LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **CHEMISTRY**

THIRD SEMESTER – **APRIL 2023**

16/17/18UCH3MC01 – THERMODYNAMICS

Date: 02-05-2023 Dept. No. Max. : 100 Marks

Time: 01:00 PM - 04:00 PM

PART A

Answer ALL questions **(10 x 2 = 20 marks)**

1. State Boyle's law.
2. What are exact and inexact differentials?
3. Define heat of transition.
4. Obtain the relationship between q_p and q_v for $2H_{2(g)} + O_{2(g)}$ à $2H_2O_{(g)}$ assuming ideality.
5. Mention the need for first law of thermodynamics.
6. Calculate the maximum efficiency of machine operating between 27ºC and 127ºC.
7. State the law of mass action.
8. Write the expression for Kp for the following equilibrium: $N_2O_4(g) \rightleftharpoons 2NO_2(g)$.
9. Predict the value of ln200!.
10. What is residual entropy?

PART B

Answer any EIGHT questions **(8 x 5 = 40 marks)**

11. State the postulates of kinetic theory of gases.
12. Discuss the concept of internal energy.
13. Explain the following: (i) State and path functions. (ii) Virial equation of state.
14. What is heat capacity? Obtain the relationship between C_p and C_v.
15. How calorific value of a fuel is determined using Bomb calorimeter?
16. Calculate the enthalpy change for the transition graphite $\rightleftharpoons$ diamond from ΔH^o_{comb} values of -393.5 kJ mol^{-1} and -395.4 kJ mol^{-1} for graphite and diamond respectively. Is the transition reversible?
17. Obtain Maxwell's relation among thermodynamic variables.
18. Discuss the thermodynamic principle of working of refrigerator.
19. State and explain Le–Chatelier–Braun principle.
20. Derive van't Hoff's isotherm. Calculate the ΔG^o at 100 K for the reaction whose K_p value is 10×10^{-10} at 100 K.
21. Write the major assumptions of Maxwell-Boltzmann statistics.
22. Discuss the exceptions of third law of thermodynamics. Calculate the residual entropy value of NO crystals.

PART C

Answer any FOUR questions **(4 x 10 = 40 marks)**

23. (a) Predict the various degrees of freedom for the following molecules: (i) H_2O (ii) C_{60}
    (b) Derive Van der Waals equation of state. (3+7)
24. Obtain the expression for Maxwell's distribution of molecular velocities and discuss the effect of temperature on molecular velocities.
25. (a) One mole of an ideal mono-atomic gas at 300 K expands reversibly and isothermally from a volume of 10 dm^3 to volume of 100 dm^3. Calculate q, w, ΔU and ΔH.
    (b) State and explain Hess's law of constant heat summation. (4+6)
26. (a) Describe in detail the Carnot reversible cycle for establishing the maximum convertibility of heat into work.

(b) Explain the criteria of spontaneity.

27. With the help of law of mass action and Le-Chatelier - Braun principle, explain the following effect on the equilibrium: $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$.
(i) Effect of Pressure (ii) Effect of Temperature (iii) Addition of inert gas.

28. (a) How will you determine the absolute entropies of solids, liquids and gases?
(b) What are partition functions? Write the expressions for q_{trans}. (6+4)

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