

# S/SO/2013/06 CHEMISTRY

Roll No.

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BOOKLET NO.

6292

Candidate should write his/her Roll No. in the box above. ↑

Total No. of Questions : 150

Time : 2 Hours]

No. of Printed Pages : 40

[Total Marks : 300

## INSTRUCTIONS FOR CANDIDATES

1. All questions are compulsory.
2. All questions carry equal marks.
3. The question paper contains **150** questions. The examinee should verify that the requisite number of questions are printed in the question paper, otherwise he should ask for another question paper.
4. The cover page indicates the number of printed pages in the question paper. The examinee should verify that the requisite number of pages are attached in the question paper, otherwise he should ask for another question paper.
5. Read carefully the instructions given on the answer sheet supplied and indicate your answers accordingly.
6. Kindly make necessary entries on the answer sheet only at the places indicated and nowhere else.
7. Examinees should specially pay attention that 2 marks will be awarded for correct answer.
8. Examinees should do all rough work on the space meant for rough work on the last page of the question paper and nowhere else, not even on the answer sheet.

1. Select the *correct* answer from the following :

(A) *s*-orbital is non-directional

(B) an orbital can accommodate a maximum of two electrons with parallel spins

(C) the energy of *p*-orbital is greater than that of *d*-orbital

(D) the order of increasing energy for different orbitals is

$$s > p > d > f$$

2. In Schrödinger's wave equation  $H\psi = E\psi$ , the symbol  $\psi$ , represents :

(A) Energy of the spherical wave

(B) Frequency of the spherical wave

(C) Amplitude of the spherical wave

(D) Laplacian operator

3. The wave function of a particle is  $\psi$  at point  $x$ . The probability of finding the particle between  $x$  and  $x + dx$  is  $p$ . The *correct* relation between  $p$  and  $\psi$  is :

(A)  $p = \psi dx$

(B)  $p = \psi^2$

(C)  $p \propto \psi$

(D)  $p \propto |\psi|^2 dx$

4. In a time-independent perturbation theory, Hamiltonian for the system is :
- (A) Product of simpler Hamiltonian
  - (B) Sum of the simpler Hamiltonian
  - (C) Product of the square of simpler Hamiltonian
  - (D) Sum of the square of the simpler Hamiltonian
5. The variation principle suggests that arbitrary wave function gives energy :
- (A) never less than the true energy of the system
  - (B) never high than the true energy of the system
  - (C) equal to the true value of energy of the system
  - (D) a constant value for all the systems
6. Three particles having masses  $m_1$ ,  $m_2$  and  $m_3$ , where  $m_1 > m_2 > m_3$  are moving with a constant velocity. Relation between the wavelengths  $\lambda_1$ ,  $\lambda_2$  and  $\lambda_3$  respectively associated with de Broglie waves are given below. Select the *correct* answer :
- (A)  $\lambda_1 > \lambda_2 > \lambda_3$
  - (B)  $\lambda_1 < \lambda_2 < \lambda_3$
  - (C)  $\lambda_1 = \lambda_2 = \lambda_3$
  - (D) All of the above

7. Which one of the following quantum numbers is related to the angular momentum of the electron ?

- (A)  $n$  (B)  $l$   
 (C)  $m$  (D)  $s$

8. Which one of the following is *correctly* matched ?

- (A)  $s$ -orbital—dumb-bell  
 (B)  $p$ -orbital—spherical  
 (C)  $d$ -orbital—double dumb-bell  
 (D)  $f$ -orbital—square

9. A set of some quantum numbers are given for the unpaired electron of chlorine atom. Select the *correct* answer from the following :

	$n$	$l$	$m$
(A)	2	1	1
(B)	2	1	0
(C)	3	0	0
(D)	3	1	1

10. List I and List II contain the quantum numbers for two electrons respectively in an atom. Which one of the following is not *correct* ?

	List I				List II			
	$n$	$l$	$m$	$s$	$n$	$l$	$m$	$s$
(A)	2	0	1	$+\frac{1}{2}$	2	1	0	$+\frac{1}{2}$
(B)	2	1	-1	$+\frac{1}{2}$	2	1	-1	$+\frac{1}{2}$
(C)	2	1	1	$+\frac{1}{2}$	2	1	1	$-\frac{1}{2}$
(D)	2	1	-1	$-\frac{1}{2}$	2	1	-1	$+\frac{1}{2}$

11. Which one of the following is *correctly* matched in the atomic spectrum of hydrogen ?

- (A) Lyman series — Infrared
- (B) Paschen series — Ultraviolet
- (C) Balmer series — Visible
- (D) Pfund series — Ultraviolet

12. Consider the following statements :

**Assertion (a) :** Lyman series of hydrogen spectrum are associated with the highest energy.

**Reason (r) :** The electron returns to the highest energy level than the ground level.

Select the correct answer from the following answer codes :

- (A) (a) is correct but (r) is false
- (B) (a) is false but (r) is correct
- (C) both (a) and (r) are false
- (D) both (a) and (r) are correct

13. The correct set of four quantum numbers for the outermost electron of rubidium (atomic number 37) is :

- (A) 5, 1, 0,  $+\frac{1}{2}$
- (B) 5, 0, 0,  $+\frac{1}{2}$
- (C) 5, 1, 1,  $+\frac{1}{2}$
- (D) 5, 0, 1,  $+\frac{1}{2}$

14. An electron from the fifth or higher energy level comes to third energy level in an atom. The spectral series produced is :

- (A) Lyman (B) Bracket  
(C) Pfund (D) Paschen

15. Consider the following statements :

**Assertion (a) :** Covalent compounds can show structural and space isomerism.

**Reason (r) :** Covalent bonds are rigid and directional.

Select the *correct* answer from the following answer codes :

- (A) both (a) and (r) are true  
(B) (a) is true but (r) is false  
(C) (a) is false but (r) is true  
(D) both (a) and (r) are false

