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95. The spin states for the  $d^3$  configuration are:
- (A) Quartet and doublet  
(B) Triplet and doublet  
(C) Singlet and doublet  
(D) Triplet and singlet
96. An ideal gas is at  $0^\circ\text{C}$  and 1 atm pressure initially. If it absorbs 1000 cal of heat during a reversible isothermal expansion, the final volume of 1 mole of ideal gas is:
- (A)  $152.63\text{ dm}^3$   
(B)  $110.27\text{ dm}^3$   
(C)  $134.75\text{ dm}^3$   
(D)  $121.25\text{ dm}^3$
97. Given below are two statements, one labelled as Assertion (a) and the other labelled as Reason (r). Read the statements and choose the correct answer from the codes given below:  
Assertion (a) : In  $S_N1$  reactions, a nucleophile should attack a free carbocation and result in complete racemisation of the product.  
Reason (r) : While some  $S_N1$  reactions proceed with 5-20% inversion, a few others show retention of configuration.
- (A) Both (a) and (r) are true and (r) is correct explanation of (a)  
(B) Both (a) and (r) are true but (r) is not correct explanation of (a)  
(C) (a) is true, but (r) is false  
(D) (a) is false, but (r) is true
98. The coordination compounds:  $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$  and  $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$  are :
- (A) Coordination isomers  
(B) Geometrical isomers  
(C) Ionisation isomers  
(D) Optical isomers
99. Gold solution is:
- (A) Solution of Gold in water  
(B) Gold particles dispersed in water  
(C) Golden colour solution  
(D) None of these
100. Given below are two statements, one labelled as Assertion (a) and the other labelled as Reason (r). Read the statements and choose the correct answer from the codes given below:  
Assertion (a): Reaction of (+)-1-phenyl-2-propanol with (i)  $\text{TsCl}$  and (ii)  $\text{EtOH}/\text{K}_2\text{CO}_3$  yields a (-)-ether.  
Reason (r): This is due to inversion of configuration in step (ii) of the reaction.
- (A) Both (a) and (r) are true and (r) is correct explanation of (a)  
(B) Both (a) and (r) are true and (r) is not correct explanation of (a)  
(C) (a) is true, but (r) is false  
(D) (a) is false, but (r) is true

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89. Which of the following statements is incorrect?
- (A)  $\text{Cu}^{2+}$  octahedral complexes are paramagnetic
- (B) Hg is liquid at  $0^\circ\text{C}$  due to high ionisation energy
- (C) Zn is not considered as d-block element
- (D) AgCl is colorless whereas AgI is colored
90. The correct Mulliken notation for the following irreducible representation is:
- E     $C_n$      $nC_2$     I     $\sigma_h$
- 1    1    -1    -1    -1
- (A)  $A'_{1u}$     (B)  $A''_{2u}$
- (C)  $B''_{2u}$     (D)  $A'_{2u}$
91. Among the arenes: Benzene, Naphthalene, Anthracene and Phenanthrene, the arene with highest resonance energy is :
- (A) Phenanthrene
- (B) Anthracene
- (C) Naphthalene
- (D) Benzene
92. The lowest energy absorption band for  $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$  appears at  $17,200 \text{ cm}^{-1}$ . What is the  $Dq$  value?
- (A)  $720 \text{ cm}^{-1}$
- (B)  $1720 \text{ cm}^{-1}$
- (C)  $2150 \text{ cm}^{-1}$
- (D)  $215 \text{ cm}^{-1}$
93. The entropy (S) of system is related to the partition function (q) as :
- (A)  $S \propto q$
- (B)  $S \propto 1/q$
- (C)  $S = q$
- (D) S do not depend on q
94. Match the entries in Column I and II and select the correct answer from the codes given below:
- | Column - I                 |   | Column - II           |  |
|----------------------------|---|-----------------------|--|
| P Triplet                  | 1 | Carbocations          |  |
| Q <i>Cine</i> substitution | 2 | Allylic -type cations |  |
| R $\text{S}_{\text{N}}1$   | 3 | Arynes                |  |
| S Conjugated dienes        | 4 | Carbene               |  |
- Codes:
- |     | P | Q | R | S |
|-----|---|---|---|---|
| (A) | 4 | 3 | 1 | 2 |
| (B) | 1 | 4 | 2 | 3 |
| (C) | 2 | 1 | 4 | 3 |
| (D) | 3 | 2 | 1 | 4 |



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83. Which of the following does not obey 18 electron rule?

