



Questions

Q1.

Chloroalkanes can be formed from both alkenes and alkanes.

Ethene can be converted into chloroethane.

(i) Identify, by name or formula, the reagent for this conversion.

(1)

.....

(ii) Draw the mechanism for the conversion of ethene into chloroethane.

Include curly arrows, and any relevant lone pairs and dipoles.

(4)

(Total for question = 5 marks)



The V on the symbol with the number 3 stands for vinyl or vinyl chloride.
The V is sometimes replaced by PVC, standing for polyvinyl chloride.

State the link between vinyl chloride and polyvinyl chloride.

(1)

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(Total for question = 1 mark)



Q3.

Plastic products often have a symbol on them. Two of the symbols are shown.



The symbols are used to sort the plastic products into groups of specific types of plastic when they are thrown away.

Some plastic products can be cleaned and used again.

Give two other uses of waste plastic.

(2)

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(Total for question = 2 marks)



Q4.

This question concerns alkenes and some halogen compounds.

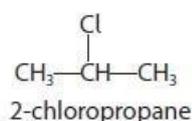
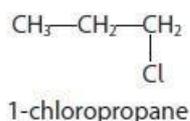
The alkene, propene, reacts with hydrogen chloride.

(i) This reaction is best described as

- A electrophilic substitution
- B electrophilic addition
- C nucleophilic substitution
- D nucleophilic addition

(1)

(ii) The reaction of propene with hydrogen chloride can produce two isomeric products:



1-chloropropane and 2-chloropropane are

- A *cis-trans* isomers
- B *E/Z* isomers
- C structural isomers
- D stereoisomers

(1)

(iii) Draw the mechanism for the reaction of propene with hydrogen chloride to produce 2-chloropropane. Include curly arrows, and any relevant dipoles and lone pairs.

(4)

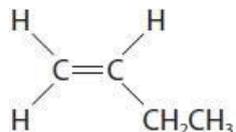
(Total for question = 6 marks)



Q5.

This question is about alkenes.

But-1-ene has the structure



- (i) Draw the structure of the polymer formed when but-1-ene polymerises.
Include **two** repeat units.

(1)

- (ii) Calculate the number of molecules in 70.0 g of but-1-ene.
[Avogadro constant = $6.02 \times 10^{23} \text{ mol}^{-1}$]

(2)

(Total for question = 3 marks)



Q6.

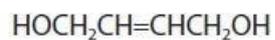
Analysis shows that a compound has the molecular formula $C_4H_8O_2$.

A student suggests that the compound could be either **A** or **B**.



A

or



B

Deduce a **chemical** test which would give a positive result for **B** but **not** for **A**.
Include the reagent and observation.

(2)

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(Total for question = 2 marks)



Q7.

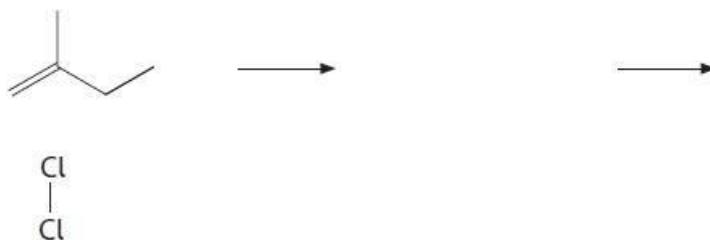
This is a question about dihalogenoalkanes.

Dihalogenoalkanes are formed when alkenes react with halogens.

(i) Complete the mechanism for the production of a dihalogenoalkane from 2-methylbut-1-ene and chlorine.

Include curly arrows and any relevant lone pairs.

(3)



(ii) Give the name of the dihalogenoalkane produced.

(1)

.....

(Total for question = 4 marks)

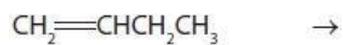


Q8.

This is a question about polymerisation.

But-1-ene and cyclohexene both form addition polymers.

Draw a section of each polymer, showing **two** repeat units.



(2)



(Total for question = 2 marks)



Q9.

2-methylbuta-1,3-diene can react with hydrogen bromide.

When 2-methylbuta-1,3-diene reacts with **excess** hydrogen bromide, several isomeric products are possible. Give the structures of **four** isomeric products.

(4)

(Total for question = 4 marks)



Q10.

This question concerns alkenes and some halogen compounds.

The halogenoalkane chloroethene is used to make the important polymer poly(chloroethene), PVC.

(i) Draw a **displayed** formula of two repeat units of poly(chloroethene).

(1)

(ii) Some polymers are disposed of by incineration. Ignoring any economic considerations, explain why incineration is **not** a suitable method for the disposal of poly(chloroethene).

(2)

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(iii) Chloroethene has a boiling temperature of 260 K and is known to be carcinogenic. Use these facts to state **one** precaution that chemists should take when using this compound.

