

THIRD SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2018

(CUCBCSS—UG)

Core Course

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 pressure P_c is related to Vander Waals constants by the relation _____.
2. The value of mean free path of a gas _____ with increasing pressure.
3. Give one example for an extensive property.
4. For Joule- Thomson expansion of a real gas, ΔH will be _____.
5. Adiabatic expansion is accompanied by _____ in entropy.
6. $\ln N! =$ _____.
7. Give one example for a State function.
8. With decrease in temperature, viscosity of a liquid will _____.
9. For the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, 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 most probable velocity of H_2 molecule at $27^\circ C$.
12. Sketch the PV isotherms of CH_4 gas and He gas.
13. Write Vander Waals equation for n moles of real gas.
14. Define critical temperature.
15. State zeroth law of thermodynamics.
16. Distinguish between a thermodynamic open and isolated system.

17. What is meant by chemical potential ?
18. What is the effect of temperature on the surface tension of a liquid.
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 and reversibly at 300 K from a volume of 10 dm^3 to 20 dm^3 . Calculate the work done by the system.
22. The equilibrium constant of a reaction is 1.5×10^{-5} at 300 K. Calculate the value of ΔG° .

(10 × 2 = 20 marks)

Section C (Paragraphs)

Answer any five questions.

Each question carries 6 marks.

23. State Le Chatelier's principle. What is the effect of pressure and temperature in the reaction $\text{N}_2\text{O}_4 (\text{g}) \rightarrow 2\text{NO}_2 (\text{g})$ $\Delta H = + 59.0 \text{ kJ}$. Explain.
24. Derive Vander Waals equation for n moles of a gas.
25. Derive the expression for Joule-Thomson coefficient and also show that its value is zero for an ideal gas.
26. Derive Clausius-Clapeyron equation and discuss its application in liquid-vapour equilibria.
27. Define critical constants. Explain the determination of critical temperature and critical pressure of a gas.
28. Calculate the enthalpy of formation of methane. Give that the standard enthalpy of formation of liquid water, carbon dioxide gas are $- 285.9 \text{ KJ/mol}$, $- 393.5 \text{ kJ/mol}$ respectively. Enthalpy of combustion of methane is $- 890.3 \text{ kJ/mol}$.
29. What is meant by Parachor ? How is it helpful in the elucidation of molecular structure ?
30. Derive the relation between equilibrium constants K_p and K_c .

(5 × 6 = 30 marks)

Section D (Essays)

Answer any **two** questions.
Each question carries 10 marks.

31. (a) Explain Maxwell's distribution of molecular velocities. Illustrate the effect of temperature on this distribution. (7 marks)
- (b) Calculate the temperature at which root mean square velocity of Hydrogen gas becomes equal to that Oxygen gas. (3 marks)
32. (a) Derive Gibbs Helmholtz equation. (7 marks)
- (b) The enthalpy of formation of ethane at 298 K and at constant pressure is - 89.90 kJ. Calculate the enthalpy of formation at constant volume at this temperature ? (3 marks)
33. (a) Derive Kirchhoff equation. (7 marks)
- (b) For the reaction $\text{NH}_4\text{Cl (s)} \rightarrow \text{NH}_3 \text{ (g)} + \text{HCl (g)}$ $\Delta H = 170.85 \text{ KJ}$ 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 Van't Hoff equation. (7 marks)
- (b) The equilibrium constant of a reaction doubles on raising the temperature from 298 K to 308 K. Calculate the standard enthalpy of the reaction. (3 marks)
- (2 × 10 = 20 marks)