- (A)  $\text{Cr}(\text{CO})_6$   
(B)  $\text{Mn}(\text{CO})_5$   
(C)  $\text{Fe}(\text{CO})_2(\text{NO})_2$   
(D)  $\text{Cr}(\text{NO})_4$

84. The following data was obtained for the decomposition of compound at  $580^\circ\text{C}$ 

$A_0(\text{mol dm}^{-3})$	0.50	1.10	2.48
$t_{1/2}(\text{s})$	4280	885	174

The order of reaction is:

- (A) 0 (B) 1  
(C) 2 (D) 3

85. In coupling reaction of an organostannane with an aromatic triflate in the presence of  $\text{Pd}(\text{PPh}_3)_4$  is named as:

- (A) Stille coupling  
(B) Negishi coupling  
(C) Ullmann coupling  
(D) Sonogashira coupling

86. Which of the following can be easily oxidised?

- (A)  $\text{Ni}(\text{C}_5\text{H}_5)_2$   
(B)  $\text{Cr}(\text{C}_5\text{H}_5)_2$

(C)  $\text{V}(\text{C}_5\text{H}_5)_2$ 

(D)  $\text{Mn}(\text{C}_5\text{H}_5)_2$ 

87. For an enzyme catalyzed reaction, slope and intercept of Eadie-Hofstee plot are  $3 \times 10^{-5}$  and 0.5, respectively. If initial concentration of free enzyme is  $2 \text{ mol dm}^{-3}$ , the catalytic efficiency of the reaction is:

- (A) 0.1 (B) 0.9  
(C) 0.25 (D) 0.3

88. Match the entries in Column I and Column II and select the correct answer from the codes given below:

	Column - I		Column -II
P	Functional group interconversion	1	Reagent
Q	Synthon	2	1,3-Dithianes
R	Carbonyl equivalent	3	Benzoin
S	Thiazolium salt	4	Retrosynthetic analysis

Codes:

	P	Q	R	S
(A)	3	2	1	4
(B)	4	1	2	3
(C)	1	3	4	2
(D)	2	4	3	1

79. The  $\sin^2 \theta$  values obtained from X-ray powder diffraction pattern of a solid are  $2x, 4x, 6x, 8x$  where  $x$  is equal to 0.06. The wavelength of X-ray used to obtain this pattern is  $1.54 \text{ \AA}$ . The unit cell and the unit cell length, respectively, are :

(A) BCC,  $3.146$

(B) FCC,  $3.146 \text{ \AA}$

(C) SCC,  $6.281 \text{ \AA}$

(D) BCC,  $1.544 \text{ \AA}$

80. Given below are two statements:

**Statement I:** In the additions to carbon-heteroatom multiple bonds, the orientation of unsymmetrical addition to is predictable in the sense that the nucleophilic attacking species always go to carbon while the electrophilic ones go to the heteroatom (O, N).

**Statement II:** Thiobenzophenone  $\text{Ph}_2\text{C}=\text{S}$ , upon treatment with phenyllithium gives, after hydrolysis, benzhydryl phenyl sulfide,  $\text{Ph}_2\text{CHSPh}$ .

In light of the above statements, choose the most appropriate answer from the codes given below:

(A) Both Statement I and Statement II are correct.

(B) Both Statement I and Statement II are incorrect

(C) Statement I is correct and Statement II is incorrect.

(D) Statement I is incorrect and Statement II is correct.

81. Match List-I and List-II and select the correct answer from the codes given below:

List-I (Orbital)		List-II (Relative bond strength)	
P	s	1	1.99
Q	p	2	2.0
R	$sp^2$	3	1.73
S	$sp^3$	4	1.0

Codes:

	P	Q	R	S
(A)	4	3	2	1
(B)	1	3	2	4
(C)	4	3	1	2
(D)	2	3	4	1

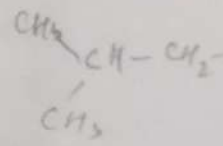
82. How many kinds of protons are there in  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_3$ ?

(A) One

(B) Two

(C) Three

(D) Four





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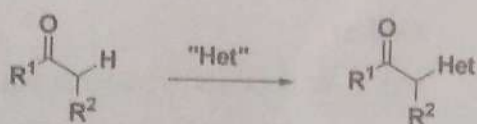
73. An octahedral complex of which of the following metal ions will be highly distorted due to Jahn-Teller effect?

- (A)  $\text{Cr}^{6+}$  (B)  $\text{Ni}^{2+}$   
(C)  $\text{Cu}^{2+}$  (D)  $\text{Ti}^{3+}$

74. A sample of two moles of  $\text{O}_2$  (g) (assumed ideal) at 500 K is expanded from 5 L to 50 L under adiabatic and reversible conditions. The change in its internal energy (in kJ) is close to ( $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$ ,  $C_{v,m} = 5/2 R$ )

- (A) -22.5 (B) -19.5  
(C) -12.5 (D) -7.5

75. The direct activation and transformation of a C-H bond adjacent to a carbonyl group (see below) into a C-Het bond can take place via a variety of mechanisms, depending on the organocatalyst applied. When small molecule based secondary amines are used as the catalyst, the first step is the formation of :



Het =  $\text{NR}_2$ , OR, F, Cl, Br, SR

(A) An aldol

- (B) An enamine  
(C) A carbanion  
(D) A radical

76. Ground state magnetic moment of which of the lanthanide ions has maximum contribution from the second order Zeeman effect ?

