



**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**FACULTY OF APPLIED SCIENCES**

**DEPARTMENT OF APPLIED CHEMISTRY**

**INDUSTRIAL INORGANIC CHEMISTRY I**

**SCH 2114**

**Exam Paper**

**December 2024 Marking Guide**

**Time Allowed: 3 hours**

**Total Marks: 100**

**Special Requirements:**

**Examiner's Name: Mr Donatus Dube**

**External Examiner: Dr G Mehlana**

**INSTRUCTIONS**

1. Answer Any four (4) questions from the five (5) provided
2. Each question comprises various sub questions
3. Each question carries 25 marks
4. Use of calculators is permissible

**MARK ALLOCATION**

<b>QUESTION</b>	<b>MARKS</b>
1.	25
2.	25
3.	25
4.	25
5.	25
<b>TOTAL</b>	<b>125</b>

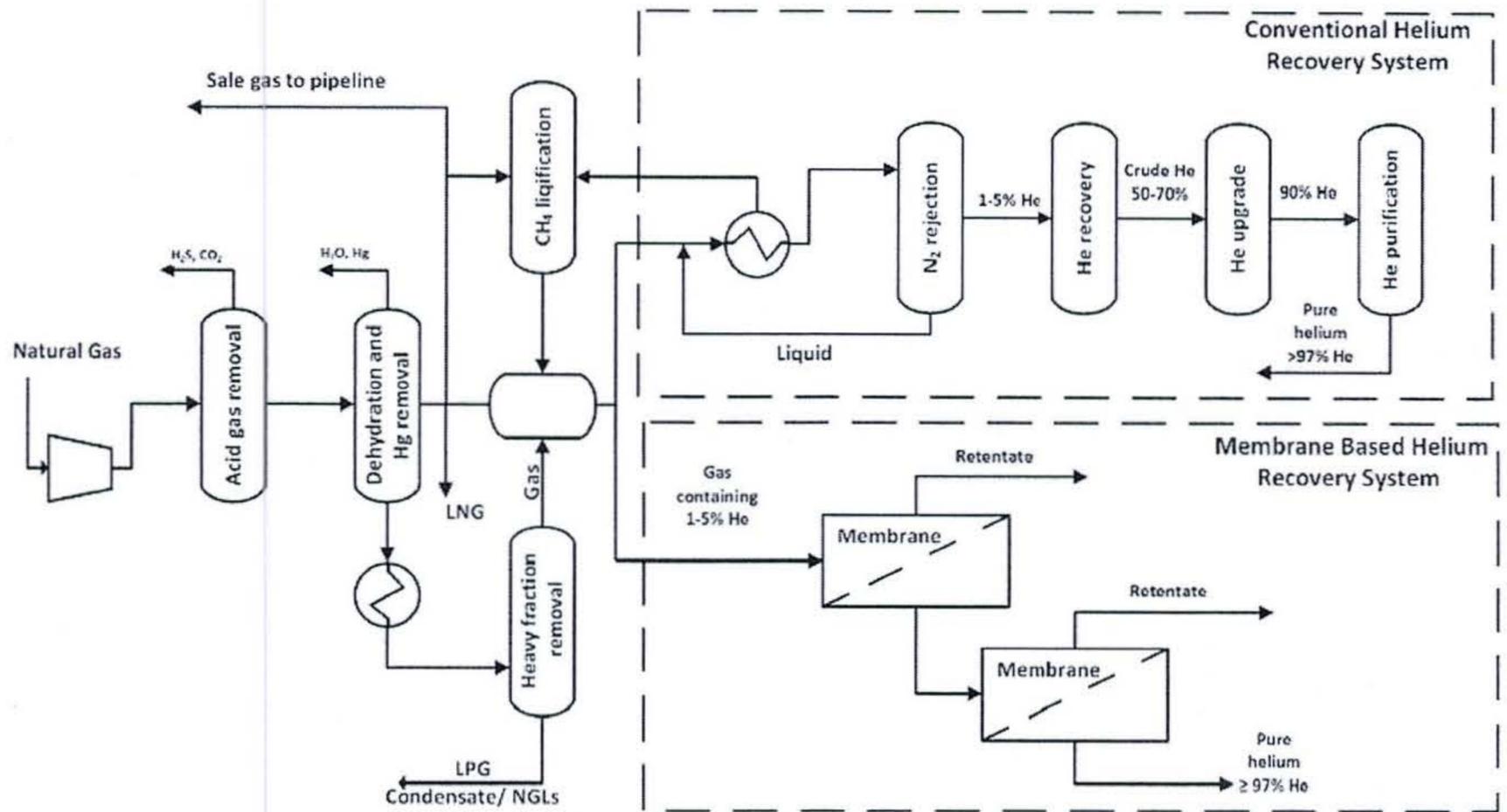
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1. a) With the help of an example explain the following Joule–Thomson equation  
 $\mu = \Delta T / \Delta P = V / C_p \times (2 a R T - b)$  where  $\mu$  = expansion coefficient [K/MPa].  $\Delta P$  = pressure difference [MPa].  $\Delta T$  = temperature difference [K].  $C_p$  = heat capacity at constant pressure and  $V$  is gas's specific volume. (6 marks)

b) Name 3 properties of Hydrogen? (3 marks)