16. Which one of the following is *correctly* matched ?

- (A) Methane — Hydrogen bond  
(B) Sodium chloride — Dative bond  
(C) Carbon dioxide — Covalent bond  
(D) Carbon tetrachloride — Ionic bond

17. The number of different types of bonds in sulphur trioxide is given below. Select the *correct* answer from the following :
- (A) one covalent and two coordinate bonds  
(B) Two covalent and two coordinate bonds  
(C) Four covalent bonds  
(D) Three covalent bonds
18. Which one of the following is common among HCl, HF, NH<sub>3</sub> and H<sub>2</sub>O ?
- (A) Intramolecular H-bonding                      (B) Absence of polar bonds  
(C) Intermolecular H-bonding                      (D) Absence of dipole moment
19. The correct order of repulsion between two lone pairs (lp-lp), two bonding pairs (bp-bp) and lone pair and bonding pair (lp-bp) is :
- (A) (lp-lp) >> (lp-bp) > (bp-bp)                      (B) (bp-bp) > (lp-lp) > (lp-bp)  
(C) (lp-bp) > (bp-bp) > (lp-lp)                      (D) (lp-bp) < (bp-bp) < (lp-lp)
20. Carbon, nitrogen and oxygen atoms are hybridised in CH<sub>4</sub>, NH<sub>3</sub> and H<sub>2</sub>O molecules. Select the *correct* answer from the following :
- (A)  $sp^3$  hybridisation  
(B)  $sp^2$  hybridisation  
(C)  $sp^3$ ,  $sp^2$  and  $sp$  hybridisation respectively  
(D) All of the above





24. The probability density in antibonding molecular orbital is :
- (A) Higher than that in either of atomic orbitals  
 (B) Equal to that of one atomic orbital  
 (C) Less than that in either of atomic orbitals  
 (D) All of the above are correct
25. How many molecular orbitals in nitrogen molecule are completely filled ?
- (A) 14 (B) 5  
 (C) 3 (D) 7
26. The value of rotational constant for a diatomic molecule is given below. Select the *correct* answer :
- (A)  $\frac{h}{8\pi^2 IC} \text{ cm}^{-1}$  (B)  $\frac{h^2}{8\pi^2 IC} \text{ cm}^{-1}$   
 (C)  $\frac{h}{4\pi IC} \text{ cm}^{-1}$  (D)  $\frac{h^2}{4\pi IC} \text{ cm}^{-1}$
27. The three principal moments of inertia for a molecule are  $I_A$ ,  $I_B$  and  $I_C$ . The condition for being spherical top molecule is :
- (A)  $I_A \neq I_B \neq I_C$  (B)  $I_B = I_C \neq I_A$   
 (C)  $I_A = I_B = I_C$  (D) None of these

28. Vibrational spectroscopy is related to the following range of electromagnetic radiation :
- (A) Radio waves (B) Infrared radiation  
(C) Microwave radiation (D)  $\gamma$ -radiation
29. Consider the following statements :
- Assertion (a)** : The vibrational energy levels are more crowded at higher vibrational quantum numbers.
- Reason (r)** : The anharmonicity constant is negative.
- Select the *correct* answer from the following answer codes :
- (A) (a) is true but (r) is false  
(B) (a) is false but (r) is true  
(C) Both (a) and (r) are false  
(D) Both (a) and (r) are true
30. The total number of vibrational degrees of freedom for  $n$ -atomic non-linear molecule is :
- (A)  $3n - 5$  (B)  $3n - 6$   
(C)  $3n + 5$  (D)  $3n + 6$
31. Absorbance (A), intensity of incident radiation ( $I_0$ ) and intensity of transmitted radiation (I) are related as :
- (A)  $A = \log \frac{I_0}{I}$  (B)  $A = \log \frac{I}{I_0}$   
(C)  $A = \frac{I_0}{I}$  (D)  $A = e^{-\frac{I_0}{I}}$

32. The Raman line appears at lower frequency side of exciting line is :
- (A) Principal line (B) Stokes' line  
(C) Antistokes' line (D) Fundamental line
33. In NMR, electromagnetic radiation is involved. Select the *correct* answer from the following :
- (A) Infrared (B) Ultraviolet  
(C) Radio waves (D) X-radiation
34. Low resolution proton NMR spectrum of  $C_2H_5OH$  has :
- (A) One peak (B) Two peak  
(C) Three peak (D) Six peak
35. How many orientations of magnetic nucleus are possible in the presence of uniform magnetic field, if nuclear spin quantum number is  $\frac{1}{2}$  ?
- (A) 1 (B) 2  
(C) 3 (D) 4
36. The peak of methyl protons in 1-bromo-propane for high resolution NMR produce :
- (A) Doublet (B) Quartet  
(C) Triplet (D) Sextet

37. ESR is a spectroscopic technique for molecule related with :
- (A) Paired proton (B) Paired electron  
(C) Unpaired proton (D) Unpaired electron
38. A gas is enclosed in a sealed glass tube. It will constitute :
- (A) An open system (B) A closed system  
(C) An isolated system (D) All of these
39. Which one of the following is suitably matched ?
- (A) Viscosity — Extensive property  
(B) Temperature — Colligative property  
(C) Surface tension — Extensive property  
(D) Internal energy — Extensive property
40. If  $W$  is the amount of work and  $\Delta E$  is the change in internal energy for an adiabatic process. The relationship between  $W$  and  $\Delta E$  is :
- (A)  $-W = \Delta E$  (B)  $W = \Delta E$   
(C)  $W = \Delta E = 0$  (D) All of the above