- (A)  $\text{Eu}^{3+}$   
(B)  $\text{Pm}^{3+}$   
(C)  $\text{La}^{3+}$   
(D)  $\text{Lu}^{3+}$

77. For entropy (S) of a perfect gas, the correct relation is:

- (A)  $S \propto V$   
(B)  $S \propto V^2$   
(C) S is independent of V  
(D)  $S \propto \ln V$

78. Conversion of  $\alpha$ -diketones with base to form salts of  $\alpha$ -hydroxy acids is named as :

- (A) Benzoin condensation  
(B) Claisen reaction  
(C) Benzil - benzilic acid rearrangement  
(D) Perkin reaction



70. Given below are two statements, one labelled as Assertion (a) and the other labelled as Reason (r). Read the statements and choose the correct answer from the codes given below:

**Assertion (a):** Potassium dichromate is intensely colored.

**Reason (r):** The color of the d-block metal complexes with partially filled/unfilled d-orbitals may arise from d-d transitions as well as the charge-transfer transitions.

- (A) Both (a) and (r) are true and (r) is correct explanation of (a)  
(B) Both (a) and (r) are true but (r) is not correct explanation of (a)  
(C) (a) is true, but (r) is false  
(D) (a) is false, but (r) is true

71. Correct form of Langmuir adsorption isotherm is:

- (A)  $\theta = \frac{(Kp)^{1/2}}{1 + (Kp)^{1/2}}$   
(B)  $\theta = \frac{(Kp)^{3/2}}{1 + (Kp)^{1/2}}$   
(C)  $\theta = \frac{(Kp)^{3/2}}{1 + (Kp)^{3/2}}$   
(D)  $\theta = \frac{1 + (Kp)^{3/2}}{(Kp)^{1/2}}$

72. Given below are two statements, one labelled as Assertion (a) and the other labelled as Reason (r). Read the statements and choose the correct answer from the codes given below:

**Assertion (a):** Aromatic compounds exhibit a diamagnetic ring current due to migration of the delocalized  $\pi$  electrons under the influence of the magnetic field in an NMR spectrometer. The induced ring current in the molecules thus gives rise to a local magnetic field that is opposed to the direction of the applied magnetic field and impact chemical shifts of the protons.

**Reason (r):** Nuclei in a region above or below the plane of an aromatic ring are shielded by the induced field and appear at relatively high field in the NMR spectrum, whereas nuclei in the plane of the ring i.e., the atoms bound directly to the ring occur at downfield positions.

**Codes:**

- (A) Both (a) and (r) are true and (r) is correct explanation of (a)  
(B) Both (a) and (r) are true but (r) is not correct explanation of (a)  
(C) (a) is true, but (r) is false  
(D) (a) is false, but (r) is true





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64. Which of the following pH range is most suitable for use for the strongly basic anion exchangers?

- (A) 7 - 14  
(B) 1 - 6  
(C) 1 - 9  
(D) 1 - 14

65. For a first-order reaction, the rate of reaction depends on temperature. The value of rate constant when temperature is extremely large is:

- (A)  $\infty$   
(B) 0  
(C) A  
(D) None of these

66. Given below are two statements:

**Statement I:** Esterification of (+)-lactic acid with methyl alcohol gives (-)-methyl lactate.

**Statement II:** The configuration at the chiral carbon in the above reaction changes.

In light of the above statements, choose the most appropriate answer from the codes given below:

- (A) Both Statement I and Statement II are correct.

(B) Both Statement I and Statement II are incorrect

(C) Statement I is correct and Statement II is incorrect.

(D) Statement I is incorrect and Statement II is correct.

67. The number of lone pairs in  $\text{ClF}_3$  is :

- (A) 3  
(B) 0  
(C) 4  
(D) 2

68. A particle is confined to a one-dimensional box of length 1 mm. If the length is changed by  $10^{-9}\text{m}$ , the percent change in the ground state energy is:

- (A)  $2 \times 10^{-4}$   
(B)  $2 \times 10^{-7}$   
(C)  $2 \times 10^{-2}$   
(D) 0

Handwritten calculation for Q68:  

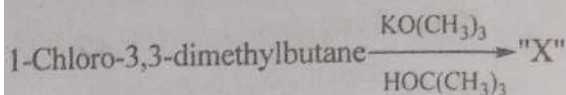
$$\frac{\Delta E}{E} = \frac{2 \times 10^{-9}}{1 \times 10^{-3}} \times 100 = 2 \times 10^{-4} \%$$

69. The deadliest of the malaria parasites and the most prevalent on the African continent is :

- (A) *Plasmodium ovale*  
(B) *Plasmodium malariae*  
(C) *Plasmodium vivax*  
(D) *Plasmodium falciparum*

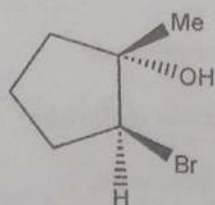


59. The IUPAC name of the product "X" of the following reaction is



- (A) 3,3-dimethyl-1-butene  
(B) 2,2-dimethyl-3-butene  
(C) *tert*-butyl chloride  
(D) Isopentyl chloride
60. What is 'X' in the following equation?  

