9.4 Chemical Monitoring and Management

9.4.1 Much of the work of chemists involves monitoring the reactants and products of reactions and managing reaction conditions?

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

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

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Describe an example of a chemical reaction such as combustion, where reactants form different products under different conditions and thus would need monitoring

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9.4.2 Chemical processes in industry require monitoring and management to maximise production

Identify and describe the industrial uses of ammonia

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Identify that ammonia can be synthesised from its component gases, nitrogen and hydrogen

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Describe that synthesis of ammonia occurs as a reversible reaction that will reach equilibrium

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Identify the reaction of hydrogen with nitrogen as exothermic

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Explain why the rate of reaction is increased by higher temperatures (illustrate your answerwith a suitable diagram)

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

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

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Explain that the use of a catalyst will lower the reaction temperature required and **identify** the catalyst(s) used in the Haber process

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

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

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

Describe the use of atomic absorption spectroscopy (AAS) in detecting concentrations of metal ions in solutions (illustrate with a suitable diagram)

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and **assess** its impact on scientific understanding of the effects of trace elements

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9.4.4. 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

Describe the composition and layered structure of the atmosphere (illustrate your answer with a diagram)

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Identify the main pollutants found in the lower atmosphere and their sources (use a table for your answer)

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

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Describe the formation of a coordinate covalent bond

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Demonstrate the formation of coordinate covalent bonds using Lewis electron dot structures

Compare the properties of the oxygen allotropes O_2 and O_3 and **account** for them on the basis of molecular structure and bonding (using a table)

Compare the properties of the gaseous forms of oxygen and the oxygen free radical (using a table)

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

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Identify and name examples of isomers (excluding geometrical and optical) of haloalkanes up to eight carbon atoms

Discuss the problems associated with the use of CFCs

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and **assess** the effectiveness of steps taken to alleviate these problems

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Analyse the information available that indicates changes in atmospheric ozone concentrations, **describe** the changes observed and **explain** how this information was obtained…….

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9.4.5 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

Identify that water quality can be determined by considering:

concentrations of common ions…….

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total dissolved solids ..……..……

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hardness ……

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turbidity……

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acidity……

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dissolved oxygen and biochemical oxygen demand……..……

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

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Describe and assess the effectiveness of methods used to purify and sanitise mass water supplies (Illustrate your answer with a **flow chart**)

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Describe the design and composition of microscopic membrane filters and **explain** how they purify contaminated water (illustrate your answer with a labeled diagram)

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PRACTICAL TASKS

9.4.1 Much of the work of chemists involves monitoring the reactants and products of reactions and managing reaction conditions?

- gather, process and present information from secondary sources about the work of practising scientists identifying:
- the variety of chemical occupations
  a specific chemical occupation for a more detailed study

9.4.2 Chemical processes in industry require monitoring and management to maximise production

- gather and process information from secondary sources to describe the conditions under which Haber developed the industrial synthesis of ammonia and evaluate its significance at that time in world history

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

- perform first-hand investigations to carry out a range of tests, including flame tests, to identify the following ions:
  - phosphate sulfate carbonate chloride barium
  - calcium lead copper iron
- gather, process and present information to describe and explain evidence for the need to monitor levels of one of the above ions in substances used in society
- identify data, plan, select equipment and perform first-hand investigations to measure the sulfate content of lawn fertiliser and explain the chemistry involved
- analyse information to evaluate the reliability of the results of the above investigation and to propose solutions to problems encountered in the procedure
- gather, process and present information to interpret secondary data from AAS measurements and evaluate the effectiveness of this in pollution control

9.4.4 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

- present information from secondary sources to write the equations to show the reactions involving CFCs and ozone to demonstrate the removal of ozone from the atmosphere
- gather, process and present information from secondary sources including simulations, molecular model kits or pictorial representations to model isomers of haloalkanes
- present information from secondary sources to identify alternative chemicals used to replace CFCs and evaluate the effectiveness of their use as a replacement for CFCs

9.4.5 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

- perform first-hand investigations to use qualitative and quantitative tests to analyse and compare the quality of water samples
- gather, process and present information on the range and chemistry of the tests used to:
  identify heavy metal pollution of water
- monitor possible eutrophication of waterways
- gather, process and present information on the features of the local town water supply in terms of:
  - catchment area
  - possible sources of contamination in this catchment
  - chemical tests available to determine 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