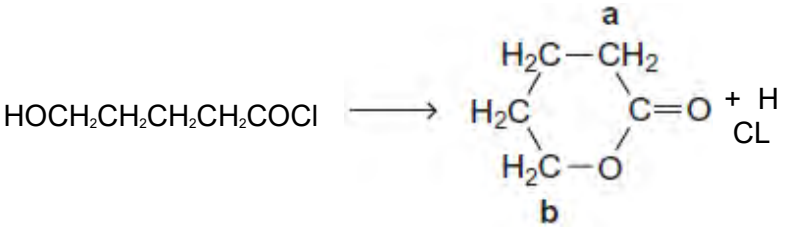
(6)
(Total 7 marks)

Q5. This question is about some isomers of $C_5H_8O_2$

(a) Compound **H** is a cyclic ester that can be prepared as shown.

On the structure of **H**, two of the carbon atoms are labelled.



H

(i) Name and outline a mechanism for this reaction.

Use **Table C** on the Data Sheet to give the ^{13}C n.m.r. δ value for the carbon atom labelled **a** and the δ value for the carbon atom labelled **b**.

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(7)

(ii) $HOCH_2CH_2CH_2CH_2COCl$ can also react to form a polyester in a mechanism similar to that in part (i).

Draw the repeating unit of the polyester and name the type of polymerisation involved.

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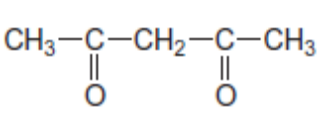
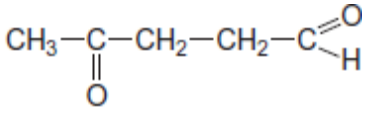
(2)

(b) State how you could distinguish between compounds **J** and **K** by a simple test-tube reaction.

State how you could distinguish between **J** and **K** by giving the number of peaks in the ^1H n.m.r. spectrum of each compound.



J



K

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(5)

(c) Draw the structure of each of the following isomers of $C_5H_8O_2$
Label each structure you draw with the correct letter **L**, **M**, **N**, **P** or **Q**.

L is methyl 2-methylpropenoate.

M is an ester that shows E-Z stereoisomerism.

N is a carboxylic acid with a branched carbon chain and does **not** show stereoisomerism.

P is an optically active carboxylic acid.

Q is a cyclic compound that contains a ketone group and has only two peaks in its ^1H n.m.r. spectrum.

(5)
(Total 19 marks)

Q6. Which compound forms optically active compounds on reduction?

A $CH_3CH_2C(CH_3)=CHCH_3$ ⬭

B $CH_3CH_2C(CH_3)=CH_2$ ⬭

C CH_3COCH_3 ⬭

D $CH_3CH_2COCH_3$ ⬭

(Total 1 mark)

Q7. The carbonyl compound CH_3CH_2CHO reacts very slowly with HCN

(a) Name and outline a mechanism for the reaction of CH_3CH_2CHO with HCN

Name of mechanism .....

Mechanism

(5)

(b) The reaction in part (a) produces a pair of enantiomers.

(i) Draw the structure of each enantiomer to show how they are related to each other.

(2)

(ii) State and explain how you could distinguish between the two enantiomers.

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(2)

(c) Give the IUPAC name of the product of the reaction in part (a).

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(1)

(d) In practice, KCN rather than HCN is added to the carbonyl compound.

Given that K_a for HCN = 4.0×10^{-10} mol dm^{-3}, suggest why the reaction with HCN is very slow.

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(2)

(e) Acrylic fibres are used as a substitute for wool. Acrylics are copolymers of acrylonitrile with other compounds.

Acrylonitrile is the common name for the following compound.

$$H_2C = CH - C \equiv N$$

(i) Acrylonitrile can be formed from propene.

Write an equation for the reaction of propene with ammonia and oxygen to form acrylonitrile and one other product.

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(1)

(ii) The term copolymer is used to describe the product obtained when two or more different monomers form a polymer.

Draw the repeating unit of the acrylic copolymer that contains 75% acrylonitrile monomer and 25% chloroethene monomer.

(1)

(iii) Name the type of polymerisation involved in part (ii)

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(1)

(Total 15 marks)