Q1. Many naturally-occurring organic compounds can be converted into other useful products.

(a) Glucose, $C_6H_{12}O_6$, can be fermented to make ethanol, which can then be dehydrated to make the unsaturated compound, ethane.

(i) Write an equation for the fermentation of glucose to form ethanol.

.....

(ii) Identify a catalyst for the dehydration of ethanol to form ethene. Write an equation for this reaction.

Catalyst .....

Equation .....

(3)

(b) Vegetable oils, which contain unsaturated compounds, are used to make margarine. Identify a catalyst and a reagent for converting a vegetable oil into margarine.

Catalyst .....

Reagent .....

(2)

(c) Oleic acid can be obtained from vegetable oils. Oleic acid is an example of an unsaturated compound.

$CH_3(CH_2)_7CH=CH(CH_2)_7COOH$

oleic acid

(i) Deduce the molecular formula and the empirical formula of oleic acid.

Molecular formula .....

Empirical formula .....

(ii) State what is meant by the term *unsaturated*.

.....

(iii) Identify a reagent for a simple chemical test to show that oleic acid is unsaturated. State what you would observe when oleic acid reacts with this reagent.

Reagent ….....

Observation with oleic acid …….....

.....

(5)
(Total 10 marks)

Q2. (a) In the manufacture of margarine, unsaturated vegetable oils such as sunflower oil are hardened.

(i) State the reagent and conditions used in this process.

Reagent .....

Conditions .....

.....

(ii) Soft and hard margarines are obtained from the same vegetable oil. How does the structure and the melting point of a soft margarine differ from that of a hard one?

Difference in structure .....

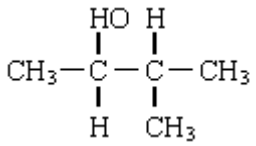
.....

Difference in melting point .....

.....

(5)

(b) In the presence of reagent **X**, the alcohol shown below undergoes a reaction to form two isomeric alkenes.



(i) Name this alcohol.

.....

(ii) Give the name of the type of reaction involved in the formation of the two alkenes.

.....

(iii) Suggest the identity of reagent **X**.

.....

(iv) Give the structural formulae of the two isomeric alkenes.

Alkene 1 *Alkene 2*

(5)
(Total 10 marks)

Q3. (a) One of the isomers in part (a) is resistant to oxidation by acidified potassium dichromate(VI).

(i) Identify this isomer.

.....

(ii) This isomer can be dehydrated. Give a suitable dehydrating agent and write an equation for this dehydration reaction.

Dehydrating agent.....

Equation .....

(3)

(b) (i) Identify the isomer in part (a) which can be oxidised to a ketone. Give the structure of the ketone formed.

Isomer .....

Structure of the ketone

(ii) Identify **one** of the isomers in part (a) which can be oxidised to an aldehyde. Give the structure of the aldehyde formed.

Isomer .....

Structure of the aldehyde

(iii) Give a reagent that can be used in a test to distinguish between a ketone and an aldehyde. State what you would observe in the test.

Reagent .....

Observation with ketone .....

.....

Observation with aldehyde .....

.....

(7)

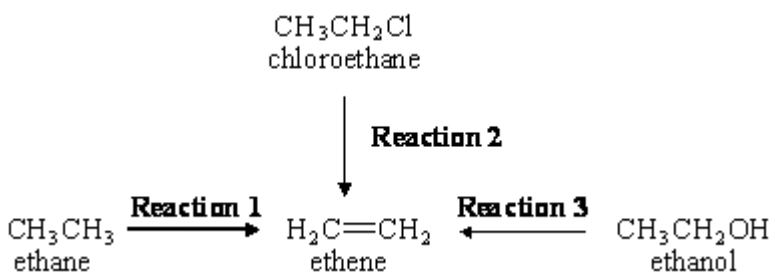
(c) Butan-1-ol can be oxidised to form a carboxylic acid. Using [O] to represent the oxidising agent, write an equation for this reaction and name the product.

Equation .....

Name of product .....

(2)
(Total 12 marks)

Q4. Ethene is an important starting point for the manufacture of plastics and pharmaceutical chemicals. Most of the ethene used by industry is produced by the thermal cracking of ethane obtained from North Sea gas (**Reaction 1**). It is also possible to make ethene either from chloroethane (**Reaction 2**) or from ethanol (**Reaction 3**).



(a) Give essential conditions and reagents for each of **Reactions 2** and **3**.

(4)

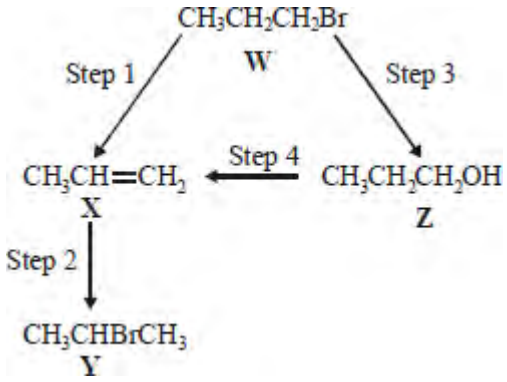
(b) Name and outline a mechanism for **Reaction 2**. Suggest a reason why chloroethane is **not** chosen by industry as a starting material to make ethene commercially.

(5)

(c) Name and outline a mechanism for **Reaction 3**. Suggest why this route to ethene may become used more commonly in the future as supplies of North Sea gas begin to run out.

(6)
(Total 15 marks)

Q5. For this question refer to the reaction scheme below.



Which one of the following reagents would **not** bring about the reaction indicated?

A Step 1 : alcoholic KOH

B Step 2 : aqueous Br_2

C Step 3 : aqueous NaOH

C Step 4 : concentrated H_2SO_4

(Total 1 mark)

Q6. Glucose can be used as a source of ethanol. Ethanol can be burned as a fuel or can be converted into ethene.

$C_6H_{12}O_6 \rightarrow CH_3CH_2OH \rightarrow H_2C=CH_2$

glucose ethanol ethene

(a) Name the types of reaction illustrated by the two reactions above.

Glucose to ethanol .....

Ethanol to ethene .....

(2)

(b) (i) State what must be added to an aqueous solution of glucose so that ethanol is formed.

.....

(ii) Identify a suitable catalyst for the conversion of ethanol into ethene.

.....

(2)

(c) (i) State the class of alcohols to which ethanol belongs.

.....

(ii) Give **one** advantage of using ethanol as a fuel compared with using a petroleum fraction.

.....

(2)

(d) Most of the ethene used by industry is produced when ethane is heated to 900°C in the absence of air. Write an equation for this reaction.

.....

(1)

(e) Name the type of polymerisation which occurs when ethene is converted into poly(ethene).

.....

(1)

(Total 8 marks)

Q7. 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)