41.  $\Delta H$  for the reaction  $\text{PCl}_5 \rightleftharpoons \text{PCl}_3 + \text{Cl}_2$  is equal to :
- (A)  $\Delta E + 2 RT$  (B)  $\Delta E - 2 RT$   
(C)  $\Delta E + RT$  (D)  $\Delta E - RT$
42. Standard heat of formation by convention, for all elements is :
- (A) Infinity (B) Always negative  
(C) Always positive (D) Zero
43. Change in enthalpy for combustion process is :
- (A) always negative (B) always positive  
(C) always zero (D) all of the above
44. The heat of combustion of ethane ( $\text{C}_2\text{H}_6$ ) is  $-336.0$  kcal at  $30^\circ\text{C}$ . The heat of reaction when 3 g of ethane is burnt completely is :
- (A) 33.6 kcal (B) 3.36 kcal  
(C)  $-3.36$  kcal (D)  $-33.6$  kcal
45. Which one of the following reactions will have identical values of change in enthalpy and change in internal energy ?
- (A)  $\text{N}_2\text{O}_4 \rightarrow 2\text{NO}_2$  (B)  $\text{N}_2 + \text{O}_2 \rightarrow 2\text{NO}$   
(C)  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$  (D)  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$

46. A heat engine is working reversibly between temperatures 400 K and 200 K. Its efficiency is :
- (A) 40% (B) 60%
- (C) 30% (D) 50%
47.  $\Delta G$ ,  $\Delta A$ ,  $\Delta V$ ,  $\Delta H$  and  $\Delta S$  are change in free energy, change in work function, change in volume, change in enthalpy and change in entropy respectively. Which one of the following is *correct* ?
- (A)  $\Delta G = \Delta H + P.\Delta V$  (B)  $\Delta G = \Delta A - \Delta S$
- (C)  $\Delta G = \Delta H - T.\Delta S$  (D)  $\Delta G = \Delta H + \Delta S$
48. One mole of water (L) is converted separately into vapour (V) and Ice (I). Select the *correct* answer for entropies (S) of these species.
- (A)  $S_L > S_V > S_I$  (B)  $S_I > S_V > S_L$
- (C)  $S_V > S_L > S_I$  (D)  $S_V > S_I > S_L$
49. Consider a reaction :
- $$A + B \rightleftharpoons C + D$$
- The change in free energy ( $\Delta G$ ) at equilibrium is :
- (A)  $\Delta G = 0$  (B)  $\Delta G > 0$
- (C)  $\Delta G < 0$  (D) All of these

50. If equilibrium constants at two different temperatures are known,  $\Delta H$  or  $\Delta E$  may be evaluated by :
- (A) Gibb's-Helmholtz equation      (B) Kirchoff's equation  
 (C) Clapeyron equation      (D) Van't Hoff isochore
51. Which one of the following is suitably matched ?
- (A)  $S_{\text{rhombic}} \rightarrow S_{\text{monoclinic}}$  — fusion  
 (B)  $S_{\text{liquid}} \rightarrow S_{\text{vapour}}$  — Sublimation  
 (C)  $S_{\text{rhombic}} \rightarrow S_{\text{monoclinic}}$  — Transition  
 (D)  $S_{\text{solid}} \rightarrow S_{\text{vapour}}$  — Vapourisation
52. Which one is associated with decrease in entropy ?
- (A) Crystallisation of sugar from aqueous solution  
 (B) Rusting of iron  
 (C) Boiling of water  
 (D) Sublimation of camphor
53. Select the *correct* unit of entropy :
- (A)  $\text{JK mol}^{-1}$       (B)  $\text{JK}^{-1} \text{ mol}^{-1}$   
 (C)  $\text{JK}^{-1} \text{ mol}$       (D)  $\text{JK mol}$
54. F, P and C are degree of freedom, number of phases and number of components for a heterogeneous system. The phase rule equation is given as :
- (A)  $F = C + P - 2$       (B)  $F = C - P - 2$   
 (C)  $F = C - P + 2$       (D)  $F = C + P + 2$

55. Thermal dissociation of ammonium chloride in a closed vessel is an example of :

- (A) Three component system                      (B) Two component system  
(C) One component system                      (D) All of these

56. For a system :



the degree of freedom is :

- (A) 0    (B) 3  
(C) 2    (D) 1

57. Which of the following iron state is employed by Haemoglobin ?

- (A) Fe(II)    (B) Fe(III)  
(C) Fe(I)    (D) Fe

58. Eutectic mixture of two-component system has :

- (A) Highest melting point  
(B) Lowest melting point  
(C) Melting point equal to one of the components  
(D) All of the above

59. A mixture of nitrogen and helium gas is kept in a closed vessel. The number of components in this system is :

- (A) 0    (B) 1  
(C) 2    (D) All of these



60. How many number of eutectic points are present in a zinc–magnesium system ?

(A) 0

(B) 1

(C) 3

(D) 2

61.  $N$ ,  $V$ ,  $T$  and  $E$  are the number of particles, volume, temperature and energy respectively for different assembly. Which one of the following conditions are necessary for a canonical ensemble ?

(A)  $N$ ,  $V$  and  $T$  must be same for each assembly

(B)  $N$ ,  $V$  and  $E$  must be same for each assembly

(C)  $V$  and  $E$  must be the same for each assembly

(D) All of the above are correct

62. Entropy  $S$  and Probability  $W$  are related as :

(A)  $S = K + \ln W$

(B)  $S = K \ln W$

(C)  $S = e^W$

(D)  $\ln S = \ln KW$

where  $K$  is Boltzmann's constant.

63. The *correct* expression for the partition function, when  $g_i$  is the degeneracy of energy level  $\epsilon_i$  is :

(A)  $\sum g_i e^{\epsilon_i/KT}$

(B)  $\sum e^{-g_i \epsilon_i/KT}$

(C)  $\sum g_i e^{-\epsilon_i/KT}$

(D)  $\sum e^{g_i \epsilon_i/KT}$

where  $K$  and  $T$  are Boltzmann's constant and temperature respectively.

64. Which one of the following relationship between canonical partition function  $Q$  containing  $N$  molecules of ideal gas and molecular partition function  $q$  is correct ?

(A)  $Q = \frac{q^N}{N!}$

(B)  $Q = \frac{q^N}{N}$

(C)  $Q = q^N$

(D) All of these

65. What will be the value of molecular translational partition function ( $q$ ) when volume containing oxygen gas at constant temperature is doubled ?

