C 31128 (Pages : 3) 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 Tc 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 μ_{JT} = ————.
6. In N! = ————.
7. Give one example for a path function.
8. With decrease in temperature, viscosity of a liquid will ————.
9. For the reaction $N_2O_4(g) \rightarrow 2NO_2(g)$, Kc and Kp 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°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 dm^3 to 20 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 7.5×10^{-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 Cp (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 Cp 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 $CaCO_3(s) \rightarrow CaO(S) + CO_2(g)$ $\Delta H = 170.85$ KJ and $\Delta S = 0.15 KJ.K^{-1}$ at 300 K. Predict whether the reaction is spontaneous or not at 300 K. Explain. (3 marks)

34. (a) Derive vant Hoffs equation. (7 marks)

(b) Express the value of equilibrium constant in terms of concentration of reactants and products for a hypothetical reaction $aA + bB \rightarrow cC + d D$. How is the value related to Kp ? (3 marks)

[2 × 10 = 20 marks]