Chemistry AQA Paper 14 Term 2.

1)

A student carried out an experiment to study the rates of hydrolysis of some haloalkanes.

(a) In the experiment, two different haloalkanes were placed in separate test tubes containing silver nitrate solution. The haloalkanes reacted with the water in the silver nitrate solution. The student timed how long it took for the first appearance of the silver halide precipitate in each tube at a constant temperature. This time was used to provide a measure of the initial rate of reaction.
The student obtained the following results.

	1-bromobutane	1-iodobutane
Time to form a precipitate / s	480	15

(a) (i) State the meaning of the term *hydrolysis*.

.....

(1 mark)

(a) (ii) State the colour of the precipitate formed when iodide ions react with silver nitrate and write the **simplest** ionic equation for this reaction.

Colour of precipitate.....

Simplest ionic equation

.....

(2 marks)

(a) (iii) Use your knowledge of the reactions of halide ions with silver nitrate to suggest why the student did **not** include 1-fluorobutane in this experiment.

.....

(2 marks)

2)

(b) (iii) State why the precise relative atomic mass for the ^{12}C isotope is exactly 12.00000

.....

(1 mark)

3)

Sulfuric acid is an important chemical in many industrial and laboratory reactions. Consider the following three reactions involving sulfuric acid.

Reaction **1** $Mg(OH)_2 + H_2SO_4 \longrightarrow MgSO_4 + 2H_2O$

Reaction **2** The reaction of solid sodium bromide with concentrated sulfuric acid

Reaction **3** $H_2C{=}CH_2 + H_2O \xrightarrow{\text{conc. } H_2SO_4} CH_3CH_2OH$

(a) Give a use for magnesium hydroxide in medicine.

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(1 mark)

(b) Sulfuric acid behaves as an oxidising agent in Reaction **2**.

(b) (i) In terms of electrons, state the meaning of the term *oxidising agent*.

.....

(1 mark)

(b) (ii) Give the formula of the oxidation product that is formed from sodium bromide in Reaction **2**.

.....

(1 mark)

(b) (iii) Deduce the half-equation for the reduction of H_2SO_4 to SO_2 in Reaction **2**.

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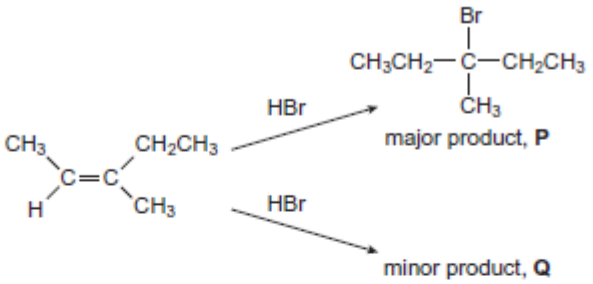
(1 mark)

4)

The alkene (Z)-3-methylpent-2-ene reacts with hydrogen bromide as shown below.



(a) (i) Name the major product **P**.

.....

(1 mark)

(a) (ii) Name the mechanism for these reactions.

.....

(1 mark)

(a) (iii) Draw the displayed formula for the minor product **Q** and state the type of structural isomerism shown by **P** and **Q**.

Displayed formula for **Q**

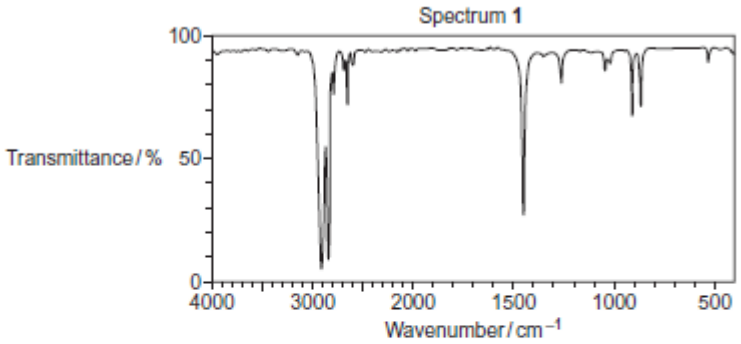
Type of structural isomerism .....

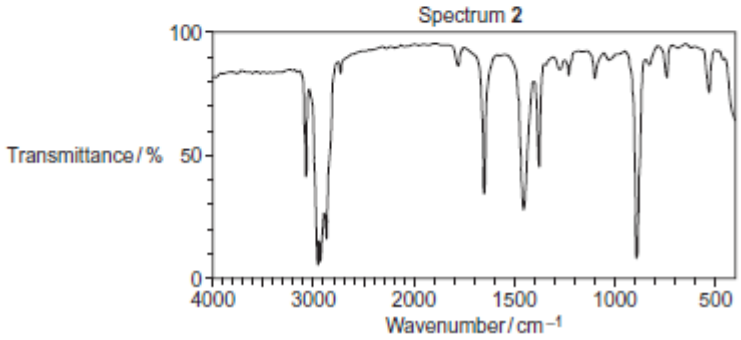
(2 marks)

(a) (iv) Draw the structure of the (E)-stereoisomer of 3-methylpent-2-ene.

