

K1 –LEVEL

1. E X E in C_{3v} _____
(a) E (b) **A_1+E** (c) A_1+A_2+E (d) A_2+E
2. What is the point group for SO_2 molecule?
(a) **C_{2v}** (b) C_2 (c) $D_{\infty h}$ (d) C_{2h}
3. The point groups are represented by
(a) **Schoenflies symbols** (b) Term symbols (c) Taft symbols (d) Both (a) and (b)
4. What is the point group for AB_4 type molecule?
(a) D_{3h} (b) O_h (c) **T_d** (d) D_{5h}
5. A set of elements in a group which are conjugate to one another is said to form -----
(a) **group** (b) class (c) similarity transformation (d) isomorphic group
6. All the symmetry elements commute each other is called
(a) sub group (b) **abelian group** (c) non abelian group (d) isomorphic groups
7. The vibrational modes belonging to g symmetric species are vibration -----
(a) **Raman active** (b) infra-red active (c) infra-red inactive (d) none
8. The vibrational modes belonging to u symmetric species are vibration -----
(a) Raman active (b) **infra-red active** (c) infra-red inactive (d) none
9. The irreducible representations are represented by
(a) Schoenflies symbols (b) Term symbols (c) Taft symbols (d) **Mullikens symbols**
10. Which one is the symmetry element for rotation followed by reflection?
(a) C_n (b) **S_n** (c) i (d) D_n
11. What is the point group for AB_5 type molecule
(a) **D_{3h}** (b) O_h (c) T_d (d) D_{5h}
12. What is the point group for AB_6 type molecule
(a) D_{3h} (b) **O_h** (c) T_d (d) D_{5h}
13. Which of the following is the example for D_{6h}
(a) ammonia (b) PCl_5 (c) **benzene** (d) BF_3
14. Number of vibrational modes for ammonia molecule is
(a) E (b) A_1+E (c) **A_1+A_2+E** (d) A_2+E
15. Number of vibrational modes for water molecule is
(a) E (b) A_1+E (c) A_1+A_2+E (d) **A_1+B_1**
16. How many vectors are possible for water molecule
(a) 6 (b) **9** (c) 3 (d) 12

17. which of the following vectors are possible for ammonia molecule
 (a) 6 (b) 9 (c) 3 (d) **12**
18. which of the following is the example for c_{2v} point group
 a) **H₂O** b) NH₃ c) benzene d) BCl₃
19. Water molecule belongs to both
 a) Raman active (b) infra-red active (c) infra-red inactive (d) **both raman and infra-red active**
20. For which type of representation A symbol is used
 a) **1 D** b) 2D c) 3D d) none
21. Rate of reaction is defined as
 (a) decrease in the concentration of a reactant (b) increase in the concentration of a product
 (c) **change in the concentration of any of the reactants or products per unit time**
 (d) all the above are correct
22. What is the name of the following equation $\log k = \log k_0 + 1.02 Z_A Z_B \sqrt{\mu}$
 (a) Bjerrum equation (b) **Bronsted-Bjerrum equation** (c) Bronsted equation
 (d) Debye equation
23. The minimum amount of energy required for the reacting molecules to undergo reaction is called
 (a) Potential energy (b) Internal energy (c) **Activation energy** (d) Threshold energy
24. The collision will take place only if the molecules have
 (a) Minimum potential energy (b) **Minimum AE** (c) Minimum kinetic energy (d) none
25. A reaction involving two different reactants can never be a
 (a) bimolecular reaction (b) **unimolecular reaction** (c) first order reaction
 (d) second order reaction
26. For a reaction $3A \rightarrow \text{product}$, the order of a reaction
 (a) 3 (b) 1,2 or 3 (c) 0 (d) **any value between 1 and 3**
27. Increase in the concentration of the reactants leads to change in
 (a) heat of reaction (b) Threshold energy (c) **collision energy** (d) Activation energy
28. According to the Arrhenius equation a straight line is to be obtained by plotting the logarithm of rate constant of a reaction against
 (a) T (b) $\log T$ (c) **1/T** (d) $\log 1/T$

29. During the decomposition of an activated complex
(a) energy is always released (b) energy is always absorbed (c) energy does not change

(d) reactants may be formed

30. Rate of a reaction can be expressed by Arrhenius equation as: $k = Ae^{-E/RT}$. In this equation, E represents

(a) the energy below which colliding molecules will not react

(b) the total energy of the reacting molecules at a temperature, T

(c) the fraction of molecules with energy greater than the activation energy

(d) the energy above which all the colliding molecules will react.

