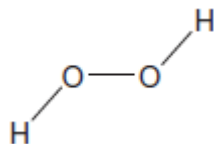


Q1.A hydrogen peroxide molecule can be represented by the structure shown.



(a) Suggest a value for the H–O–O bond angle.

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(1)

(b) Hydrogen peroxide dissolves in water.

(i) State the strongest type of interaction that occurs between molecules of hydrogen peroxide and water.

.....

(1)

(ii) Draw a diagram to show how one molecule of hydrogen peroxide interacts with one molecule of water. Include all lone pairs and partial charges in your diagram.

(3)

- (c) Explain, in terms of electronegativity, why the boiling point of H_2S_2 is lower than H_2O_2 .

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(2)
(Total 7 marks)

Q2.(a) Ammonia gas readily condenses to form a liquid when cooled.

- (i) Name the strongest attractive force between two ammonia molecules.

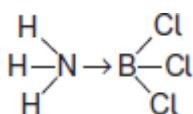
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(1)

- (ii) Draw a diagram to show how two ammonia molecules interact with each other in the liquid phase.
Include all partial charges and all lone pairs of electrons in your diagram.

(3)

- (b) Ammonia reacts with boron trichloride to form a molecule with the following structure.



State how the bond between ammonia and boron trichloride is formed.

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(1)

(c) The following table shows the electronegativity values of some elements.

	H	Li	B	C	O	F
Electronegativity	2.1	1.0	2.0	2.5	3.5	4.0

(i) Give the meaning of the term **electronegativity**.

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(2)

(ii) Suggest the formula of an ionic compound that is formed by the chemical combination of two different elements from the table.

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(1)

(iii) Suggest the formula of the compound that has the least polar bond and is formed by chemical combination of two of the elements from the table.

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(1)

(Total 9 marks)

Q3. Which compound has the highest boiling point?

A

C₂H₄



- B** C_2H_6
- C** CH_3NH_2
- D** CH_3F

(Total 1 mark)

Q4. 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.

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(3)

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

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(1)

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

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

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(5)

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

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(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.

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(5)
(Total 16 marks)

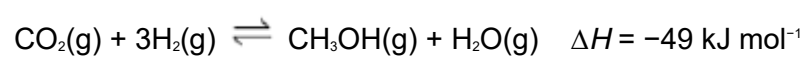
Q5. Use your understanding of intermolecular forces to predict which of these compounds has the highest boiling point.

- A** HF
- B** HCl
- C** HBr
- D** HI

(Total 1 mark)

Q6. 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 (S°) / 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

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(4)

(Total 10 marks)

Q7. Which of these substances does **not** show hydrogen bonding?

A HF

B NH₃

C CH₃COOH

D CHF₃

(Total 1 mark)

Q8. Which of these substances has permanent dipole-dipole attractions between molecules?

A CCl₄

B C₂F₄

C (CH₃)₂CO

D CO₂

(Total 1 mark)