

C 31128

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Name.....

Reg. No.....

**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,  $\Delta H$  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  $10 \text{ dm}^3$  to  $20 \text{ dm}^3$  against a constant external pressure of 1 atmosphere. Calculate the work done by the system.
22. The equilibrium constant of a reaction is  $7.5 \times 10^{-5}$  at 300 K. Calculate the value of  $\Delta G^0$ .

(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  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$   $\Delta H = -92.38 \text{ KJ}$ . 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  $-241.82 \text{ KJ/mol}$ . Estimate its value at 373 K. Given the following value of  $C_p$  (Molar) :
  - (i)  $\text{H}_2\text{O}(\text{g}) = 33.58 \text{ JK}^{-1} \text{ mol}^{-1}$ .
  - (ii)  $\text{H}_2(\text{g}) = 28.84 \text{ JK}^{-1} \text{ mol}^{-1}$  and
  - (iii)  $\text{O}_2(\text{g}) = 29.37 \text{ JK}^{-1} \text{ mol}^{-1}$ .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  $\text{CaCO}_3(\text{s}) \rightarrow \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$   $\Delta H = 170.85$  KJ and  $\Delta S = 0.15$  KJ.K<sup>-1</sup> 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  $a\text{A} + b\text{B} \rightarrow c\text{C} + d\text{D}$ . How is the value related to  $K_p$ ? (3 marks)
- [2 × 10 = 20 marks]