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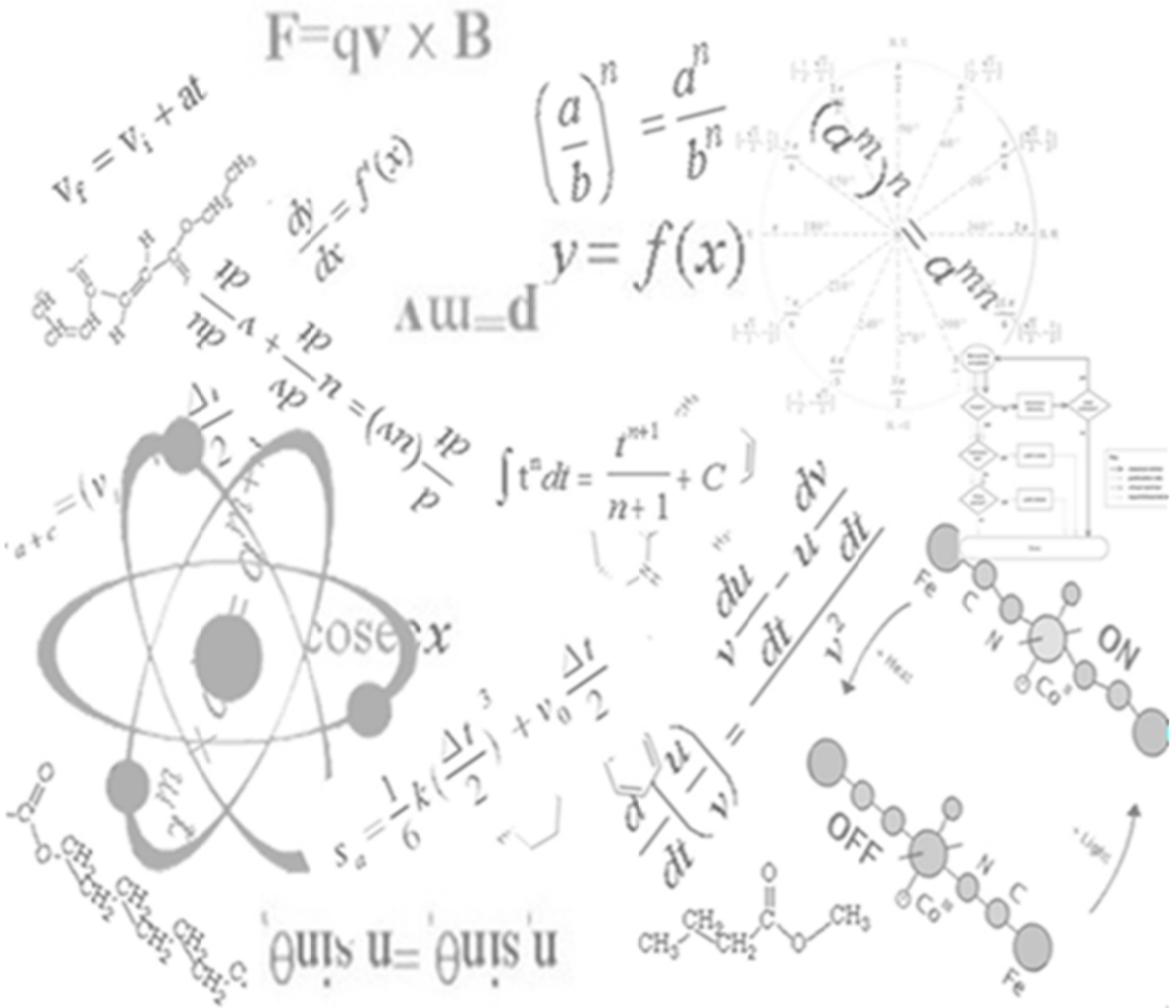
S4S coaching

Year 12- Chemistry

# Chemical Monitoring & Management



# Chemical Monitoring exam 1 – Questions

1. **(6 marks)**
   The Haber Process has been used for over 90 years for the industrial production of ammonia. This process must be carefully managed and monitored by industrial chemists.
   Analyse the impact of changes in pressure and temperature on the yield and rate of production of ammonia during the Haber Process.

2.

**a.** Identify the purpose of using standard solutions in atomic absorption spectroscopy (AAS)

**2 marks**

**b.** Assess the impact of atomic absorption spectroscopy (AAS) on scientific understanding of the effects of ONE trace element that you have studied.

**4 marks**

3. The hardness of a sample of water was investigated using the following methods.

| **Method A** | **Method B** |
|---|---|
| 25.0 mL samples of water were titrated against ethylendiamine tetra-acetic acid (EDTA) with Eriochrome Black T indicator. 21.7 mL of EDTA was required. The hardness was calculated to be equivalent to 17mg/L of $CaCO_3$. | Three drops of detergent were added to separate vials containing 5 mL samples of distilled water, hard water and the sample. After shaking the vials ten times the heights of froth were compared. The procedure was repeated twice. As the amount of froth in the three samples was only slightly less than in the distilled water, the sample was determined to be soft. |

**a.** Identify which of the TWO methods is classified as qualitative.

**1 mark**

**b.** Using the following table, the results from Method A indicated the sample was soft.

| **Water Hardness Scale** | |
|---|---|
| **Concentration of $CaCO_3$** | **Classification** |
| Less than 20 ppm | Soft |
| 20-60 ppm | Slightly hard |
| 60-120 ppm | Moderately hard |
| More than 120 ppm | hard |

Justify this conclusion.

