

Final Exam

TEC: ENGINEERING 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: 14/05/2026
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.

Answer all the questions below:

Question 1

[10 marks]

Multiple Choice Questions (MCQ)

(10 x 1 = 10 marks)

(i) Unit of the zero-order rate constant is:

- (a) s^{-1} , (b) $\text{L mol}^{-1} \text{s}^{-1}$, (c) $\text{mol L}^{-1} \text{s}^{-1}$, (d) $\text{L}^2 \text{mol}^{-2} \text{s}^{-1}$

(ii) Activation energy of a chemical reaction is:

- | | |
|-----------------------------|----------------------|
| (a) minimum energy required | (b) heat of reaction |
| (c) zero energy | (d) product energy |

(iii) Rate-determining step of the chemical reaction controls:

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|------------------------------|------------------|
| (a) equilibrium | (b) ΔH |
| (b) equilibrium constant (K) | (d) overall rate |

(iv) The example of zero-order reaction is:

- | | |
|--|---------------------------------|
| (a) Reaction between H_2 and I_2 , | (b) enzyme saturation reaction, |
| (c) decomposition of NH_3 , | (d) combustion |

(v) Rate constant of the reaction increases with:

- | | |
|-----------------------------|------------------------|
| (a) temperature, | (b) pressure decrease, |
| (c) concentration decrease, | (d) volume decrease |

(vi) If equilibrium constant $K > 1$:

- | | |
|------------------------|-----------------------|
| (a) reactants favored, | (b) products favored, |
| (c) no equilibrium, | (d) slow reaction |

(vii) In an equilibrium chemical reaction, if $Q < K$ the reaction condition is:

- | | | | |
|------------------|-----------------|------------------|----------|
| (a) right shift, | (b) left shift, | (c) equilibrium, | (d) stop |
|------------------|-----------------|------------------|----------|

(viii) Pure solids involved in an equilibrium reaction are _____ in the expression for the equilibrium constant (K).

- (a) Included, (b) excluded, (c) variable, (d) reactive

(ix) The nature of the equilibrium is:

- (a) Static, (b) frozen, (c) dynamic, (d) dead

(x) In an open system the attainment of equilibrium:

- (a) possible, (b) not possible, (c) stable, (d) instant

Question 2**[10 marks]**

- (a) The H_2/CO ratio in mixtures of carbon monoxide and hydrogen (called synthesis gas) is increased by the water-gas shift reaction $\text{CO (g)} + \text{H}_2\text{O(g)} \leftrightarrow \text{CO}_2 \text{ (g)} + \text{H}_2 \text{ (g)}$, which has an equilibrium constant $K_c = 4.24$ at 800 K. Calculate the equilibrium concentrations of CO_2 , H_2 , CO , and H_2O at 800 K if only CO and H_2O are present initially at concentrations of 0.150 M (5 marks)

- (b) Calculate the equilibrium concentrations at 800 K for the reaction in above problem if CO, H₂O, CO₂ and H₂ are added to a reaction vessel with initial concentrations of 0.100 M (5 marks)

Question 3**[10 marks]**

- (a) Explain how surface area affects the rate of a chemical reaction. Illustrate your answer with suitable examples. (2 marks)

- (b) A catalyst increases rate but not equilibrium constant. Analyze using energy profile.” (2 marks)

(c) The equilibrium constant K_p for the reaction $C_{(s)} + H_2O_{(g)} \rightleftharpoons CO_{(g)} + H_{2(g)}$ is 2.44 at 1000K.

What are the equilibrium partial pressures of H_2O , CO , H_2 , if the initial partial pressures are $P_{CO} = 1.00 \text{ atm}$, $P_{H_2O} = 1.00 \text{ atm}$ and $P_{H_2} = 1.00 \text{ atm}$? (6 marks)

Question 4**[10 marks]**

- (a) Derive the integrated rate equation for a first-order reaction starting from its rate law.
Show all necessary steps. (5 marks)

(b) Show that half-life of a first-order reaction is independent of initial concentration.

(2 marks)

(c) A first-order reaction has a rate constant $k=0.0321\text{min}^{-1}$. Calculate the time required for 80% of the reactant to decompose.

(3 marks)

MLO and Bloom's Level of Complexity

Q #	MLO Addressed	Complexity Level	Mark
1	5	Create	10
2	2	Create	10
3	1	Apply	10
4	2	Analyze	10