الجامعة الوطنية
National University
Science & Technology للعلوم والتكنولوجيا
كلية عمان البحرية الدولية
International Maritime College Oman

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

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	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) Order of reaction is determined by:

(a) Stoichiometry, (b) Experiment, (c) Products, (d) Pressure

(ii) Arrhenius equation is:

(a) $k = Ae^{-Ea}/RT$, (b) $k = A + E$, (c) $k = RT/E_a$, (d) $k = \ln A$

(iii) Zero-order reaction rate is:

(a) constant, (b) proportional to [A], (c) proportional to $[A]^2$, (d) zero

(iv) The order of the reaction $2NO(g) + O_{2(g)} \rightarrow 2NO_{2(g)}$ is the sum of:

(a) Coefficients (b) Exponents, (c) Products, (d) Energies

(v) Second-order rate constant unit:

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

(vi) For $N_2 + 3H_2 \rightleftharpoons 2NH_3$ increasing pressure of nitrogen:

(a) left, (b) right, (c) no change, (d) stops

(vii) $K_p = K_c (RT)^{\Delta n}$ applies to:

(a) solids, (b) liquids, (c) gases, (d) solutions

(viii) Increasing temperature favors endothermic reaction:

(a) right, (b) left, (c) no change, (d) stop

(ix) Reaction quotient predicts:

(a) speed, (b) direction, (c) energy, (d) mass

(x) The effect of catalyst in equilibrium reaction is:

(a) changes K, (b) shifts equilibrium, (c) no effect on K, (d) stops reaction

Question 2 **[10 marks]**

(a) Calculate the equilibrium concentrations of N_2O_4 and NO_2 at 25°C in a vessel that contains an initial $N_2O_{4(g)} \leftrightarrow 2\ NO_{2(g)}$ is 1.6 at 25°C. (6 marks)

(b) Methane burns according to the reaction: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O(g)$. The enthalpy changes ($\Delta H$) of the reaction is -802 kJ and internal energy change is (ΔE) -799.7 kJ at 1 atm pressure. Calculate the volume change (ΔV) for the reaction. (4 marks)

Question 3 **[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) Using the first order rate equation obtained from the above, explain how the rate constant can be determined using a graph based on concentration and time. (3 marks)

(c) Calculate the half life ($t_{1/2}$) period of the first order reaction, if the rate constant, k = 0.002 min^{-1}. (2 marks)

Question 4 **[10 marks]**

(a) Derive the integrated rate equation for a zero-order reaction starting from its rate law.

(3 marks)

(b) Draw a graph for the determination of rate constant from the graph. (1 mark)

(c) Show the equation that the half-life of a zero-order reaction depends on initial concentration. (1 mark)

(d) Calculate the equilibrium concentrations of H_2, I_2, and HI at 700 K, if the initial concentrations are $[H_2] = 0.100$ M and $[I_2] = 0.300$ M. The equilibrium constant K_c for the reaction $H_{2(g)} + I_{2(g)} \leftrightarrow 2\ HI_{(g)}$ is 57.0 at 700 K. (5 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**