(A)  $q$  becomes half of the original value.

(B)  $q$  becomes double of the original value

(C)  $q$  remains constant

(D) All of the above are correct

66. The number of particles are distributed into different energy states. Select the correct answer from the following :

(A) Bosons > Fermions > Boltzmannons

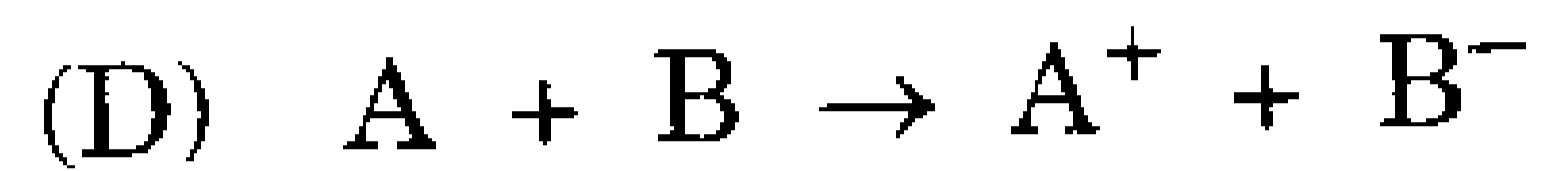
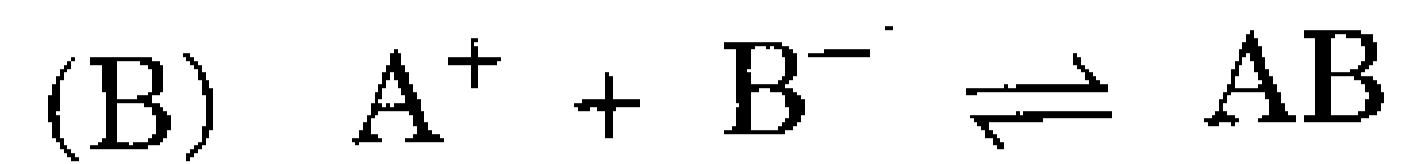
(B) Fermions > Boltzmannons > Bosons

(C) Boltzmannons > Bosons > Fermions

(D) Bosons > Boltzmannons > Fermions

67. In Bose-Einstein statistics, the particles are assumed to be :
- (A) Indistinguishable
- (B) Distinguishable
- (C) Sometimes distinguishable and sometime indistinguishable
- (D) All of the above
68. A large value of equilibrium constant for a reversible reaction shows :
- (A) small production of products
- (B) at equilibrium, large reactant remains
- (C) at equilibrium, small reactant remains
- (D) reaction goes to completion
69. The equilibrium constant,  $K$  for the reaction  $\text{N}_2 + \text{O}_2 \rightleftharpoons 2\text{NO}$  is given by :
- (A)  $K = [\text{N}_2] [\text{O}_2]/[\text{NO}]$
- (B)  $K = [\text{N}_2] [\text{O}_2] [\text{NO}]^2$
- (C)  $K = [\text{NO}]/[\text{N}_2] [\text{O}_2]$
- (D)  $K = [\text{NO}]^2/[\text{N}_2] [\text{O}_2]$
70. The equilibrium constants in terms of concentration,  $K_c$  and in terms of partial pressure,  $K_p$  are related as :
- (A)  $K_c = K_p \cdot (RT)^{\Delta n}$
- (B)  $K_c = K_p (RT)^{-\Delta n}$
- (C)  $K_c = K_p \cdot RT$
- (D)  $K_c = K_p \cdot (RT)^{-1}$

71. A sparingly soluble substance ionises in solution. Equilibrium constant  $K$  is given for ionisation reaction as  $K = [A^+] [B^-]$ . Find out the ionisation reaction from the following :



72. Which one of the following factors will increase the formation of  $Fe_2O_3$  at equilibrium from the reaction :



(A) Removing Fe

(B) Removing  $H_2(g)$

(C) Removing  $H_2O(g)$

(D) All of these

73. Relaxation effect in strong electrolyte solution at higher concentration :

(A) increases the conductance

(B) does not change the conductance

(C) decreases the conductance

(D) all of the above

74. The equivalent conductance at lower concentration of an electrolyte is :

(A) lower

(B) higher

(C) does not change

(D) all of these

75. At which electrode of a galvanic cell, the following reaction occur :



- (A) at cathode with positive polarity
- (B) at cathode with negative polarity
- (C) at anode with negative polarity
- (D) at anode with positive polarity

76. The anode of a galvanic cell bears :

- (A) positive charge
- (B) negative charge
- (C) sometime positive, sometime negative
- (D) No charge

77. The half cell potential, E where reaction  $\text{Zn} \rightarrow \text{Zn}^{2+} + 2e$  occurs at temperature T is :

- (A)  $E = E^\circ - 2.303 RT \log [\text{Zn}^{2+}]$
- (B)  $E = E^\circ + 2.303 RT \log [\text{Zn}^{2+}]$
- (C)  $E = E^\circ + \frac{2.303 RT}{2F} \log [\text{Zn}^{2+}]$
- (D)  $E = E^\circ - \frac{2.303 RT}{2F} \log [\text{Zn}^{2+}]$



82. The rate law for a reaction is  $\frac{dx}{dt} = k[P]^0 [Q] [R]^2$

The overall order of the reaction is :

- (A) 0 (B) 2  
(C) 3 (D) All of these

83. Which of the following rate laws has an overall order of 0.25 for the reaction having reactants A, B and C ?

- (A) rate =  $k. [A]^{1.5} [B]^{-0.5} [C]^{-0.75}$   
(B) rate =  $k. [A]^{2.2} [B]^{1.3} [C]^{-2.5}$   
(C) rate =  $k. [A]^{1.5} [B]^{-1} [C]^{-0.75}$   
(D) rate =  $k. [A]^{1.5} [B]^{0.5} [C]^{-1.5}$