$${}_{13}^{27}\text{Al} + \text{'X'} \rightarrow {}_{15}^{30}\text{P} + {}_0^1\text{n}$$
 (A)  ${}_1^1\text{H}$  (B)  ${}_2^4\text{He}$   
 (C)  ${}_1^1\text{n}$  (D)  ${}_1^3\text{H}$
61. For FCC lattice, which of the following Miller indices are not possible?  
 (A) 110 (B) 222  
 (C) 111 (D) 311
62. The IUPAC name of the following compound is :



- (A) *cis*-1-Bromo-2-methylcyclopentanol  
 (B) *trans*-2-Bromo-1-methylcyclopentanol  
 (C) *cis*-2-Bromo-1-methylcyclopentanol  
 (D) *trans*-1-Bromo-2-methylcyclopentanol

63. Given below are two statements:

**Statement I:**  $\text{Ce}^{3+}$  ( $f^1$ ) and  $\text{Yb}^{3+}$  ( $f^{13}$ ) are colorless because they do not absorb in the visible region

**Statement II:** The solution of  $\text{Ce}^{4+}$  ( $f^0$ ) is intensely colored due to the d-d transitions

In light of the above statements, choose the most appropriate answer from the codes given below:

- (A) Both Statement I and Statement II are correct.  
 (B) Both Statement I and Statement II are incorrect  
 (C) Statement I is correct and Statement II is incorrect.  
 (D) Statement I is incorrect and Statement II is correct.



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54. Which of the following involves  $p\pi - d\pi$  multiple bonding?

- (A) CO
- (B) NO
- (C)  $CS_2$
- (D)  $CN^-$

55. Which of the following conditions are satisfied by Hermitian operator?

- (I)  $a_n = a_n^*$
- (II)  $\int \psi_n \hat{A} \psi_n^* d\tau = \int \psi_n (\hat{A} \psi_n)^* d\tau$
- (III)  $\int_{-\infty}^{+\infty} \psi_m^* \psi_n dx = 0$
- (IV)  $\int_{-\infty}^{+\infty} \psi_m^* \psi_n dx \neq 0$

Codes:

- (A) All of the above
- (B) Only (I) and (II)
- (C) Only (I), (II) and (III)
- (D) Only (I), (II) and (IV)

56. Given below are two statements:

**Statement – I:** The Diels-Alder reactions are stereospecific.

**Statement – II:** Cycloaddition reaction of 1,3-butadiene with dimethyl fumarate yields *trans*-cycloaddition product.

In light of the above statements, choose the most appropriate answer from the codes given below:

- (A) Both statements I and II are incorrect
- (B) Statement I is incorrect but II is correct
- (C) Statement I is correct but II is incorrect
- (D) Both Statements I and II are correct.

57. Which of the following does not give IR peaks?

- (A) HF
- (B) CN
- (C)  $N_2$
- (D) CO

58. Diatomic molecule dissociates in the limit that  $\Delta v \rightarrow 0$ , where  $\Delta v$  is the spacing between adjacent lines. Given fundamental line for  $^{127}I^{35}Cl$  is at  $381.2 \text{ cm}^{-1}$  and first overtone at  $759.6 \text{ cm}^{-1}$ , what is the maximum vibrational quantum number?

- (A) 140
- (B) 136
- (C) 120
- (D) 133

for 20  
756  
380  
376





50. Given below are two statements, one labelled as Assertion (a) and the other labelled as Reason (r). Read the statements and choose the correct answer from the codes given below:

**Assertion (a) :** The most compelling evidence in favour of the  $E_2$  mechanism is found in stereochemical studies.

**Reason (r) :** Because the other evidences such as isotope effect or second-order kinetics are often compatible with other mechanisms also such as  $E_1cB$ .

**Codes:**

- (A) Both (a) and (r) are true and (r) is correct explanation of (a)  
(B) Both (a) and (r) are true but (r) is not correct explanation of (a)  
(C) (a) is true, but (r) is false  
(D) (a) is false, but (r) is true

51. Which of the following statements are correct for Raman spectroscopy?

- I Raman spectroscopy deals with the scattering of light.  
II Raman spectroscopy deals with the absorption of light.  
III For the elastic collision the scattered photon and the incident photon have the same energy.

