STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI 600 086
(For candidates admitted from the academic year 2019-20 & thereafter)

SUBJECT CODE: 19CH/MC/PC64

B.Sc. DEGREE EXAMINATION, APRIL 2023
BRANCH IV - CHEMISTRY
SIXTH SEMESTER

COURSE : MAJOR-CORE
PAPER : PHYSICAL CHEMISTRY III
TIME : 3 HOURS **MAX. MARKS :100**

SECTION – A

ANSWER ALL THE QUESTIONS: **(30x1=30)**

Choose the correct answer:

1. One of the following is an intensive property
   a) Mass b) Volume c) Density d) Energy

2. Criteria for a Spontaneous reaction
   a) ΔH = +ve &ΔS = -ve b) ΔH = -ve &ΔS = +ve
   c) ΔH = -ve & ΔS = -ve d) ΔH = +ve & ΔS = +ve

3. Mathematical formulation of I law of thermodynamics
   a) $\Delta E = q-W$ b) $\Delta E = q+W$ c) $\Delta S = Q_{rev}/T$ d) $\Delta S = Q_{irrev}/T$

4. The work done when two moles of an ideal gas expand reversibly and isothermally from a volume of 15L to 30 L at a temperature of 298K
   a) -820.92 cal b) - 1830 cal c) 0 cal d) 1.987 cal

5. The maximum efficiency of a steam engine operating between 100°C and 25°is
   a) 0.5 b) 0.25 c) 25 d) 0.75

6. Maximun work done is given by
   a) -ΔG b) -ΔA c)- ΔH d) –ΔS

7. In the phase diagram of water the number of phases present at the triple point
   a) 0 b) 1 c) 2 d) 3

8. Effect of pressure does not influence these equilibria
   a) $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$ b) $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$
   c) $2O_{3(g)} \rightleftharpoons 3O_{2(g)}$ d) $2NO_{2(g)} \rightleftharpoons N_2O_{4(g)}$

9. A system with lower and upper CST
   a) Phenol- Water b) Triethylamine- Water c) Nicotine-Water d) Phenol-NaCl

10. System with Eutectic point
    a) Zn-Mg b) Ag-Pb c) Ag-Au d) H_2O

..2

Fill in the blanks:

11. Chemical potential difference $\Delta\mu$ should be ----------than zero for spontaneous mixing.
12. Variation of ΔH with temperature is given by-------- equation.
13. Dissolution of a solute in a solvent is a ----------(reversible/irreversible) process.
14. Fugacity is also known as----------pressure.
15. The number of components in the equilibrium Ice $\rightleftharpoons$ water is ----------
16. $N_{2(g)} + 3\ H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ Increase in pressure shifts the equilibrium to ----------
17. The activity of a solid at standard conditions of pressure and temperature is----------
18. When pressure increases, the boiling point of water ----------.
19. The heat change in a chemical reaction at volume is ----------
20. During association of molecules the value of the Van't Hoff factor is----------.

Match the following:

21. Maximum work done	Abnormal molecular weight
22. Van't Hoff factor	Ethanol and water
23. Solvent extraction	μ_i
24. $(dG/dni)_{T, P}$	ΔA
25. Azeotrope	Nernst distribution law

Answer in one or two sentences:

26. Give the Lewis Randall statement of III law of Thermodynamics.
27. What is the effect of adding NaCl to Phenol-water system?
28. What is meant by partial molar properties?
29. What is lever rule?
30. Write the Vanthoff reaction Isochore.

SECTION – B

ANSWER ANY FIVE QUESTIONS: (5x6=30)

31. Derive an expression for work done and internal energy in an isothermal expansion of a real gas.
32. Derive any two Maxwell's relations.
33. Applying Clapeyron equation, discuss the effect of pressure on melting point of ice?
34. Derive Gibbs-Duhem equation for a binary system.
35. Calculate ΔH_{mix} ΔS_{mix} ΔG_{mix} when 10 moles of H_2 are mixed with 10 moles of N_2 at 298 K and 1atm pressure
36. 1.20g of nonvolatile organic compound was dissolved in 100g of acetone at 20^0 C. The vapour pressure of the solution was found to be 182.5 torr. Calculate the molar mass of the substance.(V.P of acetone at 20^0 C is 185 torr)
37. Illustrate how molecular weight can be determined by measuring osmotic pressure

SECTION – C

ANSWER ANY TWO QUESTIONS: (2x20=40)

38. (a) Distinguish between isothermal and adiabatic processes. Derive the relation between temperature and volume, temperature and pressure in reversible adiabatic expansion of an ideal gas (10)

(b) Derive Gibbs-Helmoltz equation and mention any two applications of the equations. (6)

(c) Show that Joule-Thomson coefficient is zero for an ideal gas (4)

39. (a) With the help of a neat diagram explain the functioning of Carnot's cycle. (8)

(b) Draw the phase diagram of a system with congruent melting point and explain the phase changes. (7)

(c) How is fractional distillation used for separation of azeotropes? (5)

40. (a) In the dissociation of $N_2O_4 \rightleftharpoons 2NO_2$ Derive K_p. If the equilibrium constant is 1.2 atm at 298K and a total pressure of 2 atm. Calculate the degree of dissociation (6)

(b) Discuss the Phase diagram of sulphur (6)

(c) Derive Nernst distribution law and discuss it's applications. (8)

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