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M.E. / M.TECH. DEGREE EXAMINATIONS, DEC 2019

First Semester

CL18101 – ADVANCED THERMODYNAMICS FOR CHEMICAL ENGINEERS*(Chemical Engineering)***(Regulation 2018)****Time: Three Hours****Maximum : 100 Marks**Answer **ALL** questions**PART A - (10 X 2 = 20 Marks)**

	CO	RBT
1. Highlight the difference between point functions and path functions in thermodynamics? Give two examples of each.	1	U
2. Distinguish between entropy and internal energy.	1	AN
3. Show an isothermal line below critical temperature starting from liquid state to super heated vapor state on p-v diagram.	2	U
4. Write the 4 Maxwell's relations	2	R
5. Distinguish between activity coefficient and fugacity coefficient.	3	AN
6. Give important differences between ideal and non-ideal solutions.	3	U
7. State excess Gibb's free energy? What conditions this value will be zero for a binary system.	4	U
8. List the importance of VLE and its application.	4	R
9. Write is the criterion of equilibrium for a chemically reacting system	4	U
10. What happen when conversion to exothermic reaction and equilibrium constant if heat is added in isothermal condition?	4	U

PART B - (5 X16 = 80 Marks)

11. (a) (i) Write any two axioms of second law of thermodynamics. (12) **1** **U**
Explain in detail.
- (ii) Comment on the feasibility of cooling your kitchen in the summer by opening the door to the electrically powered refrigerator. (4) **1** **AN**

(OR)

- (b) Define Legendre Transformations and inverse transformation. (16) **1** **U**
Perform these transformations for a simple algebraic function. Give usefulness of these transformations in thermodynamics.

12. (a) Define stability of thermodynamic system. Derive the thermodynamic conditions for mixing of two different gases. (16) 2 U

(OR)

- (b) State phase rule. Explain phase diagram for a single component. (16) 2 U
13. (a) Derive Gibbs- Duhem equations from partial molar properties. (16) 3 AP
- (OR)
- (b) (i) Define and explain fugacity and fugacity coefficient for ideal gas. How fugacity coefficient is estimated for a pure gas using the equation of state. (10) 3 U
- (ii) Explain the UNIQUAC method to find out activity coefficient in a liquid mixture. (6) 3 U

14. (a) State and explain Henry's law and Lewis- Randall rule. Show that in a binary solution if the solute obeys Henry's law, solvent obeys Lewis- Randall rule. (16) 4 AP

(OR)

- (b) Calculate the dew temperature for a binary vapor mixture of benzene (1) and toluene (2) at 760 Torr. The mole fraction of benzene in the vapor is 0.6263. Perform maximum of two iterations. (16) 4 AP

The Antoine constants are given by

	A	B	C
Benzene(1)	6.87987	1196.760	219.161
Toluene (2)	6.95087	1324.310	219.187

15. (a) Derive the equation for showing the temperature effects on equilibrium constant of a chemical reaction. (16) 4 AP

(OR)

- (b) In a laboratory investigation, acetylene is catalytically hydrogenated to ethylene at 1120°C and 1 bar. If the feed is an equimolar mixture of acetylene and hydrogen, what is the composition of the product stream at equilibrium? (16) 4 AP

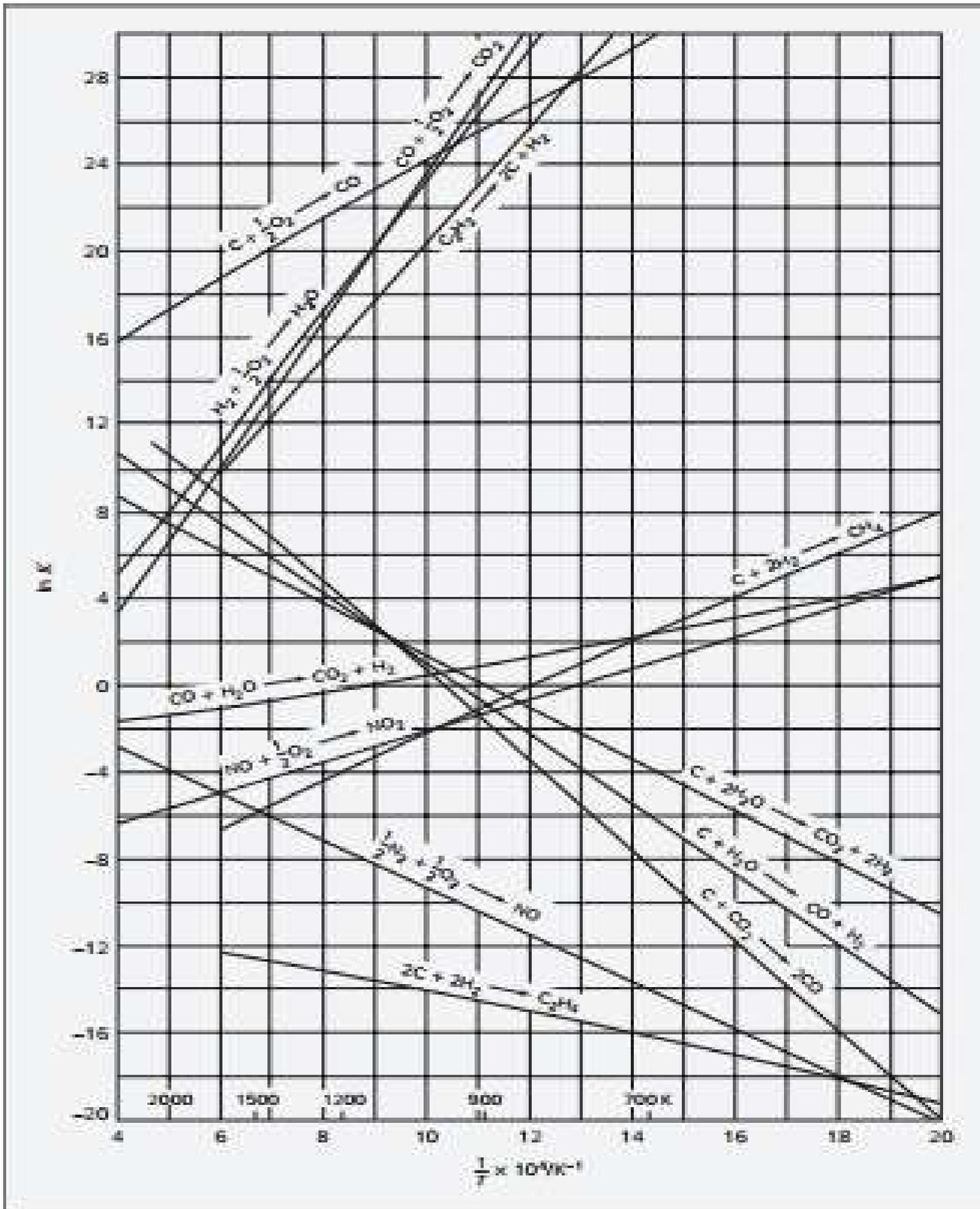


Figure 14.2: Equilibrium constants as a function of temperature.