31. In Hydrogen-chlorine reaction, the intermediates are

a) H and HO₂ **b) H and Cl** (c) Cl and HO₂ (d) Cl and O₂

32. The rate of the reaction is influenced by

a) volume of the vessel **b) shape of the vessel** (c) both a and b (d) heat capacity

33. The rate of a chemical reaction doubles for every 10°C rise of temperature. If the temperature is raised by 50°C, the rate of the reaction increases by about

(a) 64 times (b) 10 times (c) 24 times **(d) 32 times**

34. For the reaction $N_2O_5(g) \rightarrow 2NO_2(g) + \frac{1}{2} O_2(g)$ the value of rate of disappearance of N_2O_5 is given as $6.25 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$. The rate of formation of NO_2 and O_2 is given respectively as

(a) $6.25 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$ and $3.125 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$

(b) $6.25 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$ and $6.25 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$

(c) $6.25 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$ and $6.25 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$

(d) $1.25 \times 10^{-2} \text{ mol L}^{-1} \text{ s}^{-1}$ and $3.125 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$

35. Which of these does not influence the rate of reaction? [Karnataka CET 2005]

(a) Nature of the reactants

(b) Concentration of the reactants

(c) Temperature of the reaction

(d) Molecularity of the reaction

36. The activation energy of a reaction at a given temperature is found to be $2.303 RT \text{ J mol}^{-1}$. The ratio of rate constant to the Arrhenius factor is

(a) 0.1 (b) 0.01 (c) 0.001 (d) 0.02

37. In a reaction, $A + B \rightarrow \text{Product}$, rate is doubled when the concentration of B is doubled, and rate increases by a factor of 8 when the concentrations of both the reactants (A and B) are doubled, rate law for the reaction can be written as

(a) $\text{Rate} = k[A][B]$

(b) $\text{Rate} = k[A]^2[B]$

(c) $\text{Rate} = k[A][B]^2$

(d) $\text{Rate} = k[A]^2[B]$

38. For the reaction $A + B \rightarrow C$, it is found that doubling the concentration of A increases the rate by 4 times, and doubling the concentration of B doubles the reaction rate. What is the overall order of the reaction?

(a) 4 (b) $3/2$ **(c) 3** (d) 1

39. which type of wave is used in shock tube method for determining fast reactions

(a) short moving wave **(b) fast moving wave** (c) micro wave (d) none

40. Which of these does not influence the rate of reaction? [Karnataka CET 2005]

(a) Nature of the reactants (b) Concentration of the reactants (c) Temperature of the reaction

(d) Molecularity of the reaction

41. Which one of the following polymers is prepared by condensation polymerization?

- (a) Teflon (b) Rubber (c) styrene (d) **nylon 6,6**

42. Which of the following monomer mixture is used in bulk polymerization?

- (a) **undiluted monomer**
(b) monomer –solvent mixture
(c) monomer-water mixture
(d) none of the mentioned

43. How is the solvent in solution polymerization, more useful to overcome the disadvantages of bulk polymerization?

- (a) **it reduces the viscosity gain**
(b) increases the rate of reaction
(c) causes chain transfer
(d) all of the mentioned

44. Water insoluble monomers can be polymerized by

- (a) bulk polymerization (b) solution polymerization (c) **suspension polymerization** (d) All

45. The most commonly used vulcanizing agent is _____

- a) graphite b) carbon black **c) sulphur** d) dry ice

46. _____ is an example of addition polymerization.

- (a) **Polyvinyl chloride** (b) hexamethylene diamine (c) terephthalic acid (d) dacron

47. Which of the following is a demerit of solution polymerization?

- a) handling of inflammable solvents
b) recovery of solvent
c) chain transfer to solvent
d) all of the mentioned

48 . The process used in producing continuous films is _____.

- (a) Die casting **(b) Film casting** (c) Calendering (d) Blowing

49. _____ is always higher than the number average molecular weight, except for the special case when they are equal if all of the polymers have the exact same molecular weight.