c) Compare and contrast any two methods of production of Hydrogen? Draw the process flow diagrams (10 marks)

d) Explain the process shown by the following process flow diagram



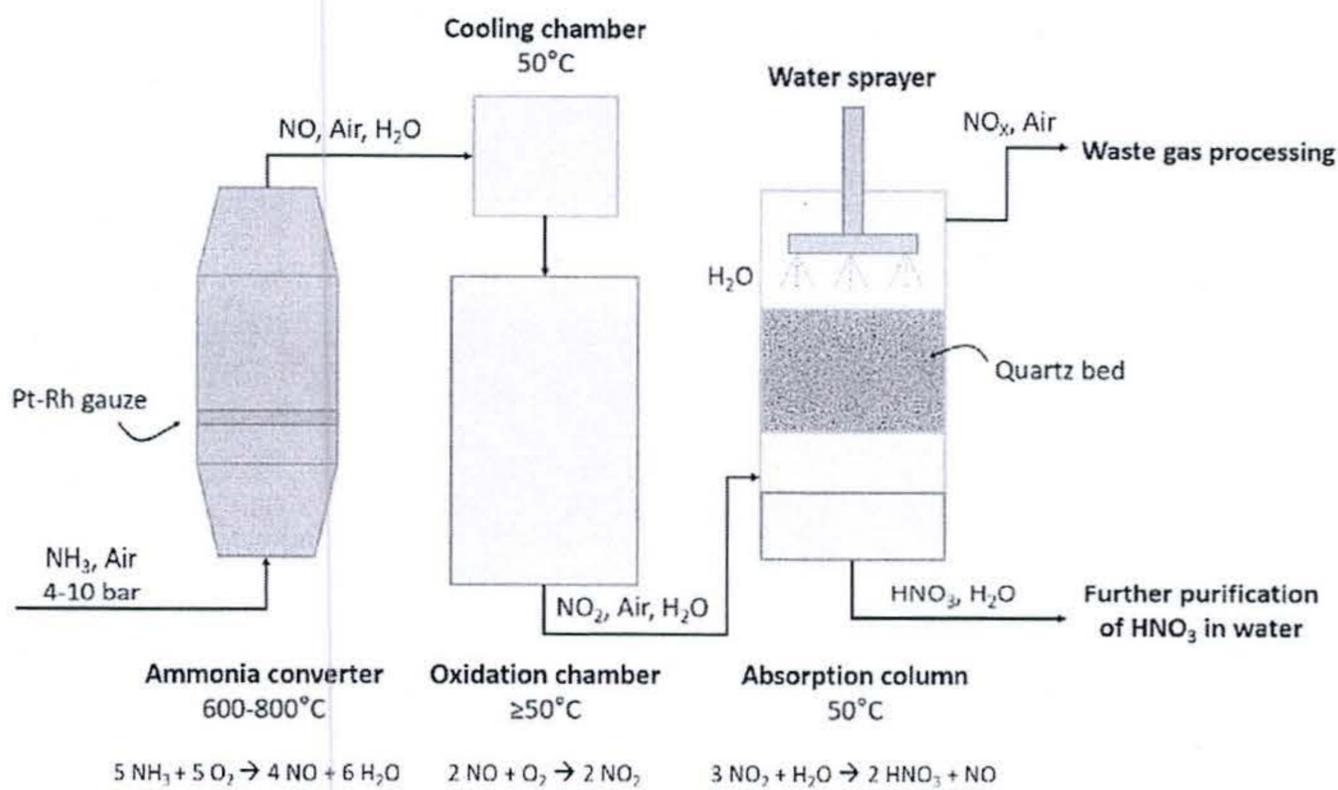
(6 marks)

2. a) Using an appropriate process flow chart Explain how Ammonium Nitrate is manufactured from Ammonia (10 marks)

b) Using a labeled diagram of the Contact process for manufacture of sulphuric acid explain the following:

- i. Role of Catalyst (3 marks)
- ii. Conversion of  $\text{SO}_2$  to  $\text{SO}_3$  (6 marks)
- iii. Write the balanced reaction at the oleum tower. (3 marks)
- iv. 3 uses of sulphuric acid (3 marks)

3. Study the following diagram and answer the questions that follow:



- i. Write reaction equations for each reaction process (6 marks)
- ii. Which catalyst is used in the converter and why? (4 marks)
- iii. Explain why water is used to absorb  $\text{NO}_2$  to  $\text{HNO}_3$  but cannot be used to absorb  $\text{SO}_3$  to produce  $\text{H}_2\text{SO}_4$  (4 marks)
- iv. Name 3 constituents of spent gases and explain their origin in the Oswald process (6 marks)
- v. Explain how nitric acid is used in the gold production industry? (5 marks)

4. Using process flow diagrams explain the following manufacturing processes:

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- a) Fischer-Tropsch process
- b) AOD process
- c) Partial hydrocarbon oxidation process
- d) Haber process
- e) Production of Silver nanoparticles (25 marks)

5. a) Define ceramics? (2 marks)
- (b) Draw a sketch for extrusion molding (6 marks)
- (c) Explain the thermal transformation of a ceramic body being heated from 100°C to 1450°C (8 marks)
- (d) Using a process flow diagram explain how glass is made (9 marks)

\*\*\*\*\*END\*\*\*\*\*