- IV The selection rule for the vibrational Raman spectroscopy spectrum of a diatomic molecule is  $\Delta v = 0$

**Codes:**

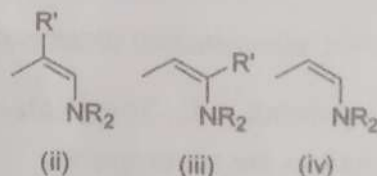
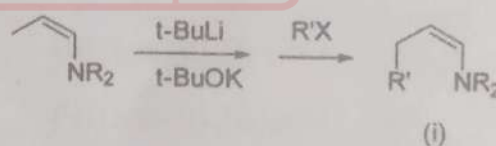
- (A) I, III (B) II, III  
(C) II, IV (D) I, IV

52. For the given character table of point group  $C_{3v}$

	E	$2C_3$	$3\sigma_v$	
$A_1$	1	1	1	z
$A_2$	1	1	-1	
E	2	-1	0	(x, y)

The restricted transition is:

- (A)  $a_1 \leftrightarrow a_2$   
(B)  $a_1 \leftrightarrow e$   
(C)  $a_2 \leftrightarrow e$   
(D) None of the above
53. In the aliphatic nucleophilic substitution reaction depicted below, identify the probable product



- (A) (i) (B) (ii)  
(C) (iii) (D) (iv)



45. Ground state molecular term symbol for  $N_2^+$  would be:

- (A)  $^2\Sigma_g^-$  (B)  $^2\Sigma_g^+$   
(C)  $^1\Sigma_g^+$  (D)  $^2\Sigma_g^+$

46. Given below are two statements:

**Statement -I:** Pyridine is more basic than piperidine.

**Statement - II:** Nitrogen lone pair occupies an  $sp^3$  hybridized orbital in piperidine and  $sp^2$  in pyridine.

In light of the above statements, choose the most appropriate answer from the codes given below:

- (A) Statement I is incorrect and II is correct  
(B) Statement I is correct and II is incorrect  
(C) Both statements I and II are correct  
(D) Both statements I and II are incorrect

47. Which of the following metal exhibits highest coordination number?

- (A) Ni  
(B) Co  
(C) Os  
(D) Fe

48. Considering Huckel MO theory for benzene,  $\pi$ -electron charge on each carbon atom and bond order in benzene are:

- (A) 1, 2/3  
(B) 0, 1/6  
(C) 0, 1  
(D) 1, 2

49. Given below are two statements, one labelled as Assertion (a) and the other labelled as Reason (r). Read the statements and choose the correct answer from the codes given below:

**Assertion (a):** Aldohexoses have four chirality centers.

**Reason (r):** A total of 16 stereoisomeric aldohexoses are possible.

Codes:

- (A) Both (a) and (r) are true and (r) is correct explanation of (a)  
(B) Both (a) and (r) are true but (r) is not correct explanation of (a)  
(C) (a) is true, but (r) is false  
(D) (a) is false, but (r) is true



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41. Given that molar conductance at infinite dilution ( $\lambda_m^0 / 10^{-2} \text{Sm}^2 \text{mol}^{-1}$ ) for HCl, KCl and  $\text{CH}_2\text{ClCOOK}$  is 4.26, 1.49 and 1.132, respectively. Molar conductance at infinite dilution for  $\text{CH}_2\text{ClCOOH}$  is:

- (A) 3.89 (B) 389.4  
(C) 0.3894 (D) 38.9

42. Match List-I and List-II and select the correct answer from the codes given below:

	List-I (Biomolecules)		List-II (Function)
P	Sugars	1	Structure, binding and transport
Q	Nucleic acids	2	Source of carbon and energy
R	Proteins	3	Structure and catalysis
S	Polysaccharides	4	Store genetic information

Codes:

- |     | P | Q | R | S |
|-----|---|---|---|---|
| (A) | 1 | 4 | 2 | 3 |
| (B) | 4 | 2 | 3 | 1 |
| (C) | 2 | 4 | 3 | 1 |
| (D) | 3 | 1 | 2 | 4 |

43. Which of the following is not a Borane?

- (A)  $\text{B}_5\text{H}_9$

- (B)  $\text{B}_5\text{H}_{10}$   
(C)  $\text{B}_5\text{H}_{11}$   
(D)  $\text{B}_6\text{H}_{10}$

44. Determine transport number of  $\text{Cl}^-$  ion at infinite dilution ( $t_-^0$ ) at  $25^\circ\text{C}$  for AgCl, where

- (A) 0.45  
(B) 0.35  
(C) 0.50  
(D) 0.55

45. Cysteine has  $\text{pK}_{a1} = 1.96$  and  $\text{pK}_{a2} = 10.28$ . The  $\text{pK}_a$  due to the -SH group of the side chain is 8.18. What is the isoelectric point of cysteine?

- (A) 2.10  
(B) 9.23  
(C) 5.07  
(D) 7.00

46. According to Wade's rule the structure of the cluster  $[\text{Fe}_5\text{C}(\text{CO})_{15}]$  is :

- (A) Closo  
(B) Nido  
(C) Arachno  
(D) Capped

Handwritten calculations:  
 $40$   
 $4$   
 $30$   
 $14$   
 $74 - 60 = 14$   
 $14 / 2 = 7$   
 $7 + 1 = 8$



