

Final Exam
TICHEM: INDUSTRIAL CHEMISTRY
Spring 2026

Points of attention:

- For each question, the maximum earned points are specified in the question.
- Write clearly! Answers that are not readable are not marked and don't earn marks!
- All answers should be written in English using **blue or black pens** only.
- Use the pencil only for diagrams and graphs.
- Show all the calculation steps in the given space.
- When finished, submit the question paper, together with the answer scripts and the signed cover page to the invigilator.
- Any cheating/copying may result in an instant failing of the examination.

Exam Duration: 2.5 hours
Instructor's Name: Dr. G. Chandrasekar
Exam Date: 11/05/2026
Program: PE

	40
	10

Student Information

Name: ID:
Signature:

Invigilator

Initials: ☐ Student ID checked
Time received:

Instruction:

(i) Multiple answers for MCQ questions will not be accepted. Write the correct answer separately below the question.

(ii) Providing correct units is compulsory wherever a physical quantity is mentioned. Half a mark will be deducted if units are not included.

Question 1

[10 marks]

Answer all the questions below:

(10 x 1 = 10 marks)

(i). Fractional distillation of crude oil is mainly based on:

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|------------------------------|---------------------------|
| (a) Density difference | (b) Molecular weight only |
| (c) Boiling point difference | (d) Solubility difference |

(ii). Catalyst used in cracking petroleum Process:

- | | |
|-----------------------------|--|
| (a) Fe_2O_3 | (b) $\text{SiO}_2\text{-Al}_2\text{O}_3$ |
| (c) NaCl | (d) CuSO_4 |

(iii). Copper removes sulphur as:

- | | |
|---------------------|---------------------|
| (a) CuS | (b) CuSO_4 |
| (c) CuCl_2 | (d) CuO |

(iv). Branching in the hydrocarbons increases:

- | | |
|--------------|---------------------|
| (a) Knocking | (b) Octane number |
| (c) Density | (d) Sulphur content |

(v). Hardness expressed as:

- | | |
|-----------------------|-----------------------|
| (a) CaO | (b) MgCl ₂ |
| (c) CaSO ₄ | (d) CaCO ₃ |

(vi). Sodium aluminate forms:

- | | |
|------------------------------------|-------------------------|
| (a) Al ₂ O ₃ | (b) Al(OH) ₃ |
| (c) NaCl | (d) MgCl ₂ |

(vii). MgCl₂ causes:

- | | |
|------------------------|-------------|
| (a) Temporary hardness | (b) |
| (c) Softness | (d) Acidity |

(viii). Optimal temperature for SO_2 oxidation is:

- | | | | |
|-----|--------|-----|--------|
| (a) | 800 °C | (b) | 200 °C |
| (c) | 400 °C | (d) | 150 °C |

(ix). Oleum is:

- | | | | |
|-----|------------------------------------|-----|--|
| (a) | $\text{SO}_2 + \text{H}_2\text{O}$ | (b) | SO_3 in H_2SO_4 |
| (c) | HCl solution | (d) | Na_2SO_4 solution |

(x). In Haber process, increasing temperature decreases yield because:

- | | | | |
|-----|-------------------------|-----|------------------------|
| (a) | Reaction is endothermic | (b) | No equilibrium |
| (c) | Catalyst deactivates | (d) | Reaction is exothermic |

Question 2**[10 marks]**

(a) An automobile company introduces a new engine with a very high compression ratio. Customers report knocking issues when using regular petrol.

- (i) Analyze why knocking occurs in this engine.
- (ii) Suggest fuel-related solutions to solve this problem.
- (iii) Explain how octane number is linked to engine design. (1 x 3 = 3 marks)

(b) The moving bed catalytic cracking process allows continuous operation in petroleum refining. Describe this process with a neat sketch and explain working principle of the moving bed catalytic cracking process used in petroleum refining. (7 marks)

Question 3**[10 marks]**

- (a) Explain the Cold Lime–Soda Process for the removal of hardness of water with a neat description. Include the removal of temporary and permanent hardness with chemical equations and describe the role of sodium aluminate as a coagulant. (7 marks)
- (b) A water sample contains 60 mg/L $\text{Ca}(\text{HCO}_3)_2$, 30 Na₂O mg/L, and 40 mg/L MgSO_4 . Calculate total hardness (as CaCO_3). (3 marks)

Question 4**[10 marks]**

(a) Explain the Contact Process for the manufacture of sulphuric acid, including purification of gases, catalytic oxidation, and absorption stages. Also discuss the removal of arsenic impurities and the role of catalyst. (7 marks)

(b) A reversible chemical reaction at equilibrium is subjected to changes in concentration, pressure, and temperature. According to Le Chatelier's Principle, when a system at equilibrium is disturbed, it adjusts itself to partially oppose the change applied. For example, in the synthesis of ammonia by the Haber process ($\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$), changes in external conditions affect the yield of ammonia.

Explain Le Chatelier's Principle and discuss how changes in concentration, pressure, and temperature affect the equilibrium position of the ammonia synthesis reaction. (3 marks)

MLO and Bloom's Level of Complexity

Q #	MLO Addressed	Complexity Level	Mark	Remark
1	1, 2, 3	Knowledge, Apply, Analyze	10	3 of 4 problems are required
2	3, 5	Analyze , Create	10	
3	3, 4	Analyze, Evaluate	10	
4	2, 3, 5	Apply, Analyze, Create	10	