84. For a chemical reaction  $A \rightarrow B$  the rate of reaction is tripled when the concentration of A is increased nine times. The order of reaction is :

- (A) 9 (B)  $\frac{1}{2}$   
(C) 3 (D)  $\frac{1}{4}$

85. The energy at transition state is :

- (A) minimum (B) equal to that of reactant  
(C) equal to that of product (D) maximum

86. Which of the following catalyses the reaction of conversion of glucose into ethanol ?
- (A) Urease (B) Zymase  
(C) Invertase (D) Maltase
87. If dilute AgCl sol is prepared by adding AgNO<sub>3</sub> solution into excess of KCl solution, it bears :
- (A) Negative charge  
(B) Positive charge  
(C) No charge  
(D) Negative as well as positive charge
88. The number average and weight average molecular weights for a macromolecule are  $\bar{M}_n$  and  $\bar{M}_w$ . Which one of the following relation between the two is *correct* ?
- (A)  $\bar{M}_w = \bar{M}_n$  (B)  $\bar{M}_w < \bar{M}_n$   
(C)  $\bar{M}_w > \bar{M}_n$  (D)  $\bar{M}_w = 2\bar{M}_n$
89. Gold number of hydrophilic colloids  $p$ ,  $q$ ,  $r$  and  $s$  are given below.  
 $p = 0.025$ ,  $q = 0.250$ ,  $r = 2.500$ ,  $s = 25.000$
- Select the *correct* order of their protective powers :
- (A)  $r > q > p > s$  (B)  $q > r > s > p$   
(C)  $s > r > q > p$  (D)  $p > q > r > s$



90. If  $w$  is the mass of the gas adsorbed on given mass  $m$  of adsorbent of a pressure  $p$ , the Freundlich adsorption isotherm is given as :

$$(A) \quad \ln \frac{m}{w} = \ln k + n \ln p$$

$$(B) \quad \ln \frac{w}{m} = \ln k + \frac{1}{n} \ln p$$

$$(C) \quad \ln \frac{w}{m} = \ln k + n \ln p$$

$$(D) \quad \ln \frac{m}{w} = \ln k - \frac{1}{n} \ln p$$

where  $k$  and  $n$  are constants.

91. What is the *correct* point group of the allene molecule ?

$$(A) \quad C_{2v}$$

$$(B) \quad S_4$$

$$(C) \quad D_{2d}$$

$$(D) \quad D_{2h}$$

92. Identify the matrix representation of the  $\sigma_{xz}$  plane :

$$(A) \quad \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$$

$$(B) \quad \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$(C) \quad \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$$(D) \quad \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

93. The character table for  $C_{2v}$  point group is given below. Identify  $B_1$  irreducible representation.

$C_{2v}$	E	$C_2$	$\sigma_{xz}$	$\sigma_{yz}$
(A)	1	1	1	1
(B)	1	1	-1	-1
(C)	1	-1	1	-1
(D)	1	-1	-1	1

94. Which of the following molecules belongs to  $C_{3v}$  point group ?

(A) $BH_3$	(B) $CO_3^{2-}$
(C) $ClF_3$	(D) $NH_3$

95. X-ray diffraction cannot measure minimum interplanar distance which is :

- (A) less than half of the wavelength of X-ray  
 (B) greater than half of the wavelength of X-ray  
 (C) equal to four times wavelength of X-ray  
 (D) all of the above

96. Consider the following statements :

**Assertion (a) :** First group elements of periodic table react with halogens to form their halide.

**Reason (r) :** Elements of both groups have similar electronic configuration.

Select the *correct* answer from the following answer codes :

- (A) (a) is wrong and (r) is true  
 (B) (a) is true and (r) is false  
 (C) (a) and (r) both are true  
 (D) (a) and (r) both are false

97. Which one of the following show the *correct* order of the acidity ?
- (A)  $\text{CO}_2 < \text{SiO}_2 < \text{SnO}_2 < \text{PbO}_2$   
 (B)  $\text{SiO}_2 < \text{SnO}_2 < \text{PbO}_2 < \text{CO}_2$   
 (C)  $\text{PbO}_2 > \text{SnO}_2 > \text{SiO}_2 < \text{CO}_2$   
 (D)  $\text{CO}_2 > \text{SiO}_2 > \text{SnO}_2 > \text{PbO}_2$
98. Which one of the following has octahedral shape ?
- (A)  $\text{SF}_4$  (B)  $\text{XeF}_2$   
 (C)  $\text{SF}_6$  (D)  $\text{BF}_3$
99. Which one of the following has zero bond order ?
- (A)  $\text{H}_2$  (B)  $\text{He}_2$   
 (C)  $\text{He}_2^+$  (D)  $\text{Li}_2$
100. Consider the given reaction at high temperature :
- $$\text{CaO} + \text{SiO}_2 \rightarrow \text{CaSiO}_3$$
- Which one is acidic on the basis of Lux-Flood definition ?
- (A)  $\text{CaO}$  (B)  $\text{CaSiO}_3$   
 (C)  $\text{SiO}_2$  (D) All of these
101. Which one of the following sets are hard acids ?
- (A)  $\text{Ag}^+, \text{Cd}^{2+}$  (B)  $\text{Br}_2, \text{I}_2$   
 (C)  $\text{BH}_3, \text{GaCl}_3$  (D)  $\text{Li}^+, \text{Na}^+$
102. Which one is crystalline form of Carbon ?
- (A) Coal (B) Charcoal  
 (C) Diamond (D) All of these

103. Consider the following statements :

**Assertion (a)** : Fluorine forms only one oxide,  $F_2O$ .

**Reason (r)** : Fluorine shows variable oxidation states.

Select the *correct* answer from the following answer codes :

- (A) (a) and (r) are false                      (B) (a) and (r) are true  
(C) only (r) is true                              (D) only (a) is true