- (a) **Weight average molecular weight**
(b) Weight average cation weight

(c) Weight average anion weight

(d) Weight average quinon weight

50. What is the name of the hidden part?

_____ = $(\sum N_i \times \sum DP_i) / (\sum N_i)$

(a) Number average molecular weight

(b) Weight average

(c) Monodisperse

(d) Polydispersity

K2-LEVEL

1. Define symmetry operation.
2. What is meant by symmetry element?
3. Define identity operation.
4. What is meant by improper rotation?
5. Define Classes.
6. Define point group.
7. Define Abelian group and nonabelian group.
8. Define sub group.
9. What is meant by isomorphic group?
10. Give the statement of orthogonality theorem.
11. Define reducible representation.
12. What is secular determinant?
13. Write the symmetry selection rule for rotational spectroscopy.
14. Write the symmetry selection rule for Raman spectroscopy.
15. Define mutual exclusion principle.
16. Write the possible infrared spectral activity of vibrational modes in NH_3 molecule.
17. Write the possible infrared spectral activity of vibrational modes in H_2O molecule.
18. What is meant by reducible representation?
19. Define direct product representation.
20. Define projection operator.
21. Define order of the reaction.
22. What is meant by simultaneous reactions?
23. Define parallel reaction.
24. What are consecutive reactions?
25. What is meant by unimolecular reactions?
26. Define Collision factor.
27. Define the steady state approximation
28. What is meant by salt effect?
29. Define primary salt effect.
30. What will be the rate of reaction when the pressure increases?
31. Define chain reactions.
32. Write any two characteristics of chain reactions.

33. Define Auto oxidation.
34. Define non-stationary chain reactions.
35. Define upper explosion limit.
36. Give Grunwald-Winstein equation.
37. Write the steps involved in decomposition of N_2O_5 reaction.
38. What is the effect of ionic strength on reaction rate?
39. Give the rate equation for the photochemical decomposition of H_2Br_2 reaction.
40. How does the change in temperature affect the rate of reaction?
41. Define addition polymers. Give examples.
42. Define condensation polymers. Give examples.
43. Define functionality.
44. Define the degree of polymerization.
45. What is spinning?
46. Define vulcanization.
47. What is casting?
48. Define the term moulding.
49. Why the determination of molecular weights in polymers is very important?
50. What are the different methods for determination of molecular weights in polymers?

K3 LEVEL

1. Explain the different types of groups.
2. Discuss the reducible and irreducible representation of groups.
3. Define i) symmetry elements ii) symmetry operations iii) identity element
4. Explain about similarity transformation.
5. Explain the properties of the group.
6. Explain the hybridization scheme of AB₄ type molecule.
7. Discuss the symmetry selection rule for IR and Raman spectra.
8. Define and explain mutual exclusion principle.
9. Discuss about direct product representation.
10. How the projection operator is used to determine the symmetry of a given function?
11. Explain about simple collision theory.
12. Derive the thermodynamical formulation of ARRT.
13. Discuss briefly about Lindemann's theory unimolecular reactions.
14. Explain the effect of pressure on reaction rates.
15. Write a note on secondary salt effect.
16. Discuss about the general characteristics of chain reactions
17. Explain the Kinetics of decomposition of nitrogen pentoxide.
18. Describe the upper and lower explosion limits.
19. Explain Grunwald-Winstein equation.
20. Explain about shock tube method.
21. Differentiate addition and condensation polymers.
22. Discuss the determination of number average and weight average molecular weight.
23. Describe about bulk and suspension polymerization techniques.
24. Explain about vulcanization of polymers.
25. Explain the sedimentation and viscosity average molecular weight determination of polymers.

K4-LEVEL

1. Discuss about different types of symmetry operations.
2. Explain the construction of group multiplication table for C_{2V} point group.
3. Explain the construction of group multiplication table for C_{3V} point group.
4. State and explain orthogonality theorem and its consequences.
5. Explain the classification of point group.
6. Construct the character table for C_{2V} point group.
7. Explain the hybridization scheme for orbital in AB_6 .
8. Explain the Symmetry Adapted Linear combinations.
9. Discuss in detail about Huckel approximation.
10. Explain infrared spectral activity of vibrational modes in H_2O molecule.
11. What is modified collision theory ? Explain the causes of weaknesses of the collision theory.
12. Derive the integrated form of Arrhenius equation.
13. How the Debye- Huckel equation is applied to primary salt effect? Explain with derivation.
14. Derive Statistical mechanical derivation of the rate equation.
15. What are simultaneous reactions? Explain its types.
16. Discuss the photochemical reaction between $H_2 - Br_2$
17. Discuss the experimental methods for fast reactions.
18. Explain the kinetics of reaction between hydrogen and chlorine.
19. What is meant by non-stationary chain reaction? Explain the kinetics of H_2-O_2 reaction.
20. Explain the effect of temperature, ionic strength and solvent on reaction rates.
21. Discuss the methods used for the determination of molecular weight of polymers.
22. Derive the rate equation for free radical polymerization.
23. Explain the different types of moulding in polymer processing.
24. Explain briefly about different spinning methods of polymers.
25. Explain about casting of polymers.