1. Much of the work of chemists involves monitoring the reactants and products of reactions and managing reaction conditions.

1. **(4 marks)**

Outline and describe the role of a particular chemist employed in a named industry.

2. **(4 marks)**

a) Identify a branch of chemistry. (1 mark);

b) Identify and explain a chemical principle used in this branch of chemistry (3 marks).

3. **(4 marks)**

Outline the role of a chemist employed in a named industry or enterprise, identifying the branch of chemistry undertaken by the chemist and explaining a chemical principle that the chemist uses.

4. **(3 marks)**

Identify the need for collaboration between chemists as they collect and analyse data.

5. **(4 marks)**

Explain the necessity for monitoring the combustion of fuels.

2. Chemical processes in industry require monitoring and management to maximise production.

1. (5 marks)

The Haber process is used to manufacture ammonia

a) Identify an industrial use of ammonia (1 mark)

b) Is the production of ammonia, using this process, exothermic or endothermic? (1 mark)

c) Identify the catalyst used in this process and explain why it is used (3 marks).

d) Why was the work of Haber, in developing the process for the production of ammonia, so significant?

2. (3 marks)

Identify and describe three industrial uses of ammonia.

3. (2 marks)

Outline the source of the nitrogen and hydrogen used in the synthesis of ammonia.

4. (5 marks)

Describe the synthesis of ammonia occurs as a reversible reaction that will reach equilibrium and explain why the synthesis of ammonia has a high activation energy.

5. (4 marks)

Explain the exothermic nature of the synthesis of ammonia. Hence predict whether the reverse reaction is exothermic or endothermic.

6. (3 marks)

Explain why the rate of reaction is increased by higher temperatures.

7. (3 marks)

Explain why the yield of product in the Haber process is reduced at higher temperatures using Le Chatelier's principle.

8. (6 marks)

Chemical reactions need to be monitored continuously in the industry to maximise yield and costs are kept low. Discuss this statement with reference to the Haber process

9. (4 marks)

Potassium metabisulphite, $K_2S_2O_5$ is added to wine to prevent oxidation. It works by reacting with water and the acids in the wine as follows

$$S_2O_5^{2-}{}_{(aq)} + H_2O_{(l)} \rightarrow 2HSO_3^-{}_{(aq)}$$

Then $2HSO_3^-{}_{(aq)} + H_3O^+{}_{(aq)} \Longleftrightarrow SO_{2(g)} + H_2O_{(l)}$

Use the above equation to explain how the addition of $K_2S_2O_5$ affects the pH of wine.

10. (4 marks)

Explain why the Haber process is based on a delicate balancing act involving reaction energy, reaction rate and equilibrium.

11. (3 marks)

Explain the use of the catalyst used in the Haber process.

12. (4 marks)

Analyse the impact of increased pressure on the system involved in the Haber process.

13. (5 marks)

Explain why monitoring of the reaction vessel used in the Haber process is crucial and discuss the monitoring required.

14. (6 marks)

With reference to the history at that time, evaluate the significance of the Haber-Bosch process.

15. (6 marks)

Assess the significance of the industrial development of the Haber process to society in the beginning of the 1900's. Include a relevant chemical equation in your answer.

3. Manufactured products, including food, drugs and household chemicals, are analysed to determine or ensure their chemical composition.

1. **(6 marks)**

Devise 2 flow charts to show a series of procedures that could be used to test a solution for the given cations and anions.

2. **(6 marks)**

Assess the impact of the use of Atomic Absorption Spectroscopy on society and the environment.

3. **(3 marks)**

Outline the principal of atomic absorption spectroscopy.

4. **(3 marks)**

How does an AAS work?

5. **(3 marks)**

Describe some uses of AAS in different areas of science.

6. **(8 marks)**

Assess the impact of AAS on our understanding of the effects of trace elements.

7. **(4 marks)**

Define the terms standard solution and absorbance; and relate these terms to the technique of AAS.

8. **(3 marks)**

Explain the use of a calibration curve in quantitative analysis and explain why this is an example of a quantitative technique.

9. **(4 marks)**

Explain the evidence for the need to monitor levels of lead n substances used in society.

10. **(7 marks)**

Describe a procedure that could be used to determine the nitrogen content of fertiliser. In your answer, include relevant chemical equations and justify any assumptions that are made.

11. **(5 marks)**

One method used to determine the sulphate content of fertilisers is to add barium chloride and measure the mass of the precipitate formed.

a) Identify the name of the precipitate that is formed. (1 mark)

b) Discuss some precautions that should be taken to minimise errors and improve reliability of this method (4 marks).

12. (5 marks)

Describe the method you used to determine the sulphate content in fertiliser, whilst also explaining the chemistry.

13. (5 marks)

A sample of fertiliser was weighted to be 1.05 g and was then dissolved in acid. Then excess of barium chloride was added to precipitate the sulphate as barium sulphate. This mixture was then filtered and the barium sulphate precipitate was collected in the filter paper. After washing and drying this precipitate, the mass of barium sulphate was found to be 1.25 g. calculate the percentage of sulphate in the fertiliser.