(1 mark)

(b) The infrared spectra of two compounds **R** and **S** are shown below. **R** and **S** have the molecular formula C_6H_{12} and are structural isomers of 3-methylpent-2-ene. **R** is an unsaturated hydrocarbon and **S** is a saturated hydrocarbon.





(b) (i) Identify the infrared Spectrum **1** or **2** that represents compound **R**.
Use information from the infrared spectra to give **one** reason for your answer.
You may find it helpful to refer to **Table 1** on the Data Sheet.

R is represented by Spectrum .....

Reason .....

(2 marks)

(b) (ii) State the type of structural isomerism shown by **R** and **S**. .....

(1 mark)

(b) (iii) Name **one** possible compound which could be **S**.

.....

(1 mark)

5)

Chlorine is a useful industrial chemical.

(a) Chlorine gas is used in the manufacture of chlorine-containing organic compounds.

(a) (i) Write equations for the following steps in the mechanism for the reaction of chlorine with ethane to form chloroethane (CH_3CH_2Cl).

Initiation step

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First propagation step

.....

Second propagation step

.....

A termination step producing butane.

.....

(4 marks)

(a) (ii) Give **one** essential condition and name the type of mechanism in this reaction of chlorine with ethane.

Essential condition .....

Type of mechanism .....

(2 marks)

(b) Chlorine reacts with cold water.

(b) (i) Write an equation for this reaction.

.....

(1 mark)

(b) (ii) Give **one** large-scale application of the use of chlorine in water. Explain why it is used in this application even though chlorine is very toxic. Do **not** include cost.

Example of application.....

Explanation of use .....

(2 marks)

(b) (iii) Two different chlorine-containing compounds are formed when chlorine reacts with cold, dilute sodium hydroxide solution. One of these compounds is sodium chloride. Name the other chlorine-containing compound formed.

.....

(1 mark)

(c) Chlorine is used in the extraction of bromine from seawater.

(c) (i) Write the **simplest** ionic equation for the reaction of chlorine with bromide ions.

.....

(1 mark)

(c) (ii) Explain why bromine has a higher boiling point than chlorine.

.....

(2 marks)

6)

Glucose, produced during photosynthesis in green plants, is a renewable source from which ethanol can be made. Ethanol is a liquid fuel used as a substitute for petrol. The processes involved can be summarised as follows.

Process **1** Photosynthesis in green plants

$$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$$

Process **2** Fermentation of glucose to form ethanol

Process **3** Complete combustion of ethanol

$$CH_3CH_2OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$$

(a) State **three** essential conditions for the fermentation of aqueous glucose in Process **2**.

Write an equation for the reaction that takes place during this fermentation.

.....

(4 marks)

(b) It has been claimed that there is no net carbon (greenhouse gas) emission to the atmosphere when ethanol made by Process **2** is used as a fuel.

State the term that is used to describe fuels of this type.

Use the equations for Processes **1**, **2** and **3** to show why it can be claimed that there is no net emission of carbon-containing greenhouse gases.

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(3 marks)

(c) Use the information from the equation for Process **3** on page 16 and the mean bond enthalpies from the table below to calculate a value for the enthalpy change for this process.

	C–H	C–C	C–O	O–H	C=O	O=O
Mean bond enthalpy / kJ mol^{-1}	+412	+348	+360	+463	+743	+496

Give **one** reason why the value calculated from mean bond enthalpies is different from the value given in a data book.

.....

(4 marks)

(d) A student carried out a simple laboratory experiment to measure the enthalpy change for Process **3**. The student showed that the temperature of 200 g of water increased by 8.0 °C when 0.46 g of pure ethanol was burned in air and the heat produced was used to warm the water.

Use these results to calculate the value, in kJ mol^{-1}, obtained by the student for this enthalpy change. (The specific heat capacity of water is 4.18 J K^{-1} g^{-1})

Give **one** reason, other than heat loss, why the value obtained from the student's results is less exothermic than a data book value.

.....

(4 marks)

7)

Group 2 metals and their compounds are used commercially in a variety of processes.

(a) Strontium is extracted from strontium oxide (SrO) by heating a mixture of powdered strontium oxide and powdered aluminium.

Consider these standard enthalpies of formation.

	SrO(s)	Al_2O_3(s)
$\Delta H_f^{\ominus}$ / kJ mol^{-1}	–590	–1669

$$3SrO(s) + 2Al(s) \longrightarrow 3Sr(s) + Al_2O_3(s)$$

Use these data and the equation to calculate the standard enthalpy change for this extraction of strontium.

The use of powdered strontium oxide and powdered aluminium increases the surface area of the reactants.
Suggest **one** reason why this increases the reaction rate.

Suggest **one** major reason why this method of extracting strontium is expensive.

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(5 marks)

(b) Explain why calcium has a higher melting point than strontium.

.....

(2 marks)

(c) Magnesium is used in fireworks. It reacts rapidly with oxygen, burning with a bright white light. Magnesium reacts slowly with cold water.

Write an equation for the reaction of magnesium with oxygen.

Write an equation for the reaction of magnesium with cold water.

Give a medical use for the magnesium compound formed in the reaction of magnesium with cold water.

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(3 marks)