33. Sharpless epoxidation reaction was originally used for the epoxidation of
- (A) Vinylic alcohols
  - (B) Allylic alcohols
  - (C) Benzylic alcohols
  - (D) Heterocyclic alcohols
34. To prepare 1 N  $\text{KMnO}_4$  solution for the titration reaction of  $\text{KMnO}_4$  vs  $\text{Na}_2\text{C}_2\text{O}_4$ , the equivalent weight of  $\text{KMnO}_4$  to be taken is equal to its:
- (A) Mol. wt.
  - (B)  $1/5$  Mol. wt.
  - (C)  $1/2$  Mol. wt.
  - (D)  $2 \times$  Mol. wt.
35. For the data observations as 3, 2, 5 and 6, the standard deviation is:
- (A) 4
  - (B) 10
  - (C) 2.5
  - (D) 1.58
36. Which of the following reactions is catalyzed by the enzyme adenylate cyclase?
- (A) The conversion of ATP to cyclic AMP
  - (B) The conversion of cyclic AMP to AMP
  - (C) The conversion of cyclic AMP to ATP
  - (D) The conversion of AMP to cyclic AMP
37. *Cis*-1,2-Dimethylcyclopentane and *trans*-1,3-dimethylcyclopentane are best described as :
- (A) Stereoisomers
  - (B) Constitutional isomers
  - (C) Geometrical isomers
  - (D) Rotamers
38. Enantiomeric excess is the excess of one enantiomer over the other, expressed as a percentage of the whole. So a 98:2 mixture of enantiomers is an enantiomerically enriched mixture with:
- (A) 96 % ee
  - (B) 98% ee
  - (C) 2% ee
  - (D) All of the above





29. Given below are two statements:

**Statement –I:** According to HSAB principle, hard acid tends to bind with a hard base.

**Statement –II:**  $[\text{AlF}_6]^{3-}$  is most stable among the  $[\text{AlCl}_6]^{3-}$ ,  $[\text{AlBr}_6]^{3-}$ ,  $[\text{AlI}_6]^{3-}$

In light of the above statements, choose the most appropriate answer from the codes given below:

- (A) Statement I is true and Statement II is false  
(B) Both the statements I and II are true  
(C) Both the statements I and II are false  
(D) Statement I is false and Statement II is true

30. Correct representation for liquid junction potential is :

- (A)  $t_- \frac{RT}{F} \ln \left( \frac{a_2}{a_1} \right)$   
(B)  $(t_- + t_+) \frac{RT}{F} \ln \left( \frac{a_2}{a_1} \right)$   
(C)  $(t_- - t_+) \frac{RT}{F} \ln \left( \frac{(a_+)_2}{(a_+)_1} \right)$   
(D)  $(t_+) \frac{RT}{F} \ln \left( \frac{(a_+)_2}{(a_+)_1} \right)$

31. Match List-I and List-II and select the correct answer from the codes given below:

List-I (Reagents/techniques)		List-II (compounds and properties)	
P	RNHOSO <sub>2</sub> Ar	1	Free radicals
Q	RMgX	2	Ionic
R	Organolithiums	3	Covalent
S	Chemically induced dynamic Nuclear Polarization	4	Nitrene
		5	Arene

Codes:

	P	Q	R	S
(A)	1	5	2	4
(B)	5	2	3	1
(C)	4	3	2	1
(D)	2	3	1	4

32. Given below are two statements, one labelled as Assertion (a) and the other labelled as Reason (r). Read the statements and choose the correct answer from the codes given below:

**Assertion (a):**  $\text{BH}_3\text{CO}$  is more stable than  $\text{BF}_3\text{CO}$

**Reason (r):** CO is soft acid and  $\text{BH}_3$  and  $\text{BF}_3$  are soft and hard bases respectively.

Codes:

- (A) Both (a) and (r) are true and (r) is correct explanation of (a)  
(B) Both (a) and (r) are true but (r) is not correct explanation of (a)  
(C) (a) is true, but (r) is false  
(D) (a) is false, but (r) is true



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26. Given below are two statements, one labelled as Assertion (a) and the other labelled as Reason (r). Read the statements and choose the correct answer from the code given below:

**Assertion (a):** The "disconnection approach," also known as retrosynthetic analysis, is a method in organic chemistry where a target molecule is broken down into simpler precursor molecules by imaginarily breaking bonds, essentially working backwards from the desired product to identify potential starting materials and synthetic steps to reach it.

**Reason (r):** In the above process, one may have to perform functional group interconversions or functional group additions to reach at simpler starting precursors.

