

**STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI-86**  
**(For candidates admitted during the academic year 2019–20 & thereafter)**

**B.Sc. DEGREE EXAMINATION, NOVEMBER 2024**  
**BRANCH IV- CHEMISTRY**  
**FIFTH SEMESTER**

**COURSE : MAJOR CORE**  
**PAPER : PHYSICAL CHEMISTRY-II**  
**SUBJECT CODE : 19CH/MC/PC54**  
**TIME : 3 HOURS** **MAX.MARKS :100**  
**SECTION – A** **(30x1=30)**

**Answer all the questions.**

**I. Choose the Correct Answer:**

- Which of the following properties is not a function of state?  
a) concentration      b) internal energy      c) enthalpy      d) entropy
- The amount of heat required to raise the temperature of one mole of the substance by 1 K is called \_\_\_\_\_  
a) heat capacity      b) molar heat capacity  
c) molar heat      d) molar capacity
- The heat of combustion of solid benzoic acid at constant volume is -312.30 k J at 27°C. The heat of combustion at constant pressure is \_\_\_\_\_  
a) 100-R      b) 200-2R      c) -312.3-150R      d) 312.3+150R
- Eutectic temperature of Pb-Ag system is \_\_\_\_\_  
a) 323°C      b) 303°C      c) 343°C      d) 363°C
- Vapour pressure of pure A is 70 mm of Hg at 25°C. It forms an ideal solution with B in which mole fraction of A is 0.8. If the vapour pressure of the solution is 84 mm of Hg at 25°C, the vapour pressure of pure B at 25°C is \_\_\_\_\_  
a) 56 mm      b) 70 mm      c) 140 mm      d) 28 mm
- Work function (A) is defined as \_\_\_\_\_  
a)  $A = E - TS$       b)  $A = E + TS$       c)  $A = TS - E$       d)  $A = E / TS$
- The relative molar mass of an ionic compound is 58.5. If the experimentally observed molar mass is 30. The van't Hoff factor is \_\_\_\_\_  
a) 2.68      b) 2.95      c) 1.95      d) 1.85
- For the study of distribution law the two solvents should be \_\_\_\_\_  
a) miscible      b) non-miscible      c) volatile      d) reacting with each other
- The entropy change involved in thermodynamic expansion of 2 moles of a gas from a volume of 5 litres to a volume of 50 litres at 303 K is \_\_\_\_\_  
a) 38.92 JK<sup>-1</sup>      b) 38.29 JK<sup>-1</sup>      c) 39.48 JK<sup>-1</sup>      d) 30.48 JK<sup>-1</sup>
- The number of components present in KCl-NaBr-H<sub>2</sub>O system is \_\_\_\_\_  
a) 3      b) 2      c) 4      d) 1

**II. Fill in the blanks:**

11. Reduced phase rule is \_\_\_\_\_
12.  $C_p$  and  $C_v$  are related as \_\_\_\_\_
13. Standard free energy change and equilibrium constant are related as \_\_\_\_\_
14. Using partial pressures, the equilibrium constant expression for formation of HI \_\_\_\_\_
15. Example for path function is \_\_\_\_\_
16. By convention, the standard heat of formation of all elements is assumed to be \_\_\_\_\_
17. Mathematical representation of second law of thermodynamics is \_\_\_\_\_
18. Example for a system with formation of compounds having congruent melting point is \_\_\_\_\_
19. Phenol + water system has \_\_\_\_\_ critical solution temperature.
20. The expression for molality is \_\_\_\_\_

**III. State whether True or False:**

21. The efficiency of a Carnot engine that works between the temperatures  $27^\circ\text{C}$  and  $127^\circ\text{C}$  is 25%
22. The entropy of a pure crystal is zero at absolute zero.
23. Isotonic solutions have different osmotic pressures.
24. Desilverisation of argentiferous tin is done by Pattinson's process.
25. Lever rule is used to determine mole fraction or weight fraction of each phase of a binary equilibrium phase diagram.

**IV. Answer in a line or two:**

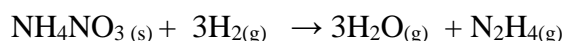
26. State Le Chatelier's principle.
27. What is inversion temperature?
28. Give any one statement of the third law.
29. Define activity.
30. What is efflorescence? Give an example.

## SECTION – B

(5X6=30)

Answer any FIVE questions:

31. Derive the expression for  $w$ ,  $q$  and  $\Delta E$  in an isothermal reversible expansion of a gas that obeys the equation of state  $PV = nRT$
32. a) What is Trouton's rule? Calculate the entropy increase in evaporation of 1 mole of water at  $100^\circ\text{C}$ . Heat of vaporisation =  $540 \text{ cal/g}$   
 b) Which of the following solvents – acetone, water, acetonitrile, ethanol, dimethylformamide – are likely to exhibit deviations from the Trouton's rule? Justify the answer. (3+3)
33. Illustrate steam distillation process for the purification of aniline.
34. Derive the thermodynamic phase rule.
35. a)  $0.534\text{g}$  of solute is dissolved in  $15\text{g}$  of water, then freezing point temperature changes from  $0^\circ\text{C}$  to  $-1.57^\circ\text{C}$ . Molal depression constant of water,  $K_f = 1.85 \text{ K kg mol}^{-1}$ . Calculate i) molal concentration ii) molecular weight of the solute.  
 b) Explain the significance of Kirchoff's equation. (4+2)
36. a) Draw schematically the Vapour pressure Vs Composition curve for a binary system assuming i) Raoult's law (with deviations) ii) Henry's law  
 b) Derive van't Hoff reaction isochore. (3+3)
37.  $\text{N}_2\text{H}_4$  is a potentially valuable rocket fuel and it is desirable to find a good method for its synthesis. Would there be any justification in finding a suitable catalyst which will make the following reaction proceed at  $25^\circ\text{C}$



Data given are:

Substance	$\text{NH}_4\text{NO}_3 (\text{s})$	$\text{H}_2(\text{g})$	$\text{H}_2\text{O}(\text{g})$	$\text{N}_2\text{H}_4(\text{g})$
$\Delta H^\circ_f / \text{kJmol}^{-1}$	-365	0	-242	50
$S^\circ / \text{JK}^{-1}\text{mol}^{-1}$	150	130	189	120

## SECTION - C

Answer any TWO questions:

(2x20=40)

38. a) What is Joule –Thomson coefficient ? Show that Joule-Thomson coefficient is zero for an ideal gas while it has a positive value in the case of a real gas.

b) Derive the following two Maxwell's relations:

$$\left(\frac{\delta T}{\delta V}\right)_S = -\left(\frac{\delta P}{\delta S}\right)_V$$

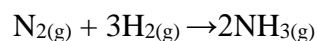
$$\left(\frac{\delta P}{\delta T}\right)_V = \left(\frac{\delta S}{\delta V}\right)_T$$

(10+10)

39. a) State Carnot's theorem . Describe in detail Carnot reversible cycle.

b) Explain the phase diagram of sulphur.

c) The enthalpy change( $\Delta H$ ) for the reaction



is -92.38 k J at 298 K . What is  $\Delta E$  at 298 K?

(10+6+4)

40. a) Derive the integrated form of Clapeyron- Clausius equation , apply it to liquid-vapour equilibria.

b) Discuss the applications of Nernst Distribution law.

c) Describe the phase diagram of sodium sulphate –water system.

(8+6+6)

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