

Reg. No .....

Name .....

23U542

**B.Sc DEGREE END SEMESTER EXAMINATION : NOVEMBER 2023**

**SEMESTER 5 : CHEMISTRY**

**COURSE : 19U5RCHE07 - PHYSICAL CHEMISTRY – I**

*(For Regular 2021 Admission and Supplementary 2020/2019 Admissions)*

Time : Three Hours

Max. Marks: 60

**PART A**

**Answer All (1 mark each)**

1. Give the expression for partial molar enthalpy.
2. State law of mass action.
3. Mention the conditions at which the efficiency of a heat engine can be 1.
4. At triple point ---- and ----- are fixed in the phase diagram of sulphur system.
5. Which among the following are extensive properties of a system?  
a) Free energy    b) Pressure    c) Surface Tension    d) Enthalpy
6. Give the relationship between temperature & volume in the reversible adiabatic expansion of an ideal gas.
7. Define residual entropy of a system.
8. Order of reaction for the hydrolysis of ethyl acetate by HCl is .....

**(1 x 8 = 8)**

**PART B**

**Answer any 6 (2 marks each)**

9. Explain the spontaneous expansion of a gas into a low-pressure region based on second law of thermodynamics.
10. Comment on the applications of second law of thermodynamics.
11. Define internal energy of a system. Is it a state function or path function?
12. State and explain zeroth law of thermodynamics.
13. Explain the reason for Joule-Thomson cooling in real gases.
14. General phase rule and reduced phase rule are used to deal with gaseous systems and condensed systems respectively. Justify.
15. Why high molecularity reactions are rare ?
16. Calculate the work done for a reversible expansion of 2 moles of an ideal gas at 273 K from 2.24 L to 22.4 L.

**(2 x 6 = 12)**

**PART C**

**Answer any 4 (5 marks each)**

17. Write the characteristics of metastable curves and metastable triple point in the phase diagram of sulphur system.
18. Discuss the enthalpy and entropy conditions for exothermic and endothermic reactions for spontaneity.

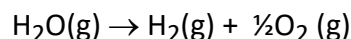
19. One mole of an ideal gas ( $C_v = 12.55 \text{ JK}^{-1}\text{mol}^{-1}$ ) at 350 K is compressed adiabatically and reversibly to one fifth of the original volume. Calculate the final temperature of the gas.
20. Calculate the entropy change involved when 3 moles of an ideal gas expands reversibly and isothermally from 500 kPa to 50kPa at 300K.
21. Explain the terms a) Mechanism of Reaction (b) Equilibrium Approximation b) Steady state approximation.
22. Three moles of an ideal gas ( $C_v = 20.92 \text{ JK}^{-1}\text{mol}^{-1}$ ) are compressed adiabatically and reversibly from a volume of  $75 \text{ dm}^3$  at 1 atm to a pressure 100 atm. Calculate (a) the final volume of the gas and (b) final temperature of the gas.

**(5 x 4 = 20)**

#### PART D

**Answer any 2 (10 marks each)**

23. What are chain reactions? Give examples. Explain the steps involved in the chlorination of methane and formation of hydrogen bromide.
24. Explain the phase diagram of sodium sulphate water system .
25. a) Derive expressions for entropy changes of an ideal gas with change in P, V and T.  
b) Obtain expressions for isothermal, isobaric and isochoric processes.
26. a) Derive Kirchoff's equation and arrive at its integrated form.  
b) Calculate  $\Delta H$  at 298 K for the reaction:



Given;  $\Delta H$  at 291 K is  $241.75 \text{ kJmol}^{-1}$ ; molar heat capacities of  $\text{H}_2$ ,  $\text{O}_2$  and  $\text{H}_2\text{O}$  are respectively; 28.83, 29.12 and  $33.56 \text{ JK}^{-1}\text{mol}^{-1}$  respectively.

**(10 x 2 = 20)**