CHE 501

M.Sc. I[st] SEMESTER EXAMINATION, 2022-23

CHEMISTRY

(Molecular Symmetry and Molecular Vibration)

(4+0)

(CBCS MODE)

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Date (तिथि) : _____

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8353

अनुक्रमांक (अंकों में) :
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अनुक्रमांक (शब्दों में) : _____

Roll No. (In Words) : _____

Time : 1 Hour
समय : 1 घण्टा

Max. Marks : 60
अधिकतम अंक : 60

नोट : पुस्तिका में 40 प्रश्न दिये गये हैं, सभी प्रश्न करने होंगे। प्रत्येक प्रश्न 1.5 अंक का होगा।

Important Instructions :

1. The candidate will write his/her Roll Number only at the places provided for, i.e. on the cover page and on the OMR answer sheet at the end and nowhere else.
2. Immediately on receipt of the question booklet, the candidate should check up the booklet and ensure that it contains all the pages and that no question is missing. If the candidate finds any discrepancy in the question booklet, he/she should report the invigilator within 10 minutes of the issue of this booklet and a fresh question booklet without any discrepancy be obtained.

महत्वपूर्ण निर्देश :

1. अभ्यर्थी अपने अनुक्रमांक केवल उन्हीं स्थानों पर लिखेंगे जो इसके लिए दिये गये हैं, अर्थात् प्रश्न पुस्तिका के मुख्य पृष्ठ तथा साथ दिये गये ओ०एम०आर० उत्तर पत्र पर, तथा अन्यत्र कहीं नहीं लिखेंगे।
2. प्रश्न पुस्तिका मिलते ही अभ्यर्थी को जाँच करके सुनिश्चित कर लेना चाहिए कि इस पुस्तिका में पूरे पृष्ठ हैं और कोई प्रश्न छूटा तो नहीं है। यदि कोई विसंगति है तो प्रश्न पुस्तिका मिलने के 10 मिनट के भीतर ही कक्ष परिप्रेक्षक को सूचित करना चाहिए और बिना त्रुटि की दूसरी प्रश्न पुस्तिका प्राप्त कर लेना चाहिए।

1. Which of the following symmetry element is present in C_2H_4 ?

(A) Inversion

(B) Improper axis of rotation (Two fold)

(C) Proper axis of rotation (Two fold)

(D) All of above

2. Five fold proper axis of rotation (C_5) is not found in :

(A) $C_5H_5^-$

(B) $Fe(C_5H_5)_2$

(C) X_eOF_4

(D) *All of above*

3. Point group which has identity, rotation and reflection symmetry element is :

(A) C_i

(B) C_5

(C) C_1

(D) $C_{nh.}$

4. Point group which does not have 'invasion (i)' operation :

(A) D_{nd}

(B) O_h

(C) $D_{\infty h}$

(D) D_n

5. T_d point group has symmetry operation :

(A) C_4

(B) S_2

(C) S_4

(D) σ_v

6. Which of the following is correct statements ?

(A) Vertical plane of symmetry passes through the principal axis

(B) Dihedral passes through the principal axis and also bisecting the angle between two successive subsidiary axis

(C) BF_3 molecules possesses C_3 axis

(D) All are correct

7. Possible number of operations in S_3 :

(A) 6

(B) 2

(C) 4

(D) 5

8. $[Ni(CN)_4]^{2-}$ has :

(A) C_4 axes

(B) Two of C_3 axis

(C) Inversion absent

(D) C_5 axes

9. Which one is incorrect from the following ?

(A) $\sigma_n^n = \sigma \; when \; n \; is \; odd$

(B) $S_n^m = C_n^m, \sigma_n$

(C) $\sigma^m = \sigma \; when \; n = even$

(D) All are incorrect

10. N_2F_2 has :

(A) Dihedral plane

(B) Vertical plane

(C) Horizontal plane

(D) No plane is present

11. Borazine has :

(A) $2\sigma_v \; and \; 2\sigma_d$

(B) $2\sigma_v \; and \; 2\sigma_h$

(C) $3\sigma_v \; and \; \sigma_h$

(D) $4\sigma_v$

12. Two elements A and B is commutative then, the group is :

(A) Trivial group

(B) Abelian group

(C) Cyclic group

(D) Isomorphic group

13. For C_3^2 operation, the matrix is :

(A) $\begin{bmatrix} -\frac{1}{2} & -\frac{\sqrt{3}}{2} & 0 \\ -\frac{\sqrt{3}}{2} & -\frac{1}{2} & 0 \\ 0 & 0 & 1 \end{bmatrix}$

(B) $\begin{bmatrix} 1/2 & \sqrt{3}/2 & 0 \\ -1 & -1/2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

(C) $\begin{bmatrix} -1/2 & -\frac{\sqrt{3}}{2} & 0 \\ \sqrt{3}/2 & -1/2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

(D) $\begin{bmatrix} -\sqrt{3}/2 & -1/2 & 0 \\ -1/2 & \sqrt{3}/2 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