**Codes:**

- (A) Both (a) and (r) are true and (r) is correct explanation of (a)  
 (B) Both (a) and (r) are true but (r) is not correct explanation of (a)  
 (C) (a) is true, but (r) is false  
 (D) (a) is false, but (r) is true
27. Match List-I and List-II and select the correct answer from the codes given below:

### List-I

#### (Bond making/breaking)

- P Two new sigma bonds are formed or broken  
 Q One new sigma bond is formed as another breaks  
 R One new sigma bond is formed or broken  
 S H is replaced with a functional group

### List-II

#### (Type of reaction)

- 1 Electrocyclic reaction  
 2 Sigmatropic rearrangement  
 3 Cycloadditions  
 4 Diels-Alder reaction  
 5 Substitution reaction

**Codes:**

	P	Q	R	S
(A)	1	4	2	3
(B)	5	4	3	1
(C)	4	2	5	1
(D)	4	2	1	5

28. Reduction of only the C=C bond of the conjugated C=C-CX (where CX = C=O or CN) systems can be achieved by using one of the following reagents
- (A)  $\text{NaCNBH}_3$   
 (B)  $\text{LiAlH}_4$   
 (C)  $\text{NaBH}_4$   
 (D)  $\text{H}_2$  and a Rh catalyst





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21. Ionic strength of 0.6 molal  $\text{BaCl}_2$  aqueous solution is :

(A) 1.8 (B) 0.8  
(C) 0.9 (D) 0.5

22. An organic compound in its  $^1\text{H NMR}$  showed signals at  $\delta$  1.11 (triplet, 3H), 1.16 (doublet, 6H), 3.19 (m, 1H) and 3.41 (q, 2H). The EIMS showed a base peak and  $m/z$  88. Its IR spectrum showed a characteristic peak at  $1150\text{ cm}^{-1}$ . The compound is :

(A) Diisopropyl ether  
(B) Ethylisopropylamine  
(C) Ethylisopropyl ether  
(D) N-Ethylisopropyl ether

23. In the  $\text{M}_2\text{X}_8$  type cluster (M is  $d^4$  metal ion), the M-M bond type is :

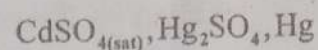
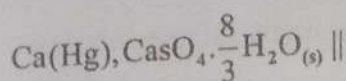
(A) Single

~~(B)~~ Triple

(C) Dative

~~(D)~~ Quadruple

24. Consider the following cell, with standard free energy change ( $\Delta G$ ) for the reaction being  $-196.5\text{ kJ}$ . What is the EMF (E) of the cell?



(A) 2.03 V

(B) 1.18 V

(C) 1.00 V

(D) 1.02 V

25. Match the entries in columns I and II and select the correct answer from the codes given below:

Column - I		Column - II	
P	HMBC	1	One Bond coupling
Q	McLafferty rearrangement	2	Electronic absorption spectroscopy
R	Absorptivity	3	C, H-correlations
S	HMQC	4	Mass spectrometry

Codes:

	P	Q	R	S
(A)	3	4	2	1
(B)	1	4	2	3
(C)	1	2	3	4
(D)	4	2	1	3



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17. The size of atoms is approximately of the order of :

- (A) 0.01 nm  
(B) 0.1 - 0.5 nm  
(C) 1 nm  
(D) 10 nm

### List-II

(Reagent)

- 1  $\text{ArNH}_2 + \text{NOHSO}_4$   
2  $\text{RCOCl} + \text{AlCl}_3$   
3  $\text{Cl}_2 + \text{FeCl}_3$   
4  $\text{ClSO}_2\text{OH}$   
5  $\text{H}_2\text{SO}_4$

18. Which of the following is not one of the twelve principles of Green chemistry?

- (A) Minimization of the use of solvents  
(B) Maximization of atom economy  
(C) Minimizing toxic reagents used in a synthesis  
(D) Using high temperatures to speed up the reactions

Codes:

	P	Q	R	S
(A)	1	5	2	4
(B)	5	1	4	3
(C)	4	3	2	1
(D)	2	3	1	4

19. Match List-I and List-II and select the correct answer from the codes given below:

### List-I

(Synthon)

- P  $^+\text{SO}_2\text{OH}$   
Q  $\text{ArN}_2^+$   
R  $\text{SO}_2\text{Cl}$   
S  $\text{Cl}^+$

20. Which of the following are the possible applications of the host-guest complexes?

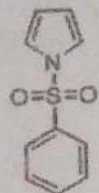
- I Catalytic  
II Molecular recognition  
III Stabilization of reactive intermediates

- (A) I only  
(B) I, II and III  
(C) II and III only  
(D) I and II only





12. Lithiation of N-sulphonylarypyrrole of the structure given below yields a C-2 carbanion due to:



- (A) More electrophilic nature of C-2  
(B) Directed lithiation  
(C) Electron delocalization  
(D) Hyperconjugation

13. Which of the following is dry ice?

- (A) Solid  $\text{NH}_3$   
(B) Solid  $\text{SO}_2$   
(C) Solid  $\text{CO}_2$   
(D) Solid  $\text{N}_2$

14. Suppose a sample was excited at 435 nm and a Raman line was observed at 444 nm. The Raman shift would be :

- (A)  $460 \text{ cm}^{-1}$   
(B)  $450 \text{ cm}^{-1}$   
(C)  $456 \text{ cm}^{-1}$   
(D)  $466 \text{ cm}^{-1}$

15. Given below are two statements, one labelled as Assertion (a) and the other labelled as Reason (r). Read the statements and choose the correct answer from the codes given below:

