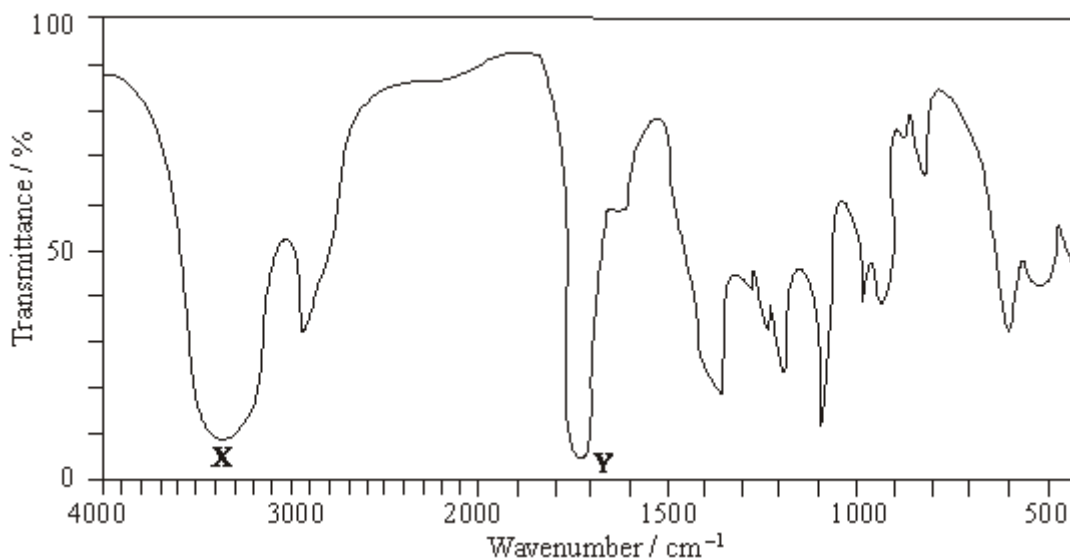


Q1. (a) The infra-red spectrum of compound **A**,  $C_3H_6O_2$ , is shown below.



Identify the functional groups which cause the absorptions labelled **X** and **Y**.

Using this information draw the structures of the three possible structural isomers for **A**.

Label as **A** the structure which represents a pair of optical isomers.

(6)

(b) Draw the structures of the three **branched-chain** alkenes with molecular formula  $C_5H_{10}$

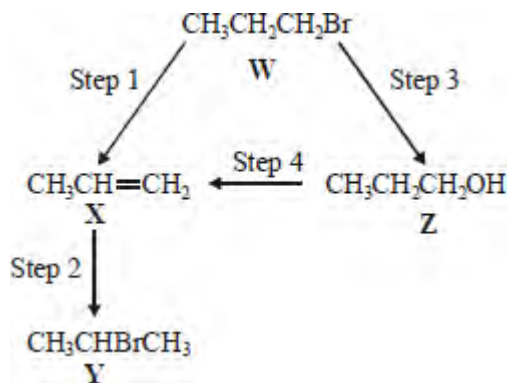
Draw the structures of the three dibromoalkanes,  $C_5H_{10}Br_2$ , formed when these three alkenes react with bromine.

One of these dibromoalkanes has only three peaks in its proton n.m.r. spectrum. Deduce the integration ratio and the splitting patterns of these three peaks.

(10)

(Total 16 marks)

Q2. For this question refer to the reaction scheme below.



Which one of the following statements is **not** correct?

- A **W** and **Y** are structural isomers.
- B **Z** is a primary alcohol.
- C **Y** gives two peaks in its proton n.m.r. spectrum.
- C **X** has geometrical isomers.

(Total 1 mark)

**Q3.** Propanone can be reduced to form an alcohol. A functional group isomer of the alcohol formed is

- A  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- B  $\text{CH}_3\text{CH}_2\text{CHO}$
- C  $\text{CH}_3\text{OCH}_2\text{CH}_3$
- D  $\text{CH}_3\text{COCH}_3$

(Total 1 mark)

**Q4.** (a) (i) Name the process used to separate petroleum into fractions.

.....

(ii) Give the molecular formula for an alkane with nine carbon atoms.

.....

.....

(iii) Write an equation for the complete combustion of the alkane  $C_{11}H_{24}$

.....

(iv) Write an equation for the incomplete combustion of  $C_{11}H_{24}$  to produce carbon and water only.

.....

(4)

(b) Alkenes can be produced by cracking the naphtha fraction obtained from petroleum.

(i) Write an equation for the thermal cracking of one molecule of  $C_{10}H_{22}$  to give one molecule of propene and one molecule of an alkane only.

.....

(ii) Draw the structure of the chain isomer of but-1-ene.

(2)

(c) The alkanes and the alkenes are examples of homologous series of compounds. One feature of an homologous series is the gradual change in physical properties as the relative molecular mass increases. State **two** other general features of an homologous series of compounds.

Feature 1 .....

.....

Feature 2 .....

.....