14. (5 marks)

Evaluate the reliability of the investigation to find the sulphate content in lawn fertiliser and propose some solutions to problems encountered when performing this experiment.

15. (4 marks)

Evaluate the effectiveness of AAS in pollution control.

4. Human activity has caused changes in the composition and the structure of the atmosphere. Chemists monitor these changes so that further damage can be limited.

1. **(6 marks)**

Describe the composition and layered structure of the atmosphere and identify the main pollutants found in the lower atmosphere and their sources.

2. **(4 marks)**

Describe ozone as a molecule able to act as both as an upper atmosphere UV radiation shield and a lower atmosphere pollutant.

3. **(2 marks)**

What is a coordinate covalent bond?

4. **(2 marks)**

Draw the hydronium ion and ammonium using Lewis electron dot structures.

5. **(2 marks)**

What is an allotrope?

6. **(4 marks)**

Compare the properties of the oxygen allotropes of O_2 and O_3 and account for them on the basis of molecular structure and bonding.

7. **(4 marks)**

Ozone and oxygen are allotropes. Account for the differences in their properties on the basis of their molecular structure and bonding.

8. **(4 marks)**

Compare the properties of the gaseous forms of oxygen and the oxygen free radical.

9. **(3 marks)**

Identify the origins of chlorofluorocarbons (CFCs) and halons in the atmosphere.

10. **(1 marks)**

What are isomers?

11. **(7 marks)**

Discuss problems associated with the uses of CFC's, analyse their effects on the atmosphere using appropriate chemical equations and evaluate the effectiveness of the steps taken to relieve this problem.

12. (6 marks)

Present equations to show the reactions involving CFC's and ozone to demonstrate the removal of ozone from the atmosphere.

13. (6 marks)

Discuss the problems associated with the use of CFCs and assess the effectiveness of steps taken to alleviate these problems.

14. (4 marks)

Explain how information is obtained for changes in atmospheric ozone concentrations.

15. (6 marks)

a) Draw the structure and name a CFC (1 mark)

b) Identify an alternative used to replace CFC and account for its use. (2 marks)

c) Describe how the information about changing atmospheric ozone concentrations is obtained (3 marks).

16. (6 marks)

Discuss the advantages and disadvantages of using models in chemistry. Use examples to illustrate your answer.

17. (3 marks)

Account for the replacement of CFC's with hydroflourocarbons.

18. (5 marks)

Name a propellant that can be used as an alternative to CFC's and discuss why this propellant is favourable to CFC's.

5. Human activity also impacts on waterways. Chemical monitoring and management assists in providing safe water for human use and to protect the habitats of other organisms.

1. (6 marks)

You have been given a sample of water to analyse for drinking quality. List three tests you would perform to test the drinking quality of water and explain the importance of each of the test for this purpose.

2. (4 marks)

Identify two common indicators of water quality that would be most useful in monitoring waste water from a fruit cannery. Justify your choices.

3. (2 marks)

Identify that water quality can be determined by considering: – concentration of common ions, – total dissolved solids, – hardness, – turbidity, – acidity, – dissolved oxygen and biochemical oxygen demand.

4. (5 marks)

A river sources in some high mountains, then flows across a plain through farmlands. It then divides into one river 'A' flowing through a town and industrial area before reaching the sea. The second river 'B' flows through a forest before reaching the sea. Describe the differences likely to be observed in the water at each river 'A' and 'B' and account for these differences and outline how the differences could be verified.

5. (6 marks)

In analysing a water sample, it is necessary to measure temperature and pH when the sample is being collected, to measure the DO and the BOD to determine water quality.

a. How does temperature influence further test results? 2

b. On sunny days, photsynthesis by algae can lead to higher than normal pH values in streams and rivers. This is due to a change in the equilibrium in the following:

$OH^- + CO_2 <==> HCO_2 <==> H^+ + CO^{2-}_3$

Explain the higher pH value in terms of equilibrium shift. 2

c. Why is it important to carry out DO and BOD tests on water samples? 2

6. (4 marks)

Identify factors that affect the concentrations of a range of ions in solution in natural bodies of water such as rivers and oceans.

7. (2 marks)

Define hard water, list all the ions that cause water to be hard and outline the problems associated with the use of hard water.

8. (2 marks)

Identify some factors that determine the ph of surface water and ground water.

9. (7 marks)

Describe and assess the effectiveness of methods used to purify and sanitise mass water supplies.

10. (4 marks)

Describe the design and composition of microscopic membrane filters and explain how they purify contaminated water.

11. (5 marks)

Define and describe eutrophication of a waterway.

12. (5 marks)

Gather, process and present information on the features of the local town water supply in terms of: – catchment, – possible sources of contamination in this catchment, – chemical tests available to determine the levels and types of contaminants, – physical and chemical processes used to purify water, – chemical additives in the water and the reasons for the presence of these additives.