(1)

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.....

(Total for question = 4 marks)



Q11.

This question concerns iodine monochloride, ICl, a red-brown solid which melts at 27 °C to form a red-brown liquid.

Iodine monochloride is used in measuring unsaturation in organic compounds.

Iodine monochloride is a polar molecule which adds rapidly to double bonds in a similar way to hydrogen chloride. This reaction can be used to determine the degree of unsaturation in oils.

(i) Add the dipole to a molecule of iodine monochloride.

(1)



(ii) Draw the mechanism for the addition of iodine monochloride to propene.

You should include all curly arrows and relevant lone pairs and dipoles.

(3)

(Total for question = 4 marks)



Q12.

Answer the questions with a cross in the boxes you think are correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

Methyl cinnamate, $C_{10}H_{10}O_2$, is a white crystalline solid used in the perfume industry.

Methyl cinnamate undergoes an addition reaction in the dark with bromine.

- (i) Draw the mechanism for the reaction between methyl cinnamate and bromine, Br_2 .
Include curly arrows, and relevant lone pairs and dipoles.

(4)

- (ii) Deduce the number of optical isomers of the addition product that can exist.

(1)

- A 2
 B 3
 C 4
 D 8

- (iii) When plane-polarised light is passed through an optical isomer, the plane of polarisation is

(1)

- A diffracted
 B reflected
 C refracted
 D rotated

(Total for question = 6 marks)



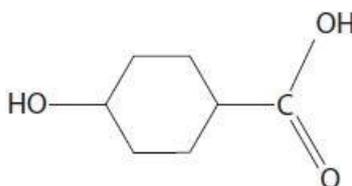
Q13.

* This question is about polymers.

Compare and contrast how each of these monomers forms a polymer.



cyclohexene



4-hydroxycyclohexanecarboxylic acid

Include equations, showing the formation of a single repeat unit for each polymer.

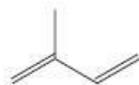
(6)

(Total for question = 6 marks)



Q14.

Some plants are able to make terpenes by linking together several molecules of 2-methylbuta-1,3-diene, also known as isoprene. The skeletal formula of 2-methylbuta-1,3-diene is



Predict the number of isoprene molecules that would be needed to make a single geraniol molecule. Justify your answer.

(2)

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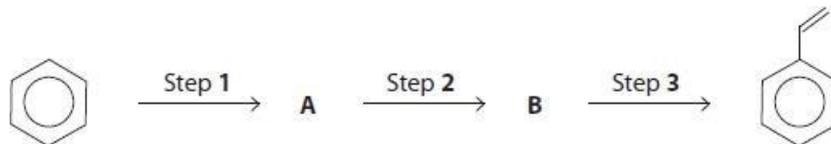
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(Total for question = 2 marks)



Q15.

Phenylethene, commonly known as styrene, is an important substance in the production of polystyrene which is used for some types of plastic packaging. Phenylethene can be made from benzene in a three-step synthesis.



Which reagent could produce a diol from phenylethene?

(1)

- A acidified potassium dichromate(VI)
- B acidified potassium manganate(VII)
- C aqueous sodium hydroxide
- D steam

(Total for question = 1 mark)

**Q16.**

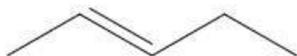
This question is about alkenes with the molecular formula C_5H_{10} .

Pent-2-ene reacts with hydrogen bromide, HBr, to form two bromoalkanes.

Complete the diagram to show the mechanism for the formation of 2-bromopentane in this reaction.

Include curly arrows, and relevant lone pairs and dipoles.

(4)



(Total for question = 4 marks)



Q17.

This question is about hydrocarbons.

Propene reacts with iodine monochloride, ICl, by an electrophilic addition mechanism.

Draw the mechanism for the reaction between propene and iodine monochloride to form the **major** product.

Include the dipole on the ICl molecule, curly arrows and any relevant lone pairs of electrons.

(4)

(Total for question = 4 marks)



Q18.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

Propene can be converted into a mixture of 1-chloropropane and 2-chloropropane, in which 2-chloropropane is the major product.

(i) Give the reagent required for this reaction.

(1)

.....

(ii) What is the type and mechanism of the reaction in (i)?

(1)

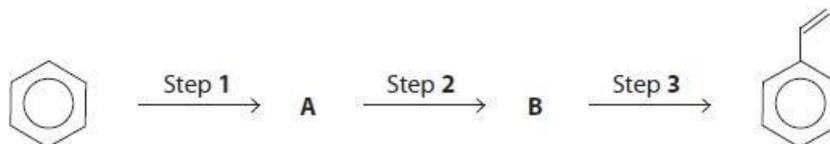
- A electrophilic addition
- B nucleophilic addition
- C electrophilic substitution
- D nucleophilic substitution

(Total for question = 2 marks)



Q19.

