



LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – CHEMISTRY

SECOND SEMESTER – NOVEMBER 2016

CH 2507 / CH 3504 / CH 3500 – THERMODYNAMICS / PHYSICAL CHEMISTRY - I

Date: 14-11-2016
Time: 01:00-04:00

Dept. No.

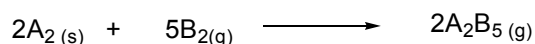
Max. : 100 Marks

PART - A

Answer ALL questions.

(10 x 2 = 20 marks)

01. How are the heat capacities C_p and C_v related?
02. Distinguish between state function and path function .
03. Show that for an ideal gas the expansivity (α) is equal to the reciprocal of the temperature of the gas (in Kelvin).
04. Define enthalpy of reaction.
05. For the reaction,



Calculate $\Delta_r H_{298K}$ for this reaction. (Given $\Delta_r U_{298K} = 62.78 \text{ KJ mol}^{-1}$).

06. Is it possible to have a Carnot cycle of efficiency one? Explain.
07. For a spontaneous process, $\Delta S = 5 \text{ JK}^{-1}$. What is ΔS for the surrounding?
08. Calculate
 - i) the value of K_p when $\Delta G^\circ = 0$ and
 - ii) the value of ΔG° when $K_p = 0$.
09. State Le-Chatelier - Braun principle.
10. State Planck's statement of Third law of thermodynamics.

PART - B

Answer any EIGHT questions.

(8 x 5 = 40 marks)

11. Calculate the root mean square velocity of CO_2 (assuming ideal behaviour) at 50°C .
12. 6.4 g of oxygen gas undergoes reversible isothermal expansion from 5L to 25L at 27°C . Assuming the gas behave ideally, Calculate the work done by the gas.
13. Derive an expression for $\mu_{J,T}$ in terms of vander Waal's constants.
14. Define enthalpy of neutralization. Enthalpy of neutralization of one mole of dilute HCl by a strong base and enthalpy of neutralization of one mole of dilute H_2SO_4 by a strong base are not equal. Explain.
15. How will you determine resonance energy of a compound from its thermochemical data?

16. One mole of an ideal gas is expanded from a pressure of 10 atm to 1 atm at 27°C, reversibly and isothermally. Calculate ΔG for the process.
17. Show that
- $$\left(\frac{\delta U}{\delta V}\right)_T = T \left(\frac{\delta P}{\delta T}\right)_V - P$$
18. State Carnot's theorems.
19. Derive equilibrium constant in terms of thermodynamic principles.
20. Explain the following effect on the equilibrium,
- $$\text{PCl}_{5(g)} \rightleftharpoons \text{PCl}_{3(g)} + \text{Cl}_{2(g)}, \Delta H = -33.2 \text{ KJ mol}^{-1}$$
- a) Effect of Pressure b) Effect of Temperature c) Addition of Cl_2
21. Derive the relationship between ΔG° and equilibrium constant (K).
22. How will you evaluate standard molar entropy of oxygen on the basis of heat capacity?

PART - C

Answer any FOUR questions.

(4 x 10 = 40 marks)

23. Derive the expression for the vander Waal's equation of state. **(10)**
24. a) State and explain Joule Thompson effect. **(5)**
 b) Derive an expression for the variation of ΔH of a reaction with temperature. **(5)**
25. Write short account on
- a) Bond energy **(2.5)**
 b) Heat of combustion **(2.5)**
 c) Heat of hydration **(2.5)**
 d) Heat of transition **(2.5)**
26. a) 1.5 moles of argon gas are mixed with 2.6 moles of nitrogen gas at 1 atm pressure and constant temperature. Calculate the entropy of mixing. **(5)**
 b) Derive Gibbs - Helmholtz equation. **(5)**
27. Derive van't Hoff equation giving quantitatively the effect of temperature on chemical reaction. **(10)**
28. a) Discuss the effect of inert gas on the equilibrium
- $$\text{PCl}_{5(g)} \rightleftharpoons \text{PCl}_{3(g)} + \text{Cl}_{2(g)} \quad \text{(4)}$$
- b) How will you determine the absolute entropy of oxygen gas?. **(6)**
