

Name of the Student: _____

Max. Marks : 26 Marks

Time : 26 Minutes

Q1.

Ethanol is an important fuel.

- (a) A dilute aqueous solution of ethanol can be produced by the fermentation of an aqueous solution of glucose.

It is claimed that the ethanol obtained from this solution is a carbon-neutral biofuel.

Write an equation for this fermentation reaction.

Give **two** other essential conditions for this reaction to produce a good yield of ethanol.

Name a process used to produce a much more concentrated solution of ethanol from a dilute aqueous solution.

State the meaning of the term **carbon-neutral** in the context of this biofuel.

(5)

- (b) A student carried out a laboratory experiment to determine the enthalpy change when a sample of ethanol was burned. The heat produced was used to warm some water in a copper calorimeter. The student found that the temperature of 75.0 g of water increased by 5.50 °C when 2.40×10^{-3} mol of pure ethanol was burned in air.

Use the student's results to calculate a value, in kJ mol^{-1} , for the enthalpy change when one mole of ethanol is burned.

(The specific heat capacity of water is $4.18 \text{ J K}^{-1} \text{ g}^{-1}$)

Deduce **two** reasons why the student's value for the standard enthalpy of combustion of ethanol is different from a Data Book value of $-1279 \text{ kJ mol}^{-1}$.

(5)

(i) Give the meaning of the term **mean bond enthalpy**.

(2)

	C—H	C—C	C—O	O=O	C=O	O—H
Mean bond enthalpy / kJ mol⁻¹	412	348	360	to be calculated	805	463

$$\text{CH}_3\text{CH}_2\text{OH}(\text{g}) + 3\text{O}_2(\text{g}) \longrightarrow 2\text{CO}_2(\text{g}) + 3\text{H}_2\text{O}(\text{g}) \quad \Delta H = -1279 \text{ kJ mol}^{-1}$$

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(3)
(Total 15 marks)

Q2.

Baking powder contains sodium hydrogencarbonate and an acid or a mixture of acids. One acid that may be in baking powder is 2,3-dihydroxybutanedioic acid. This has the molecular formula $C_4H_6O_6$ and it is often referred to as tartaric acid.

- (a) Draw the structural formula of tartaric acid.

(1)

- (b) Write an equation for the reaction of tartaric acid ($C_4H_6O_6$) with sodium hydrogencarbonate to form a salt, carbon dioxide and water.

(1)

- (c) Substances that contain carbonate or hydrogencarbonate ions can be used to confirm the presence of an acid.

Identify **one** other substance that could be used to confirm the presence of acid groups in tartaric acid.

State the observation you would make when this other substance is added to an aqueous solution of tartaric acid.

Substance _____

Observation _____

(2)

- (d) It is known that tartaric acid contains alcohol and carboxylic acid functional groups only. A test can be used to show that tartaric acid contains secondary alcohol groups, **not** tertiary alcohol groups.

- (i) Identify a reagent for this test and state the observation you would make for each type of alcohol.

Reagent _____

Observation for secondary alcohol _____

Observation for tertiary alcohol _____

(3)

- (ii) Suggest why this test **cannot** be used to distinguish between a primary alcohol and a secondary alcohol.

(1)

- (e) Baking powder usually contains starch. Starch is added to absorb any water vapour that may come into contact with the baking powder when the container is opened.

Deduce a reason why this water vapour needs to be absorbed.

(1)

- (f) Sodium hydrogencarbonate in baking powder forms carbon dioxide during the production of bread and cakes.

Suggest **one** advantage of having an acid in baking powder.

(1)

- (g) Safety information indicates that tartaric acid and its salts can act as muscle toxins. These can cause paralysis and possible death.

Suggest **one** reason why the use of tartaric acid in baking powder is **not** a hazard to health.

(1)

(Total 11 marks)