D 92249 (Pages : 3) Name.....

Reg. No.....

THIRD SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2015

(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 temperature above which a gas cannot be liquefied by applying pressure is called ————.
2. ———— systems can exchange both energy and matter with the surroundings.
3. The entropy change of the system during an adiabatic process is ————.
4. For an isothermal process, the work done is at the expense of ————.
5. The standard enthalpy of a pure element is taken as ————.
6. According to ———— law, thermochemical equations can be added or multiplied.
7. The heat of neutralisation of a strong acid by a strong base is always ————.
8. At the normal B.P. of a liquid its vapour pressure will become equal to ————.
9. The S.I. unit of surface tension is ————.
10. Chemical equilibrium is ———— in nature.

(10 × 1 = 10 marks)

Section B (Short answer)

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

11. Calculate the r.m.s. velocity of H_2 molecule at 27°C.
12. Write the vander Waals' equation for '*n*' moles of a gas and explain the terms.
13. Differentiate between extensive and intensive properties.
14. Calculate the work done during the isothermal reversible expansion of 10 moles of an ideal gas from 10 dm^3 to 20 dm^3 at 27°C.
15. The vander Waals' constants '*a*' and '*b*' for a gas are 1.40×10^{-1} Nm^4 mol^{-2} and $3.9 \times 10^{-5} m^3$ mol^{-1}, respectively at 27°C. Calculate the inversion temperature of the gas.

Turn over

16. The standard enthalpy of a compound is the same as its standard heat of formation. Illustrate with an example.

17. The heat of formation of CO_2 and CO are - 393.5 kJ and – 110.5 kJ respectively. Calculate the heat of combustion of CO.

18. What is meant by residual entropy ? Explain with example.

19. Write any *four* factors that affect the viscosity of a liquid.

20. The viscosity of an oil of density 0.97 gcm^{-3} is 5×10^{-2} Nm^{-2} at 27°C. Calculate the time required for a given volume of the oil to flow through a viscometer, if the same volume of water takes 50 seconds to flow through the viscometer. The coefficient of viscosity and density of water respectively are 8.9×10^{-4} Nm^{-2} and 1 gcm^{-3}.

21. What are heterogeneous equilibria ? Give example.

22. For the reaction $2\,NO_{(g)} + Cl_{2(g)} \rightleftharpoons 2NOCl_{(g)}$, the value of Kp is 2×10^3 a.t.m. at 27°C. Calculate the value of Kc.

(10 × 2 = 20 marks)

Section C (Paragraph)

Answer any five questions.
Each question carries 6 marks.

23. What are the features of Maxwell's distribution of molecular velocities ? Explain the effect of temperature in the distribution.

24. What is meant by compressibility factor of a gas ? Explain its significance.

25. State and formulate the first law of thermodynamics. Mention the important limitations of the law. How could the second law of thermodynamics overcome these limitations ?

26. Derive the Clausius-Clapeyron equation for the liquid $\rightleftharpoons$ vapour equilibrium. Give any *two* applications of the law.

27. What is meant by thermodynamic probability ? Deduce the relation between entropy and probability of a system.

28. What is parachor ? How is it used to elucidate the structure of compounds ? Illustrate with an example.

29. State and explain Le-Chatelier principle. Discuss the effect of temperature and pressure in the equilibrium $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$; $\Delta H = -192.5$ kJ.

30. Derive the equilibrium constant Kc for the reaction $aA + bB \rightleftharpoons cC + dD$. How is the value of Kc related to Kp ?

(5 × 6 = 30 marks)

Section D (Essay)

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

31. (i) What are critical constants ? How are they related to vander Waals' constants ? (6 marks)

(ii) Explain the determination of critical volume of a gas. (4 marks)

32. (i) Describe the different strokes in the Carnot cycle and show that the efficiency of a heat engine depends only on the temperatures of the source and the sink.

(6 marks)

(ii) Derive the Gibb's–Duhem equation. (4 marks)

33. (i) What is Joule-Thompson coefficient ? Derive an equation for the Joule Thomson coefficient of a gas.

(6 marks)

(ii) The free energy change of a reaction at 27°C and 37°C are – 85.77 kJ and – 83.68 kJ respectively. Calculate the enthalpy change of the reaction at 32°C.

(4 marks)

34. (i) The enthalpy of formation of NH_3 is – 46 kJ at 300 K. Calculate the enthalpy of formation at 325 K. The molar heat capacities at constant pressure of N_2, H_2 and NH_3 are 28.4, 28.3 and 37 JK^{-1} mol^{-1} respectively.

(4 marks)

(ii) Derive an equation for the variation of equilibrium constant of a reaction with temperature.

(6 marks)

[2 × 10 = 20 marks]