104. Select the *correct* order of thermal stability of the following hydrides :

- (A)  $LiH > NaH > KH > RbH$               (B)  $NaH > KH > RbH > LiH$   
(C)  $KH > RbH > LiH > NaH$               (D)  $RbH > LiH > NaH > KH$

105. The co-ordination number of Co in compound  $[Co(NH_3)_4Cl_2]Cl$  is :

- (A) 4    (B) 6  
(C) 8    (D) 1

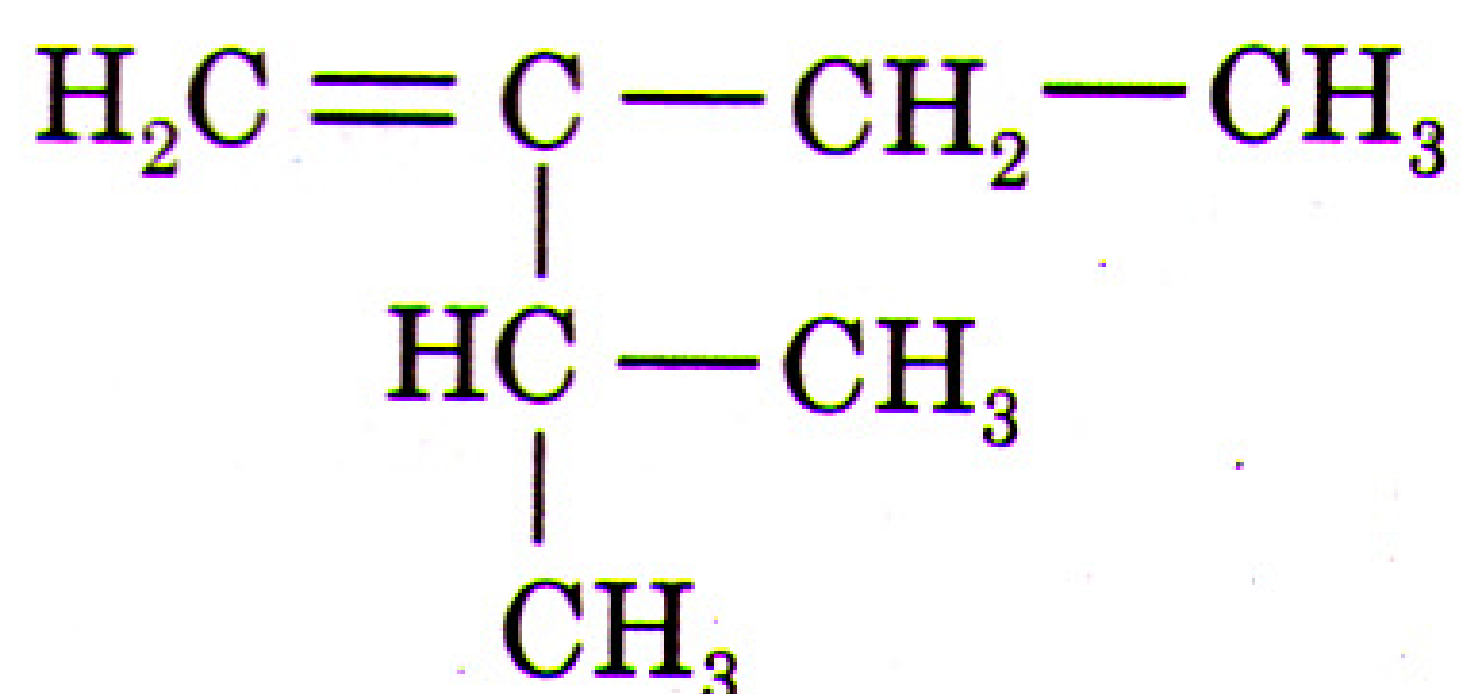
106. In the presence of octahedral ligand field, *d*-orbitals split into two levels. The *eg* levels are at :

- (A) 6  $Dq$  above the average level  
(B) 6  $Dq$  below the average level  
(C) 4  $Dq$  above the average level  
(D) 4  $Dq$  below the average level

107. Co(III) forms complexes I.  $[\text{Co}(\text{NH}_3)_6]^{3+}$  and II.  $[\text{CoF}_6]^{3-}$ . Select the *correct* answer :
- (A) I is paramagnetic and II is diamagnetic  
 (B) I is diamagnetic and II is paramagnetic  
 (C) I and II, both are paramagnetic  
 (D) I and II, both are diamagnetic
108. Elements with  $n$  number of  $f$ -electrons often have similar colour to those with :
- (A)  $14 + n$  electrons (B)  $8 + n$  electrons  
 (C)  $8 - n$  electrons (D)  $14 - n$  electrons
109. Which one of the following is paramagnetic ?
- (A)  $\text{La}^{3+}$  (B)  $\text{Lu}^{3+}$   
 (C)  $\text{Gd}^{3+}$  (D)  $\text{Ce}^{4+}$
110. The most common coordination numbers for lanthanides are :
- (A) above 7 (B) only 7  
 (C) less than 7 (D) only 4 and 6
111. Consider the following statements :
- Assertion (a)** : Grignard reagent is an organometallic compound.  
**Reason (r)** : It contains one organic compound.
- Select the *correct* answer from the following answer codes.
- (A) (a) and (r) both are correct (B) (a) is true and (r) is false  
 (C) both (a) and (r) are false (D) (a) is false and (r) is true

