

Name of the Student: _____

Max. Marks : 26 Marks

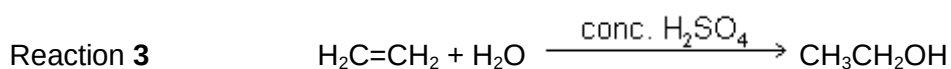
Time : 26 Minutes

Q1.

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



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



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

(1)

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

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

(1)

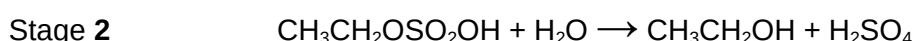
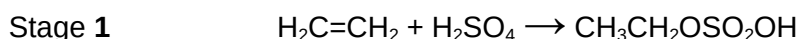
(ii) Give the formula of the oxidation product that is formed from sodium bromide in Reaction 2.

(1)

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

(1)

(c) The formation of ethanol in Reaction 3 uses concentrated sulfuric acid and proceeds in two stages according to the following equations.



(i) State the overall role of sulfuric acid in Reaction 3.

(1)

(ii) Outline a mechanism for Stage 1 of this reaction.

(4)

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

(1)

(iv) Draw the displayed formula of the carboxylic acid formed when ethanol is oxidised by an excess of acidified potassium dichromate(VI) solution.

(1)

(Total 11 marks)

Q2.

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
 $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$

Process 2 Fermentation of glucose to form ethanol

Process 3 Complete combustion of ethanol
 $\text{CH}_3\text{CH}_2\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$

- (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)

- (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.

(3)

- (c) Use the information from the equation for Process 3 above 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
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Mean bond enthalpy / kJ mol ⁻¹	+412	+348	+360	+463	+743	+496
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Give **one** reason why the value calculated from mean bond enthalpies is different from the value given in a data book.

(4)

- (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)

(Total 15 marks)