M.Sc. DEGREE EXAMINATION,APRIL 2020
I Year I Semester
Physical Chemistry - I

Time : 3 Hours **Max.marks :75**

Section A $(10 \times 2 = 20)$ Marks

Answer any **TEN** questions

1. Write the expression for calculation of fugacity at low pressure.
2. The activity of 2.5 moles of substance changes from 0.05 to 0.35. What would be the change in its free energy at 27°C?
3. What is meant by collision cross section?
4. Can the activation energy of reaction be zero? Explain.
5. What is kinetic isotopic effect?
6. State Bronsted Catalysis equation.
7. What are Abelian and non-Abelian groups.
8. Assuming a molecule AB_6 belongs to O_h point group, determine the point group if it is changed into AB_5C.
9. Which fundamental vibrational modes of CH_4 molecule are infrared-active?
10. Molecules belonging to the point groups D_{2h}, C_{3h}, T_h and T_d cannot be chiral. Which elements of these rule out chirality?
11. Write the expression for finding the fugacity of a gas in a gaseous mixture.
12. What is activation energy?

Section B $(5 \times 5 = 25)$ Marks

Answer any **FIVE** questions

13. The vapour pressure of water at 100°C is 760mm. What will be the vapour pressure at 95°C? The heat of vapourisation of water in this temperature range is 41.27 kJ per mole.
14. Briefly explain molecular beam method for studying molecular reaction dynamics.
15. How does ionic strength influence the rates of ionic reaction?
16. List the symmetry elements of the following molecules and name the point group to which they belong. (i) NO_2 (ii)$CHCl_3$

17. The group C_{2v} consists of the elements E, C_2, $\sigma_{\nu(xz)}$ and $\sigma'_{\nu(yz)}$. Construct the group multiplication table for this group.
18. Calculate the activation energy of a reaction whose rate constant is tripled by a10°C rise in temperature in the vicinity of 27°C.
19. Briefly explain Hammett-Taft equation and its importance.

Section C $(3 \times 10 = 30)$ Marks

Answer any **THREE** questions

20. What is meant by Chemical potential? How does chemical potential vary with temperature? Derive the Gibbs-Duhem equation.
21. Discuss the transition state theory of bimolecular reactions.
    Explain how this theory helps in evaluating standard enthalpy of activation and standard entropy of activation.
22. a. Write any four important characteristics of catalytic reactions
    b. Discuss the mechanism of acid-base catalytic reactions
23. State Great orthogonality theorem and list the properties of the irreps.
24. Using the character table for D_{3h} point group and the standard reduction formula determine the symmetry species to which the normal modes of vibration of BF_3 belong.

M.Sc. DEGREE EXAMINATION,APRIL 2020
I Year I Semester
Physical Chemistry - I

Time : 3 Hours **Max.marks :75**

Section A $(10 \times 2 = 20)$ Marks

Answer any **TEN** questions

1. Write the expression for calculation of fugacity at low pressure.
2. The activity of 2.5 moles of substance changes from 0.05 to 0.35. What would be the change in its free energy at 27°C?
3. What is meant by collision cross section?
4. Can the activation energy of reaction be zero? Explain.
5. What is kinetic isotopic effect?
6. State Bronsted Catalysis equation.
7. What are Abelian and non-Abelian groups.
8. Assuming a molecule AB_6 belongs to O_h point group, determine the point group if it is changed into AB_5C.
9. Which fundamental vibrational modes of CH_4 molecule are infrared-active?
10. Molecules belonging to the point groups D_{2h}, C_{3h}, T_h and T_d cannot be chiral. Which elements of these rule out chirality?
11. Write the expression for finding the fugacity of a gas in a gaseous mixture.
12. What is activation energy?

Section B $(5 \times 5 = 25)$ Marks

Answer any **FIVE** questions

13. The vapour pressure of water at 100°C is 760mm. What will be the vapour pressure at 95°C? The heat of vapourisation of water in this temperature range is 41.27 kJ per mole.
14. Briefly explain molecular beam method for studying molecular reaction dynamics.
15. How does ionic strength influence the rates of ionic reaction?
16. List the symmetry elements of the following molecules and name the point group to which they belong. (i) NO_2 (ii)$CHCl_3$

17. The group C_{2v} consists of the elements E, C_2, $\sigma_{\nu(xz)}$ and $\sigma'_{\nu(yz)}$. Construct the group multiplication table for this group.
18. Calculate the activation energy of a reaction whose rate constant is tripled by a10°C rise in temperature in the vicinity of 27°C.
19. Briefly explain Hammett-Taft equation and its importance.

Section C $(3 \times 10 = 30)$ Marks

Answer any **THREE** questions

20. What is meant by Chemical potential? How does chemical potential vary with temperature? Derive the Gibbs-Duhem equation.
21. Discuss the transition state theory of bimolecular reactions.
    Explain how this theory helps in evaluating standard enthalpy of activation and standard entropy of activation.
22. a. Write any four important characteristics of catalytic reactions
    b. Discuss the mechanism of acid-base catalytic reactions
23. State Great orthogonality theorem and list the properties of the irreps.
24. Using the character table for D_{3h} point group and the standard reduction formula determine the symmetry species to which the normal modes of vibration of BF_3 belong.