

D3BCH2301

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Reg. No.....

Name:

THIRD SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2024

(Regular/Improvement/Supplementary)

CHEMISTRY

GCHE3B03T: PHYSICAL CHEMISTRY I

Time: 2 Hours

Maximum Marks: 60

SECTION A: Answer the following questions. Each carries *two* marks.

(Ceiling 20 marks)

1. What is the expression for K_p for the equilibrium $CaCO_3(s) \leftrightarrow CaO(s) + CO_2(g)$?
2. How does the entropy change of a gaseous substance change with (i) increase in temperature and (ii) decrease in pressure?
3. Write all the binary combinations of symmetry elements of C_{2v} point group and check whether the product of all binary combinations is an element of C_{2v} point group.
4. Define enthalpy of neutralization. How is enthalpy of neutralization of strong acid x strong base reaction different from that of strong acid x weak base reaction?
5. The standard enthalpy of reaction for the hydrogenation of ethylene to ethane is -136.8 kJ mol^{-1} . The standard enthalpy of formation of ethane is -84.4 kJ mol^{-1} . Calculate the standard enthalpy of formation of ethylene.
6. What is the effect of pressure on mean free path?
7. What is meant by a C_6 axis? Give an example for a molecule that possess C_6 axis of symmetry.
8. In how many ways can the letters of the word COMBINE be arranged?
9. Give the Maxwell-Boltzmann law of distribution of molecular velocities and mention the terms used.
10. What is partition function?
11. What is a finite group? Give an example.
12. What happens to the internal energy of a system if (a) work is done on the system and (b) work is done by the system?

(PTO)

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

13. Two moles of H_2 and 3 moles of I_2 are heated in a 2-litre closed vessel at 600K. If the K_c for the reaction: $H_2(g) + I_2(g) \leftrightarrow 2HI(g)$ is 16 at 600K, calculate the concentrations of H_2 , I_2 , and HI at equilibrium.
14. The Gibbs free energy change (ΔG) for a process at 300 K is $-121.7 \text{ kJmol}^{-1}$ and at 310 K, it is $-107.9 \text{ kJmol}^{-1}$, both for a pressure of 1 bar. Calculate the change in enthalpy for the process at 300 K.
15. Identify the symmetry elements of BF_3 and NH_3 and assign their point groups.
16. Explain the term bond energy. At 298 K the bond energies of C-H, C-C, C=C and H-H bonds are respectively 414, 347, 615 and 435 kJ mol^{-1} . Calculate the $\Delta_r H$ for the reaction: $H_2C=CH_2(g) + H_2(g) \longrightarrow H_3C-CH_3(g)$ at 298 K.
17. State and explain the Zeroth Law of thermodynamics.
18. Explain the elements of symmetry of molecules.
19. State Le Chatelier principle and predict the effect of a change of pressure on the equilibrium: $H_2(g) + I_2(g) \leftrightarrow 2HI(g)$.

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

20. Derive the van der Waal's equation for a real gas. Discuss the applicability of van der Waals' equation in explaining real gas behaviour under different conditions.
21. (i) What is meant by microstate?
(ii) Get the possible microstates for a system of three vibrating diatomic molecules with a total energy of $3h\nu$.

(1 x 10 = 10 Marks)