112. The chemical reactivity of organometallic compounds of Be, Mg, Ca, Sr and Ba follow the order :
- (A)  $\text{Be} > \text{Mg} > \text{Ca} > \text{Sr} > \text{Ba}$       (B)  $\text{Be} = \text{Mg} = \text{Ca} = \text{Sr} = \text{Ba}$   
(C)  $\text{Be} < \text{Mg} < \text{Ca} < \text{Sr} < \text{Ba}$       (D)  $\text{Be} < \text{Ba} < \text{Ca} < \text{Mg} < \text{Sr}$
113. The white phosphorus molecule has the following structure :
- (A) Cage structure  
(B) Both, cage and linear structure  
(C) Linear structure  
(D) All of the above
114. The cluster of metal atoms are more likely among metals that have :
- (A) low energy of atomisation  
(B) large electronegativity  
(C) large electronegativity and low melting point  
(D) large energy of atomisation
115. Myoglobin contains :
- (A) Cu (I)      (B) Fe (I)  
(C) Fe (II)      (D) Cu (II)
116. Which one of the following is *correct* for vitamin B<sub>12</sub> ?
- (A) Absence of cyanide ion  
(B) Molecule is formed around a corrin ring containing Co (III) atom  
(C) It does not contain corrin ring  
(D) All of the above are correct

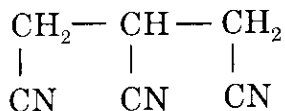
117. The active enzyme in nitrogen fixation is :
- (A) Zymase (B) Invertase  
(C) Nitrogenase (D) Oxygenase
118. Which of the following is produced by nuclear reaction between  ${}_6\text{C}^{12}$  and protons ?
- (A)  ${}_6\text{C}^{11}$  (B)  ${}_6\text{C}^{13}$   
(C)  ${}_7\text{N}^{14}$  (D)  ${}_7\text{N}^{13}$
119. Mössbauer spectroscopy involve nuclear transitions on absorption by sample of :
- (A)  $\gamma$ -rays (B) visible rays  
(C) violet rays (D) all of these
120. The EPR spectrum of  $\text{IrCl}_6^{2-}$ , due to splitting of iridium nucleus consists of :
- (A) doublet of peaks (B) quartet of peaks  
(C) triplet of peaks (D) all of these
121. The IUPAC name of the following compound



is :

- (A) 2-isopropyl butene-1 (B) 2-ethyl-3-methyl butene-1  
(C) ethyl isopropyl ethene (D) 2-methyl-3-ethyl butene-3

122. The *correct* IUPAC name of the following compound

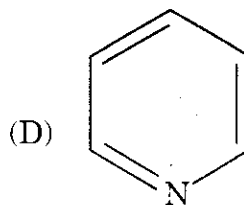
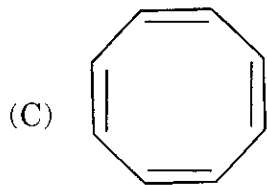
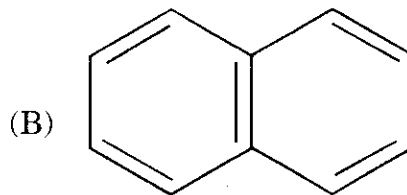
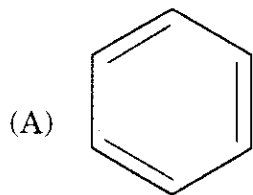


is :

- (A) 1, 2, 3-tricyanopropane  
 (B) 1, 2, 3-propane nitrile  
 (C) 3-cyanopentane-1, 5-dinitrile  
 (D) Propane nitrile
123. Which one will have least hindered rotation about carbon-carbon bond ?
- (A) Ethylene  
 (B) Ethyne  
 (C) Hexachloroethane  
 (D) Ethane
124. Stereoisomers, that are not mirror image of each other are :
- (A) Diastereomers  
 (B) Enantiomer  
 (C) Racemic mixture  
 (D) Meso form
125. Nitration of benzene with a mixture of concentrated nitric acid and sulphuric acid involve active species as :
- (A) nitronium ion  
 (B) nitrile ion  
 (C) nitrate ion  
 (D) Azide ion
126. Which one of the following is an electrophile ?
- (A)  $\text{OH}^-$   
 (B)  $\text{NO}_2^+$   
 (C)  $\text{H}_2\text{O}$   
 (D) All of these



127. Which one of the following is *not* aromatic ?



128. How many  $\pi$ -electrons are present in Pyrrole ?

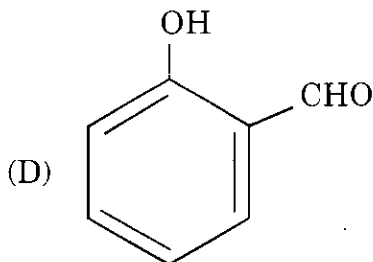
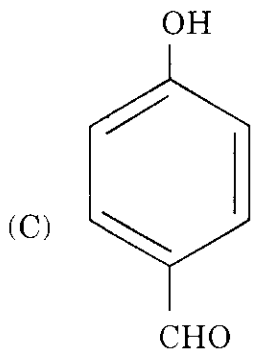
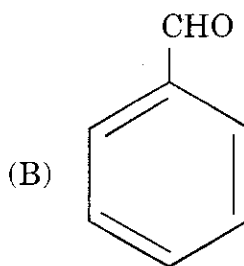
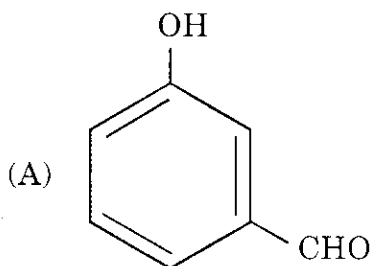
(A) 6

(B) 4

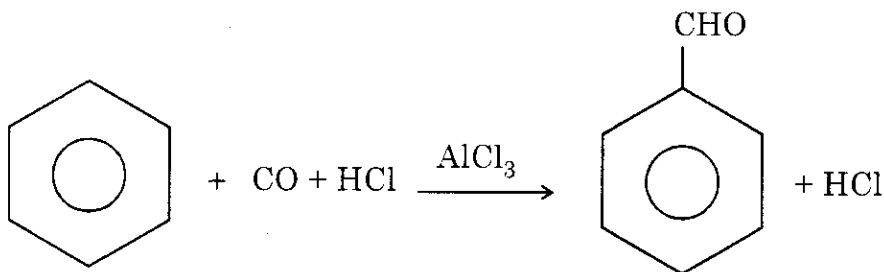
(C) 2

(D) all of these

129. When phenol is treated with aqueous sodium hydroxide with chloroform followed by acid hydrolysis, the compound formed is :