14. Which is the false statement for CH_4 molecule ?

(A) It belongs to T_d point group

(B) 3 three-fold axes collinear with the body diagonal of the cube

(C) 6 σ_d passes through the diametrically opposite edges of the cube

(D) Three C_2 axes normal to the face of the cube

15. CO_3^{2-} belongs to point group :

(A) C_{3h}

(B) D_{3d}

(C) S_3

(D) D_{3h}

16. No. of class in On point group is :

(A) 8

(B) 6

(C) 9

(D) 7

17. The reduced symmetry point group for substituted benzene according to the following Conversion, is :

(A) $D_{6h} - D_{2n}$

(B) $D_{6n} - C_{2n}$

(C) $D_{3d} - D_{2h}$

(D) $D_{6h} - C_{2v}$

18. In the character table of C_{2v} point, 'Ry' rotational vector is present in :

(A) A_1

(B) A_2

(C) B_2

(D) B_1

19. Which is not true for similarity transform ?

(A) If A is conjugate with, B must be conjugate with A

(B) Every element is not conjugate to itself

(C) If A is conjugate with B and C, then B and C are conjugate with each other

(D) All are correct

20. An example of C_1 point group :

(A) $Cis - H_2O_2$

(B) CH_3COOH

(C) $Trans - H_2O_2$

(D) CO_2

21. Correct statement for 'The Great Orthogonality Theorum' :

(A) The sum of the products of the corresponding elements of matrices of various symmetry operations belonging to two different irreducible representations is Zero

(B) $\sum_R [\Gamma_i(R)_{mn}] [\Gamma_j(R)_{m^1n^1}]^* = \frac{h}{\sqrt{K_i K_j}} \delta ij \delta mm^1 \delta nn^1$

(C) Only a is correct

(D) (A) and (B) both are correct

22. What will the Mulliken symbols for the following irreducible representation in the character table given below :

	E	$2C_3$	$3C_2$	σ_n	$2S_3$	$3\sigma_v$
Γ_1	1	1	1	1	1	1
Γ_2	1	1	-1	1	1	1
Γ_3	2	-1	0	2	-1	0

(A) A_1', A_2', E'

(B) A_1, A_2, E

(C) A_2', A_1', E

(D) A_1', A_2, E'

23. What will be the product of C_2 and i operation ?

(A) σ_h

(B) i

(C) C_2

(D) E

24. In C_{2v} point group, dxz-orbital is found in irreducible representation :

(A) A_1

(B) A_2

(C) B_1

(D) B_2

25. Which is correct statement for Similarity Transform ?

(A) $C_3^2\ \sigma_v\ C_3^1 = \sigma_v''$

(B) $C_3^{-1}\ \sigma_v\ C_3^1 = \sigma_v'$

(C) $C_3^1\ \sigma_v\ C_3^2 = \sigma_v''$

(D) All the above

26. Group Generating elements for Dnd point group is :

(A) C_n^1, S_n^1, σ_d

(B) C_n^1, C_2^*, σ_d

(C) $C_\infty\ C_2^*\ \sigma_h$

(D) $C_n^1\ C_2^*$

27. Which statement is not correct for class ?

(A) E is always a class

(B) Horizontal plane is a special class

(C) All C_n^m axes are in a class

(D) Similar σ_v and σ_d belongs to same class

28. Which pair is Isomorphic group ?

(A) $C_{2v} \sim C_{2h}$

(B) $C_{nv} \sim D_n$

(C) $C_2 \sim C_5 \sim C_i$

(D) All of above

29. C_{2h} point group belongs to GMT :

(A) G_4^2

(B) G_4^1

(C) Only (B)

(D) (A) and (B) both

30. Subgroups in C_{3v} point group are :

(A) $C_1\ C_5'\ C_5''$

(B) $C_1\ C_3, C_5, C_5'$

(C) $C_1\ C_2, C_5, C_5'\ C_5''$

(D) $C_1, C_3, C_5, C_5', C_5''$

31. In I_h point group, number of plane involved are :

(A) 10

(B) 15

(C) 12

(D) 20

32. Which is the bending mode for H_2O molecule by using normal mode vibration method ?

(A) A_1

(B) B_2

(C) A_2

(D) B_1

33. Nature of vibration of $'B_2'$ for H_2O molecule is :

(A) Impure

(B) Mixed

(C) Pure

(D) All are incorrect

34. Number of unshifted vector in NH_3 molecule while performing σ_v symmetry operation :

(A) 0

(B) 3

(C) 2

(D) 1

35. What will be number of vibrational modes in NH_3 molecule using Cartesian Coordinate method ?

(A) $A_1 + E$

(B) $2A_2 + 2E$

(C) $2A_1 + 2E$

(D) $A_1 + A_2 + 2E$

36. O- Substituted benzene (1, 2, - dichlor benzene) belongs to point group :

(A) C_2

(B) C_{4v}

(C) C_{2v}

(D) $C_{\infty v}$

37. A group is said to be _____ group if all the elements of a group can be generated from one element :

(A) Non-abelian group

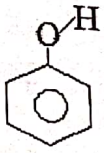
(B) Abelian group

(C) Cyclic group

(D) inverse group

38. Molecule belongs to C_5 point group :

(A) $CHBrClF$

(B) 

(C) 1, 2-dichloro, 1, 2-difluroethane

(D) None of above

39. 'E' vibrational mode of NH_3 molecule is :

(A) IR active only

(B) IR inactive

(C) IR and Raman both active

(D) Raman active only

40. In AB_4 (tetrahedral) molecule, one ligand 'B' is replaced by 'x' then the resulting species will belongs to point group :

(A) C_{2v}

(B) C_{3v}

(C) D_{2d}

(D) D_{3h}

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