



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF APPLIED SCIENCES
DEPARTMENT OF APPLIED CHEMISTRY
INDUSTRIAL INORGANIC CHEMISTRY II
SCH 4114

APRIL 2025

This examination paper consists of 3 pages

Time Allowed: 3 hours
Total Marks: 100
Examiner's Name: Ms E Bere
External Examiner: Prof. G. Mehlana

INSTRUCTIONS

Answer **ANY FOUR** questions from the **FIVE** provided.

Start your answers to different questions on new pages. Each question carries **25 marks**.

1. **GREEN** is the new catch phrase in chemistry research. The use of organic solvents is one of the processes being targeted for going green.

- (a) Define **GREEN CHEMISTRY**, [2]
- (b) Discuss ways organic solvents can be replaced/reduced so as to improve the greenness of a process. [12]
- (c) What are bio feed stocks? [1]
- (d) What are the advantages and disadvantages of bio feed stocks over traditional raw materials? [5]
- (e) Discuss how lactic acid can be produced using bio feedstock [5]

(Total 25 marks)

2. Caustic Soda is one of the most versatile inorganic compounds in use today.

- (a) Why is the **Mercury cell** the **least favoured** method for the manufacture of Caustic Soda? [1]
- (b) With the aid of diagram(s) and relevant reaction/process equations, discuss how the **membrane cell** is used in the manufacture of caustic soda. [10]
- (c) What are the common sources of **sodium chloride**? [4]
- (d) Describe the **Eutectic Freeze** method for the production of **sodium chloride**, include the advantages and disadvantages of the method. [10]

(Total 25 marks)

3. (a) Write brief notes of any industrial manufacture process and uses for the following products:

- (i) Sodium peroxide
- (ii) Sodium thiosulphate
- (iii) Sodium sulphate
- (iv) Sodium cyanide
- (v) Sodium sulphide

[5x5]

(Total 25 marks)

4. The **Solvay process** was designed as a better and more environmentally friendly alternative to the **Le-Blanc process**.

- a) Discuss **the Solvay process** using relevant reaction schemes making special emphasis on how the Solvay process is a 'green' way of producing Soda Ash. [10]
- b) Calculate the **theoretical yield** of sodium carbonate from the Solvay process, expressed in grams, if 162 g of NaCl were used in the reaction? [5]
- c) If the above reaction produces 72.7g of Na₂CO₃, what is the **percentage yield**? [1]
- d) Calculate the **Atom economy (AE)** for the Solvay process. What assumptions have been made when performing this calculation? [4]
- e) Considering all your answers above, can the Solvay process be considered to be Green Chemistry? What other information would you require besides AE and yields to give a comprehensive answer on the greenness of the process? [5]

Page 2 of 3

(Total 25 marks)

5. a) List the four common unit operations used in inorganic chemical industries giving an example of a product in which each operation is used [8]
- b) Discuss factors that influence the choice of location for an industry [6]
- c) Gases from coke smelting plants are often treated to remove SO₂ gases. With the aid of appropriate equation(s) describe how this is done and give an example of where the product can be used commercially [3]
- d) Which property of **sodium silicate** is important for the determination of the functionality of the product? [2]
- e) Describe how **sodium silicate** can be produced from **soda ash** [6]

(Total 25 marks)

END OF QUESTION PAPER!!