**2 marks**

**c.** Compare the appropriateness of Method A and Method B for determining the hardness of the water.

**5 marks**

4. A crusty white deposit around the rim of an irrigation pip is thought to consist of a mixture of sodium chloride and sodium carbonate. To test for sodium carbonate, a sample of the deposit is dissolved in water. The solution is filtered and then titrated with a standard 0.0118 mol $L^{-1}$ solution of nitric acid. The measurements are recorded below:
   Mass of solid sample = 1.32 g
   Volume of 0.118 mol $L^{-1}$ $HNO_3$ titrated = 27.3 mL
   Indicator used: Methyl Orange (pH range = 3.5 – 5)

**a.** Describe ONE laboratory test you could perform to show the presence of sodium ions in the sample.

**1 mark**

**b.** From the titration results, calculate the mass and percentage by mass of sodium carbonate in the sample.

**3 marks**

**c.** Identify reasons why methyl orange was selected as the indicator for this titration.

**2 marks**

**d.** Outline a laboratory procedure you could perform to assay the proportion of sodium chloride in the sample using the titrated solution.

**3 marks**

**e.** Identify factors in the environment and irrigation farming which result in higher salt concentrations in soil.

**3 marks**

5.

**a.** Identify the steps you followed in performing a first-hand investigation to measure the sulphate content of lawn fertiliser.

**3 marks**

**b.** Describe how you calculated the percentage of sulphate in the fertiliser including relevant equations in your answer.

**3 marks**

6.

**a.** Identify ONE factor that can affect water quality.

**1 mark**

**b.** Describe how this factor will affect the quality of water in a freshwater lake.

**3 marks**

7. When ammonia reacts with hydrochloric acid, the ammonium ion is formed.

**a.** Draw an electron dot formula for the ammonium ion. **1 mark**

**b.** Explain the term ‘coordinate covalent bond’ using this example.

**2 marks**

8. The data below gives the percentage composition of air by volume at sea level for a town on the far north coast of NSW.

| Constituent | Symbol | Volume % in Air | Molar Mass |
|---|---|---|---|
| Nitrogen | $N_2$ | 78.084 | 28.01 |
| Oxygen | $O_2$ | 20.9476 | 32.00 |
| Argon | Ar | 0.934 | 39.95 |
| Caron Dioxide | $CO_2$ | 0.037 | 44.01 |
| Neon | Ne | 0.00188 | 20.18 |
| Helium | He | 0.000524 | 4.00 |
| Methane | $CH_4$ | 0.00017 | 16.03 |

**a.** Calculate the moles of oxygen present in 20 litres of this air at 25°C and 101.3 kPa.

**1 mark**

**b.** Calculate the mass of argon which could be extracted from 200 litres of this air.

**2 marks**

9. A student analysed a 2.85 gram sample of washing powder for its phosphorous content. The phosphorous was precipitated as $Mg_2P_2O_7$. The mass of the precipitate was 0.125 grams.

**a.** To assure accuracy describe TWO procedures that the student needed to undertake after filtration and before determining the mass of the precipitate.

**2 marks**

**b.** Determine the percentage, by mass, of phosphorous in the washing powder.

**2 marks**

**c.** Phosphorous in detergents in the form of phosphates acts as low cost builders, but together with nitrates cause pollution in waterways through the process of eutrophication. Outline and describe the effects of eutrophication in natural waterways.

**2 marks**

10. $O_3$ and $O_2$ are both allotropes of oxygen.

**a.** Define the term allotrope and identify how $O_3$ and $O_2$ are allotropes of oxygen.

**2 mark**

**b.** Compare the properties of the two allotropes and account for their differences.

**4 marks**

**c.** Provide a Lewis electron dot diagram for one of the allotropes.

**1 mark**

11.

**a.** Identify evidence, which indicates changes in atmospheric ozone concentrations.

**3 marks**

**b.** Explain how this information was obtained. **2 marks**

12. Discuss the problems associated with the use of Chlorofluorocarbon's (CFC's).

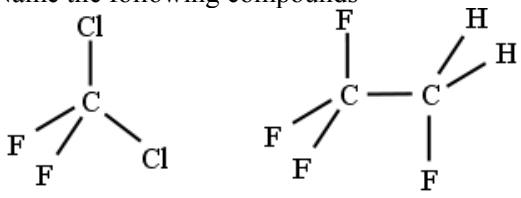
**4 marks**

13. Assess the effectiveness of steps taken to alleviate problems associated with CFC's.

**6 marks**

14.

**a.** Name the following compounds




**2 marks**

**b.** Draw the chemical structure for 1,2-Dichlorotetrafluoroethane.

**1 mark**

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

**6 marks**