**Assertion (a):** Reaction of furfural with phosphorous ylides of ethylbromoacetate gives *E*-alkene.

**Reason (r) :** Wittig reaction of stabilized ylides give *trans*-alkenes.

**Codes:**

- (A) Both (a) and (r) are true and (r) is correct explanation of (a)  
(B) Both (a) and (r) are true but (r) is not correct explanation of (a)  
(C) (a) is true, but (r) is false  
(D) (a) is false, but (r) is true

16. Match List-I and List-II and select the correct answer from the codes given below:

	List-I (Element)		List-II (Group)
P	Rb	1	Lanthanide
Q	Ca	2	Transition metal
R	Gd	3	Alkali metal
S	Ir	4	Alkaline earth metal
		5	Actinide

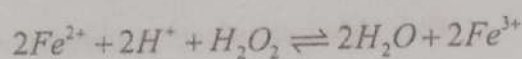
**Codes:**

- |     | P | Q | R | S |
|-----|---|---|---|---|
| (A) | 4 | 2 | 1 | 5 |
| (B) | 3 | 4 | 1 | 2 |
| (C) | 3 | 5 | 2 | 1 |
| (D) | 2 | 4 | 3 | 5 |

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8. What will be correct value of equilibrium constant for the following reaction where,  $E_{\text{Fe}^{3+}/\text{Fe}^{2+}}^0 = 0.77V$  and  $E_{\text{H}_2\text{O}_2, \text{H}^+/\text{H}_2\text{O}}^0 = 1.77V$  at  $25^\circ\text{C}$ .



- (A)  $\log k = 16.9$   
(B)  $\log k = 22.1$   
(C)  $\log k = 33.8$   
(D)  $\log k = 44.3$

9. Given below are two statements:

**Statement I:** The cyclic conjugated polyene 1,3,5,7-cyclooctatetraene, corresponds to  $4n\pi$ -electron system.

**Statement II:** Cyclooctatetraene is neither aromatic nor antiaromatic.

In light of the above statements, choose the most appropriate answer from the codes given below:

- (A) Both Statement I and Statement II are correct.  
(B) Both Statement I and Statement II are incorrect  
(C) Statement I is correct and Statement II is incorrect.  
(D) Statement I is incorrect and Statement II is correct.

10. Match List-I and List-II and select the correct answer from the codes given below:

List-I ( Name of Series )		List-II ( Series )	
P	Thorium series	1	$4n + 2$
Q	Neptunium series	2	$4n + 3$
R	Uranium series	3	$4n + 1$
S	Actinium series	4	$4n$
		5	$4n + 4$

Codes:

Al  $\frac{Th}{4n}$   $\frac{Pa}{4n+1}$   $\frac{U}{4n+2}$   $\frac{Np}{4n+3}$   $\frac{Ac}{4n}$   $\frac{Am}{4n+4}$

	P	Q	R	S
(A)	3	2	1	5
(B)	2	1	3	4
(C)	4	3	1	2
(D)	5	2	1	4

11. Which of the following relations is correct regarding molecular weight of synthetic polydisperse polymers?

- (A)  $M_n < M_w < M_z$   
(B)  $M_n > M_w > M_z$   
(C)  $M_n < M_w = M_z$   
(D)  $M_w < M_n < M_z$





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1. The coordination centre in the Wilkinson's catalyst is:

- (A) Rh (B) Mn  
(C) Co (D) Fe

2. The most appropriate method to establish the colloidal stability of charged colloids is :

- (A) Surface tension measurement  
(B) Impedance Spectroscopy  
(C) Cyclic Voltametry  
(D) Zeta Potential measurement

3. Given below are two statements:

**Statement – I:**  $\beta$ -carotene is a tetraterpene as it has 40 carbon atoms.

**Statement – II:** The two 20-carbon fragments in  $\beta$ -carotene are connected at the midpoint via head-to-tail linkage.

In light of the above statements, choose the most appropriate answer from the codes given below:

- (A) Both statements I and II are correct  
(B) Statement I is correct and Statement II is incorrect  
(C) Both statements I and II are incorrect

(D) Statement II is correct and Statement I is incorrect

4. What is true about Ferridoxin?

- (A) Non-heme compound  
(B) Mediate electron-transfer in metabolic reactions  
(C) Fe-S protein  
(D) All of the above

5. According to Variation theorem, upper bound to ground state energy of a system is:

- (A)  $E_p \geq E_0$  (B)  $E_p = E_0$   
(C)  $E_p < E_0$  (D)  $E_p > E_0$

6. A threofuranose is drawn in such a way that the OH groups at C-1 and C-2 are 'down' and the one at C-3 is 'up'. The compound is :

- (A)  $\alpha$ -L-Threofuranose  
(B)  $\beta$ -L-Threofuranose  
(C)  $\alpha$ -D-Threofuranose  
(D)  $\beta$ -D-Threofuranose

7. In Vitamin B<sub>12</sub>, the ligand system is :

- (A) Porphyrin  
(B) Corrin  
(C) Phthalocyanine  
(D) Pyrrole