19002712

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Reg. No.....

Name.....

M.Sc. DEGREE (C.S.S.) EXAMINATION, OCTOBER 2019

First Semester

Faculty of Science

AN 1C 04/AP 1C 04/CH 1C 04/PH 1C 04/POH 1C 04—CLASSICAL AND STATISTICAL THERMODYNAMICS

[Common to all Branches of Chemistry]

(2012—2018 Admissions)

Time : Three Hours

Maximum Weight : 30

Section A

Answer any **ten** *questions.*
Each question carries a weight of 1.

1. Give the equation for the dependence of entropy with T and V.
2. What are Gibb's equation ? Explain.
3. What do you mean by fugacity ? How is it varies with temperature ?
4. Explain the exergonic nature of ATP hydrolysis.
5. Explain the principle of microscopic reversibility.
6. What are the different ternary system formed by three liquids A, B and C ? Explain with an example.
7. Define the terms (i) Probability ; (ii) Cannonical ensemble.
8. What do you mean understand by thermodynamic probability ? Explain with an example.
9. Write expressions for Bose-Einstein and Fermi Dirac distribution laws. How does Maxwell-Boltzmann's law follow from these.
10. What theoretical grounds are given by Einstein to explain the variation of heat capacity of solids with temperature ?
11. Using statistical concepts rationalise Third law of thermodynamics.
12. Electrons would never follow Maxwell-Boltzmann statistics. Justify the statement.
13. Explain the effect of pressure on chemical equilibria.

(10 × 1 = 10)

Turn over

Section B

Answer **five** *questions by attempting not more than three questions from each bunch.*
Each question carries a weight of 2.

BUNCH 1 (SHORT ESSAY TYPE)

14. What are Maxwell's Relations ? Using appropriate Maxwell relation and First, Second laws of thermodynamics derive two thermodynamic equation of state.
15. Explain biological redox reaction.
16. Define partition function. Derive an expression for the translational partition function of a molecule.
17. Discuss Bose Einstein Condensation. How does it differs from ordinary condensation ?

BUNCH 2 (PROBLEM TYPE)

18. A solution is prepared by mixing 2 mole of CS_2 and 3 mole of CCl_4 at 298 K and 1 atm. Assuming ideal behaviour. Calculate ΔG, ΔS, ΔA, ΔH, ΔU and ΔV for the solution process.
19. For the reaction

    $CO(g) + SO_2(g) \rightleftharpoons CO_2(g) + SO_2(g)$ $\Delta G^\circ = -44.72$ K Cal and $\Delta H^\circ = -44.14$ K Cal at 25° C calculate (a) ΔG° at 398 K and (b) K_p at 398 K. Assume that ΔH° remains constant over the temperature interval.
20. Calculate the heat capacity of Diamond at 1000 K. Its Characteristic temperature is 1860 K.
21. Calculate the rotational partition function of hydrogen bromide gas at 300 K. If the moment of inertia of HBr is 3.31×10^{-40}g. cm^2 (R = 1. 38 $\times 10^{-16}$ erg. deg^{-1}, $h = 6.626 \times 10^{-27}$ erg. sec)

(5 × 2 = 10)

Section C

Answer any **two** *questions.*
Each question carries a weight of 5.

22. Taking an example each, explain the phase behaviour of the following three component system, using :
    (i) Solid-liquid system with compound formation.
    (ii) Liquid-liquid system with one pair of partially miscible liquids.
23. Using the principle of microscopic reversibility show that the cross-coefficients are equal.
24. Discuss in detail the Debye modification of Einstein theory of atomic crystals. Also explain the limitation of Debye theory.
25. (a) Derive the distribution law as applied to fermions.
    (b) Compare Maxwell-Boltzmann statistics with Fermi Dirac statistics.

(2 × 5 = 10)