

THIRD SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2017

(CUCBCSS—UG)

Chemistry

CHE 3B 03—PHYSICAL CHEMISTRY—I

Time : Three Hours

Maximum : 80 Marks

Section A (One Word).*Answer all questions.**Each question carries 1 mark.*

1. The critical temperature T_c is related to van der Waals constants by the relation _____.
2. The temperature at which a real gas shows ideal behavior, over a wide range of pressure is called _____.
3. Give one example for an intensive property.
4. For an isothermal reversible expansion of an ideal gas, ΔH will be _____.
5. Joule Thomson coefficient $\mu_{JT} =$ _____.
6. $\ln N! =$ _____.
7. Give one example for a path function.
8. With decrease in temperature, viscosity of a liquid will _____.
9. For the reaction $N_2O_4(g) \rightarrow 2NO_2(g)$, K_c and K_p are related as _____.
10. The equilibrium constant is related to the standard free energy change of a reaction as _____.

(10 × 1 = 10 marks)

Section B (Short Answers)*Answer any ten questions.**Each question carries 2 marks.*

11. Calculate the RMS velocity of H_2 molecule at $27^\circ C$.
12. What is compressibility factor ?
13. Define mean freepath.
14. Define inversion temperature.

Turn over

15. State and explain I law of thermodynamics.
16. Distinguish between a thermodynamic closed and isolated system.
17. What is meant by residual entropy ?
18. How is molar refraction of a liquid related to its refractive index and density ?
19. What is meant by heterogenous equilibria ? Give one example.
20. Enthalpy of neutralization of strong acid by a strong base is always constant. Explain.
21. One mole of an ideal gas expands isothermally at 300 K from a volume of 10 dm³ to 20 dm³ against a constant external pressure of 1 atmosphere. Calculate the work done by the system.
22. The equilibrium constant of a reaction is 7.5×10^{-5} at 300 K. Calculate the value of ΔG^0 .

(10 × 2 = 20 marks)

Section C (Paragraphs)

*Answer any five questions.
Each question carries 6 marks.*

23. State Le Chateliers principle. What is the effect of increase of pressure and temperature in the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ $\Delta H = -92.38$ KJ. Explain.
24. Derive van der Waals equation for n moles of a gas.
25. Show that Joule-Thomson expansion is an isenthalpic process.
26. Derive Gibbs Helmholtz equation.
27. Define critical constants. Explain the determination of critical temperature and critical pressure of a gas.
28. The standard enthalpy of formation of gaseous water at 298 K is -241.82 KJ/mol. Estimate its value at 373 K. Given the following value of C_p (Molar) :
 - (i) $H_2O(g) = 33.58$ JK⁻¹ mol⁻¹.
 - (ii) $H_2(g) = 28.84$ JK⁻¹ mol⁻¹ and
 - (iii) $O_2(g) = 29.37$ JK⁻¹ mol⁻¹.
 Assume that C_p are independent of temperature.
29. State and explain Nernst heat Theorem. What is its significance ?
30. Obtain the thermodynamic derivation of Law of Chemical equilibrium.

(5 × 6 = 30 marks)

Section D (Essays)

Answer any two questions.

Each question carries 10 marks.

31. (a) Derive kinetic gas equation. (7 marks)
- (b) Calculate the mean free path for a gas at STP. Collision diameter $\sigma = 2 \times 10^{-10}$ m. (3 marks)
32. (a) Derive Clausius- Clapeyron equation and discuss its application in liquid- vapour equilibria. (7 marks)
- (b) Calculate the efficiency of heat engine working between a source at 480 K and sink at 200K. (3 marks)
33. (a) Derive an equation relating change in entropy of an ideal gas with respect to a change in temperature and pressure. (7 marks)
- (b) For the reaction $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$ $\Delta H = 170.85 \text{ KJ}$ and $\Delta S = 0.15 \text{ KJ.K}^{-1}$ at 300 K. Predict whether the reaction is spontaneous or not at 300 K. Explain. (3 marks)
34. (a) Derive vant Hoff's equation. (7 marks)
- (b) Express the value of equilibrium constant in terms of concentration of reactants and products for a hypothetical reaction $aA + bB \rightarrow cC + dD$. How is the value related to K_p ? (3 marks)
- [2 × 10 = 20 marks]