

Name of the Student: _____

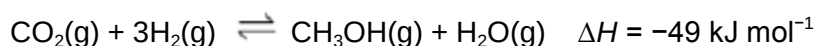
Max. Marks : 26 Marks

Time : 26 Minutes

Q1.

The table below contains some entropy data relevant to the reaction used to synthesise methanol from carbon dioxide and hydrogen. The reaction is carried out at a temperature of 250 °C.

Substance	CO ₂ (g)	H ₂ (g)	CH ₃ OH(g)	H ₂ O(g)
Entropy (<i>S</i> [°]) / J K ⁻¹ mol ⁻¹	214	131	238	189



- (a) Use this enthalpy change and data from the table to calculate a value for the free-energy change of the reaction at 250 °C.
Give units with your answer.

Free-energy change = _____ Units = _____

(4)

- (b) Calculate a value for the temperature when the reaction becomes feasible.

Temperature = _____ K

(2)

- (c) Gaseous methanol from this reaction is liquefied by cooling before storage.

Draw a diagram showing the interaction between two molecules of methanol. Explain why methanol is easy to liquefy.

Diagram

Explanation _____

(4)

(Total 10 marks)

Q2.

Ethanol can be oxidised by acidified potassium dichromate(VI) to ethanoic acid in a two-step process.



- (a) In order to ensure that the oxidation to ethanoic acid is complete, the reaction is carried out under reflux.

Describe what happens when a reaction mixture is refluxed and why it is necessary, in this case, for complete oxidation to ethanoic acid.

(3)

- (b) Write a half-equation for the overall oxidation of ethanol into ethanoic acid.

(1)

- (c) The boiling points of the organic compounds in a reaction mixture are shown in the following table.

Compound	ethanol	ethanal	ethanoic acid
Boiling point / °C	78	21	118

Use these data to describe how you would obtain a sample of ethanal from a mixture of these three compounds. Include in your answer a description of the apparatus you would use and how you would minimise the loss of ethanal. Your description of the apparatus can be either a description in words or a labelled sketch.

(5)

- (d) Use your knowledge of structure and bonding to explain why it is possible to separate ethanal in this way.

(2)

- (e) A student obtained a sample of a liquid using the apparatus in part (c).

Describe how the student could use chemical tests to confirm that the liquid contained ethanal and did **not** contain ethanoic acid.

(5)

(Total 16 marks)