THIRD SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2016

(CUCBCSS–UG)

Core Course—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 average distance travelled by a gas molecule between successive collisions is called ————.

2. Thermodynamic properties which depend on the amount of substance are known as ————.

3. For an adiabatic process, the work done is at the expense of ———— of the system.

4. Hot tea in a closed thermoflash is an example of ———— system.

5. The standard enthalpy of a compound is the same as its ————.

6. The standard absolute entropy of a substance is always ————.

7. According to ———— law, thermochemical equations can be added and subtracted.

8. With increase in temperature, the viscosity of a liquid will ————.

9. Surface active reagents such as soaps and detergents ———— the surface tension of water.

10. For the gaseous equilibrium $H_2 + I_2 \rightleftharpoons 2HI$, the value of K_p and K_c are related, at any temperature as ————.

$(10 \times 1 = 10 \text{ marks})$

Section B (Short Answers)

*Answer any **ten** questions.*
Each question carries 2 marks.

11. Calculate the RMS velocity of O_2 molecule at 27°C.

12. Write the van der Waals' equation for 'n' moles of a gas and explain the terms.

13. What are open and closed systems ? Give examples.

14. The van der Waals' constants 'a' and 'b' respectively for a gas are 2.5×10^{-1} atm dm^6 mol.$^{-2}$ and 2.6×10^{-2} dm^3 mol.$^{-1}$ Calculate the inversion temperature of the gas.

15. The heat of combustion of benzene at constant pressure is -890.5 kJ at 27° C. Calculate the heat of combustion at constant volume, at the same temperature.

16. The heat of neutralisation of a strong acid by a strong base is always constant. Why ?

Turn over

17. Calculate the bond energy of H-Br bond. Given the enthalpy of formation of HBr as − 36 kJ mol.$^{-1}$ and the bond energies of H-H and Br-Br bond respectively as 430 kJ and 188 kJ.

18. Calculate the number of ways of distributing two indistinguishable objects in two boxes.

19. What is meant by optical exaltation ?

20. Equal volumes of water and an unknown liquid X take 120 and 70 seconds respectively to flow through a capillary tube. The density and viscosity respectively of water are given as 988 kgm.$^{-3}$ and 1.000×10^{-3} PaS. If the density of X is 868 kgm.$^{-3}$, calculate its viscosity.

21. What is meant by homogeneous equilibria ? Give example.

22. The value of K_p for an equilibrium doubles, when the temperature is increased from 298 K to 308 K. Calculate the enthalpy change for the reaction.

(10 × 2 = 20 marks)

Section C (Paragraphs)

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

23. Write briefly on Maxwell's distribution of molecular velocities. What is the effect of temperature in the distribution ?

24. What are critical constants ? How are they related to van der Waal's constants ?

25. What is Joule Thomson coefficient ? Derive an equation for Joule Thomson coefficient.

26. Derive an equation for the change in entropy of 'n' moles of an ideal gas, undergoing a simultaneous change in temperature and volume.

27. State and explain Nernst heat theorem. What is the significance of the theorem ?

28. What is meant by parachor of a liquid ? With the help of an example, explain its application in structural elucidation.

29. Derive the law of chemical equilibrium thermodynamically.

30. Express the value of equilibrium constant for a hypothetical reaction $a\text{A} + b\text{B} \rightleftharpoons c\text{C} + d\text{D}$, in terms of concentration of various reactants and products. How is the value related to Kp and Kx ?

(5 × 6 = 30 marks)

Section D (Essays)

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

31. (i) Explain the effect of temperature and pressure on (a) collision number ; and (b) mean free path of a gas.

    (ii) What is meant by compressibility factor of a gas ? Explain its significance.

32. (i) Derive the Clausius-Clapeyron equation and discuss the important applications of the equation.

    (7 marks)

    (ii) Calculate the efficiency of a heat engine working between a source maintained at the normal B.P. of water and sink at its normal F.P.

    (3 marks)

33. (i) Derive an equation for the work of isothermal reversible expansion of 'n' moles of an ideal gas.

(4 marks)

(ii) The free energy change of a process changed from -138 kJ at 27° C. to -135 kJ at 37° C. Calculate the change in enthalpy of the process at 32° C.

(4 marks)

(iii) Show that $C_p - C_v = R$ for one mole of an ideal gas.

(2 marks)

34. (i) What is meant by thermodynamic probability ? Derive the relation between entropy and probability of a system.

(ii) State and explain Le-Chatelier's principle. Discuss the effect pressure on the B.P. of water and M.P. of ice.

[2 × 10 = 20 marks]