CHEMISTRY ONLINE
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CHEMISTRY

INORGANIC CHEMISTRY II

Level & Board	AQA (A-LEVEL)
TOPIC:	OPTICAL ISOMERISM
PAPER TYPE:	QUESTION PAPER - 2
TOTAL QUESTIONS	10
TOTAL MARKS	42

Optical Isomerism - 2

1. 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.

$H_2C = CH - C \equiv N$

Acrylonitrile can be formed from propene.

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

(1)

(b) 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)

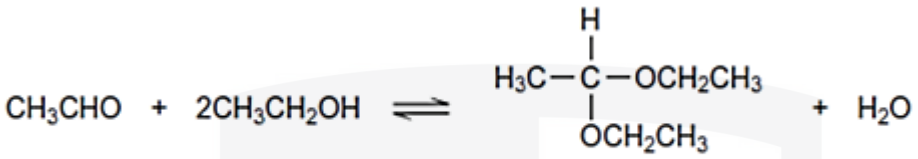
(c) Name the type of polymerisation.

(1)

2. In the presence of an acid catalyst such as dry hydrogen chloride, ethanal reacts with an excess of ethanol to form an acetal.

The overall reaction of ethanal with an excess of ethanol forms an equilibrium mixture as shown.

All reactants and products are liquids.



an acetal

A mixture of 0.75 mol of ethanal and 5.00 mol of ethanol was left to reach equilibrium in the presence of dry hydrogen chloride at a given temperature.
The equilibrium mixture contained 0.42 mol of the acetal.

(a) Calculate the amount, in moles, of ethanal and of ethanol in this equilibrium mixture**.**

(2)

(b) In a different experiment using the same reaction, an equilibrium mixture was established at a given temperature.

This mixture contained 0.58 mol of ethanal, 3.76 mol of ethanol, 0.37 mol of the acetal and 0.65 mol of water in a total volume of 310 cm^3.

Write an expression for the equilibrium constant Kc for this reaction.

Calculate a value for Kc at this temperature.
Give units with your answer.

(4)

3. P, Q and R have the molecular formula C_6H_{12}

All three are branched-chain molecules and none is cyclic.
P can represent a pair of optical isomers.
Q can represent a pair of geometrical isomers.
R can represent another pair of geometrical isomers different from Q.

Draw one possible structure for one of the isomers of each of P, Q and R.

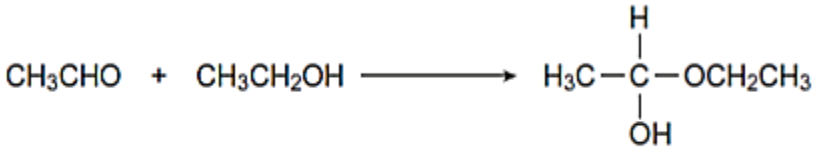
(3)

4. 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. $CH_3CH_2COCH_3$

(1)

5. Hemiacetals and acetals are compounds formed by the reaction of aldehydes with alcohols, such as the reaction of ethanal with ethanol.



a hemiacetal

(a)

i. Use your knowledge of carbonyl mechanisms to suggest the name of the mechanism of this reaction.

(1)

ii. Outline how an ethanol molecule reacts with an ethanal molecule in the first step of this mechanism.

Include two curly arrows to show the movement of electron pairs.

(2)

(b) The reaction produces a racemic mixture of chiral molecules.

i. Explain the meaning of the term racemic mixture.

(1)

ii. State the relationship between two chiral molecules with the same structural formula.

(1)

6. Which compound does not show stereoisomerism?

A. 1,2-dichloropropene
B. 1,2-dichloropropane
C. 1,3-dichloropropene
D. 1,3-dichloropropane

(1)

7. Butan-2-ol reacts with concentrated sulfuric acid to produce three isomeric alkenes.

Name and outline a mechanism to show how any one of the alkenes is formed.
Explain how this reaction can lead to the formation of each of these three alkenes.

(6)

8. This question is about isomerism.

(a) How many isomers are represented by the formula C_5H_{12}?

(1)

(b) Name the type of structural isomerism shown by the isomers of C_5H_{12}

(1)

(c) 2-Hydroxypropanenitrile displays optical isomerism.

Draw three-dimensional representations of the two enantiomers of 2-hydroxypropanenitrile, showing how the two structures are related to each other.

(2)

(d) Describe how separate samples of each of these enantiomers could be distinguished.

(2)

9. The aldehyde $CH_3CH_2CH_2CH_2CHO$ reacts with KCN followed by dilute acid to form a racemic mixture of the two stereoisomers of

$$CH_3CH_2CH_2CH_2CH(OH)CN$$

(a) Give the IUPAC name of $CH_3CH_2CH_2CH_2CH(OH)CN$

(1)

(b) Describe how you would distinguish between separate samples of the two stereoisomers of $CH_3CH_2CH_2CH_2CH(OH)CN$

(2)

(c) Explain why the reaction produces a racemic mixture.

(3)

(d) An isomer of $CH_3CH_2CH_2CH_2CHO$ reacts with KCN followed by dilute acid to form a compound that does not show stereoisomerism.

Draw the structure of the compound formed and justify why it does not show stereoisomerism.

(2)

10. This question is about isomers with the molecular formula $C_5H_{10}O$

(a) Draw the skeletal formula of a branched chain aldehyde with molecular formula $C_5H_{10}O$ that is optically active.

(1)

(b) Describe how you distinguish between separate samples of the two enantiomers of the branched chain aldehyde $C_5H_{10}O$

(2)

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