D3BCH2201 (PAGES 2) **Reg. No.....**

Name: .....

THIRD SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2023

(Regular/Improvement/Supplementary)

CHEMISTRY

GCHE3B03T: PHYSICAL CHEMISTRY

Time: 2 Hours **Maximum Marks: 60**

SECTION A: Answer the following questions. Each carries *two* marks.
(Ceiling 20 Marks)

1. Assuming that CO_2 behaves as a van der Waals' gas, calculate its *Boyle temperature*. Given that a = 3.59 atmL^{2}mol^{-2} and b =0.0427 L mol^{-1}.
2. Define critical temperature of a gas.
3. How is the internal energy change in a process related to heat and work?
4. Discuss the entropy criterion for the spontaneity of a process.
5. Define the efficiency of a heat engine.
6. Give Gibbs-Duhem equation. What is its significance?
7. Show that $S = klnW$.
8. How is standard free energy change related to equilibrium constant?
9. What is the effect of an increase in temperature on the gaseous equilibrium:

   $N_2 + 3H_2 \rightleftharpoons 2NH_3$
10. NH_4Cl dissolves in water with absorption of heat? How will an increase in temperature affect the solubility of NH_4Cl in water?
11. What is a principal axis of rotation? Identify the principal axis for benzene.
12. What are the point groups of *cis*-1,2-dichloroethene and *trans*-1,2-dichloroethene?

SECTION B: Answer the following questions. Each carries *five* marks.
(Ceiling 30 Marks)

13. Distinguish between extensive and intensive properties with suitable examples.
14. Obtain the combined mathematical form of the first and second laws of thermodynamics.
15. What is an ensemble? Discuss about different types of ensemble.
16. Discuss the term residual entropy.

(PTO)

17. Apply the law of chemical equilibrium to:

    $PCl_5(g) \leftrightarrow PCl_3(g) + Cl_2(g)$

    and obtain an expression for K_p in terms of degree of dissociation.

18. What is a mathematical group? Explain the rules for a set of elements to form a mathematical group.

19. Identify the symmetry elements of BF_3 and NH_3 and assign their point groups.

SECTION C: Answer any *one* question. Each carries *ten* marks.

20. Explain the terms collision number, collision frequency and mean free path of a gas. Discuss the effect of pressure and temperature on mean free path.

21. a) Define enthalpy of neutralization.

    b) The enthalpy of neutralization of a strong acid by a strong base is almost a constant and equal to 57.32 kJ. However, when the acid or base is weak, the measured value is different from the above value. Justify.

(1 x 10 = 10 Marks)