Phenylethene, commonly known as styrene, is an important substance in the production of polystyrene which is used for some types of plastic packaging. Phenylethene can be made from benzene in a three-step synthesis.



Draw a section of the polymer, polystyrene, showing **two** repeat units.

(1)



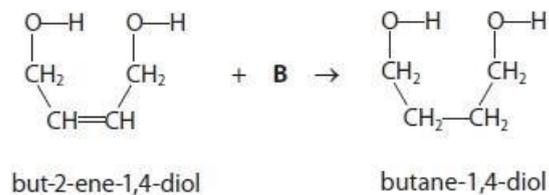
(Total for question = 1 mark)



Q20.

This question is about the synthesis and reactions of butane-1,4-diol.

Butane-1,4-diol can be synthesised from but-2-ene-1,4-diol, by reaction with a reagent, **B**.



(i) Identify reagent **B** and state suitable conditions for this reaction.

(2)

.....

(ii) This reaction is best described as

(1)

- A** hydrolysis
 B oxidation
 C reduction
 D substitution

(iii) Name **one** other commercially important product that can be manufactured by this type of reaction with the alkene group.

(1)

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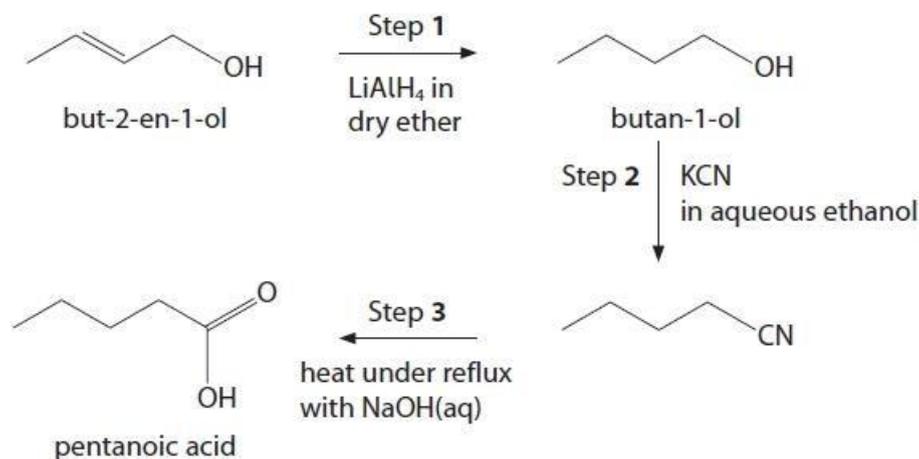
(Total for question = 4 marks)



Q21.

This question is about the synthesis of organic compounds.

A student suggested the following plan for the synthesis of pentanoic acid from but-2-en-1-ol.



(i) LiAlH_4 is a source of hydride ions, H^- .

Give a possible reason why LiAlH_4 cannot be used to reduce alkenes.

(1)

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(ii) Give a suitable reagent and condition for Step 1.

(2)

.....

(iii) Step 2 is incorrect because alcohols can only be converted to nitriles via an intermediate compound.

Identify a suitable intermediate compound by name or formula.

(1)

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(iv) Step 3 involves the hydrolysis of a nitrile.

Give the additional reagent that should be added after heating under reflux with aqueous sodium hydroxide, to produce pentanoic acid.

(1)

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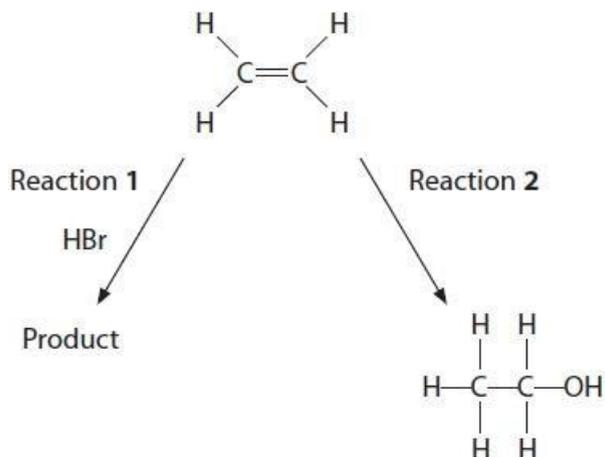
(Total for question = 5 marks)



Q22.

This question is about alkenes.

Two reactions of ethene are shown.



Complete the table.

(3)

Reaction	Reagent and condition	Product
1	HBr at room temperature	
2		$ \begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{OH} \\ \quad \\ \text{H} \quad \text{H} \end{array} $

(Total for question = 3 marks)