(2)

(Total 8 marks)

**Q5.** Which one of the following is a pair of functional group isomers?

- A**  $\text{CH}_3\text{COOCH}_2\text{CH}_3$  and  $\text{CH}_3\text{CH}_2\text{COOCH}_3$
- B**  $(\text{CH}_3)_2\text{CHCH}(\text{CH}_3)_2$  and  $(\text{CH}_3)_3\text{CCH}_2\text{CH}_3$
- C**  $\text{CH}_3\text{CH}_2\text{OCH}_3$  and  $(\text{CH}_3)_2\text{CHOH}$
- D**  $\text{ClCH}_2\text{CH}_2\text{CH}=\text{CH}_2$  and  $\text{CH}_3\text{CH}=\text{CHCH}_2\text{Cl}$

**(Total 1 mark)**

**Q6.** (a) Name and outline a mechanism for the reaction of 2-bromo-2-methylpropane with ethanolic potassium hydroxide to form the alkene 2-methylpropene,  $(\text{CH}_3)_2\text{C}=\text{CH}_2$

*Name of mechanism* .....

*Mechanism*

**(4)**

(b) Two stereoisomers of but-2-ene are formed when 2-bromobutane reacts with ethanolic potassium hydroxide.

(i) Explain what is meant by the term *stereoisomers*.

.....  
.....

- (ii) Draw the structures and give the names of the **two** stereoisomers of but-2-ene.

*Stereoisomer 1*

*Stereoisomer 2*

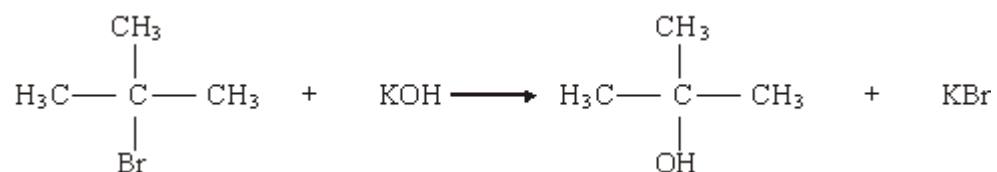
*Name* ..... *Name* .....

- (iii) Name this type of stereoisomerism.

.....

(5)

- (c) When 2-bromo-2-methylpropane reacts with aqueous potassium hydroxide, 2-methylpropan-2-ol is formed as shown by the following equation.



State the role of the hydroxide ions in this reaction.

.....

(1)

- (d) Write an equation for the reaction that occurs when  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$  reacts with an excess of ammonia. Name the organic product of this reaction.

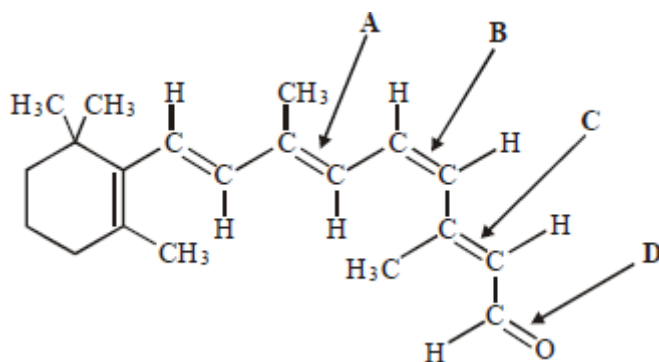
*Equation* .....

*Name of product* .....

(3)

(Total 13 marks)

**Q7.** The compound *cis*-retinal is shown below.



Which one of the labelled bonds leads to the prefix in the name?

(Total 1 mark)

**Q8.** Some alcohols can be oxidised to form aldehydes, which can then be oxidised further to form carboxylic acids.  
Some alcohols can be oxidised to form ketones, which resist further oxidation.  
Other alcohols are resistant to oxidation.

(a) Draw the structures of the **two** straight-chain isomeric alcohols with molecular formula,  $C_4H_{10}O$

(2)

(b) Draw the structures of the oxidation products obtained when the two alcohols from part (a) are oxidised separately by acidified potassium dichromate(VI). Write equations for any reactions which occur, using [O] to represent the oxidising agent.

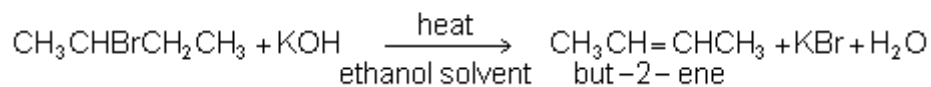
(6)

(c) Draw the structure and give the name of the alcohol with molecular formula  $C_4H_{10}O$  which is resistant to oxidation by acidified potassium dichromate(VI).

(2)

(Total 10 marks)

**Q9.** Consider the following reaction in which an alkene is formed from a haloalkane.



- (a) Name the haloalkane used in this reaction.

.....

(1)

- (b) Name and outline a mechanism for this reaction.

*Name of mechanism* .....

*Mechanism*

(4)

- (c) Another alkene, which is a structural isomer of but-2-ene, is also formed during this reaction.

- (i) State what is meant by the term *structural isomers*.

.....

.....

- (ii) Draw the structure of this other alkene.

(2)  
(Total 7 marks)