130. Consider the following reaction :



The reaction is called as :

- (A) Gattermann-Koch reaction      (B) Friedel-Crafts reaction  
 (C) Wurtz reaction      (D) Mannich reaction

131. Primary ( $A1^\circ$ ), secondary ( $A2^\circ$ ) and tertiary ( $A3^\circ$ ) free radicals are formed by abstraction of H-atom from alkane. The ease of formation follow the order :

- (A)  $A1^\circ > A2^\circ > A3^\circ$       (B)  $A2^\circ > A3^\circ > A1^\circ$   
 (C)  $A3^\circ > A2^\circ > A1^\circ$       (D) All of these

132. Select the *correct* pyridine alkaloid :

- (A) Quinine      (B) Nicotine  
 (C) Gramine      (D) All of these

133. Which one is the *correct* order of acidity in the following compounds ?  
 Butanoic acid (I), 2-chlorobutanoic acid (II), 3-chlorobutanoic acid (III).

- (A)  $\text{III} < \text{II} < \text{I}$       (B)  $\text{II} < \text{I} < \text{III}$   
 (C)  $\text{I} < \text{II} < \text{III}$       (D)  $\text{I} < \text{III} < \text{II}$

134. Consider the following statements :

**Assertion (a) :** Benzyl carbanion is more stable than propyl carbanion.

**Reason (r) :** Propyl carbanion is not stabilised by resonance.

Select the *correct* answer from the following answer codes :

(A) Both (a) and (r) are correct

(B) Both (a) and (r) are false

(C) (a) is false but (r) is true

(D) (a) is true but (r) is false

135. In a rearrangement reaction the product formed is always :

(A) Optical isomer

(B) Structural isomer

(C) Stereoisomer

(D) Geometrical isomer

of the original compound.

136. Which one of the following gives a tertiary alcohol when treated with Grignard reagents ?

(A) H—CHO

(B)  $\text{H}_3\text{C—CO—CH}_3$

(C)  $\text{H}_3\text{C—CHO}$

(D) All of these

137. 4-ethyl-3-hexanone reacts with ethyl magnesium bromide to give a product which on hydrolysis yields an alcohol which undergoes dehydration with concentrated sulphuric acid to form P. Ozonolysis of P gives 3-pentanone as the only product. What is P ?

(A) 3, 4 diethyl hex-3-ene

(B) 4, 4-dimethyl hex-2-ene

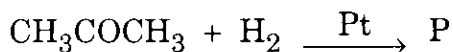
(C) 3, 4-diethyl hexan-3-ol

(D) All of these

138. When ethylene glycol is oxidised with per iodie acid, it gives :

- (A) Formic acid (B) Acetic acid  
(C) Formaldehyde (D) Acetaldehyde

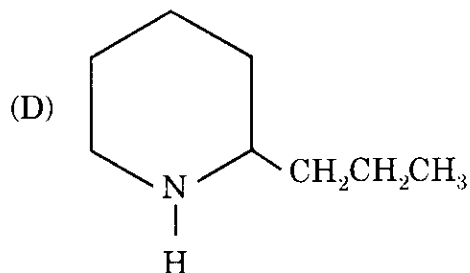
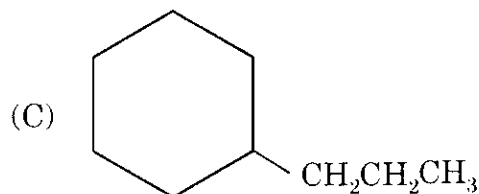
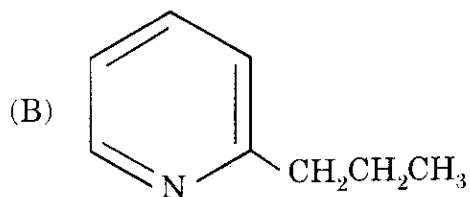
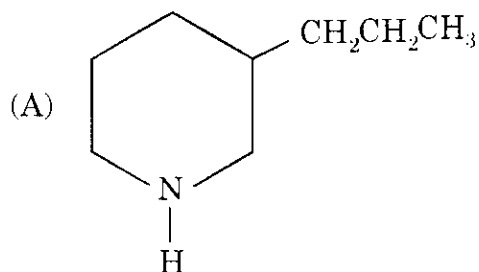
139. Consider the reaction :



The compound P is :

- (A) Propan-1-ol (B) Propanal  
(C) Propan-2-ol (D) All of these

140. The *correct* formula for coniine alkaloid is :



141. Which one of the following is suitably matched ?

- (A) Monoterpene — Two isoprene unit
- (B) Sesquiterpene— One isoprene unit
- (C) Triterpene — Three isoprene unit
- (D) Diterpene — Six isoprene unit

142. Which one of the following statements is *correct* ?

- (A) Estrogen is a male sex hormone
- (B) Estrone has a phenolic group
- (C) Estrone is not a steroid
- (D) Estrone has no  $\text{>C}=\text{O}$  group

attached to a six membered ring.

143. When thiophene is treated with conc. sulphuric acid, the principal product is :

- (A) 3-thiophene sulphate
- (B) 4-thiophene sulphonic acid
- (C) 3-thiophene sulphonic acid
- (D) 2-thiophene sulphonic acid

144. Propylene polymerises to produce polypropylene. Which one of the following is suitably matched ?
- (A) Isotactic — Methyl groups on both side of extended chain
  - (B) Syndiotactic — Methyl groups on one side of the extended chain
  - (C) Atactic — Methyl groups are randomly distributed
  - (D) Peritactic — Contains one methyl group
145. Nicotinamide adenine dinucleotide (NAD) is :
- (A) a reducing agent
  - (B) a coenzyme
  - (C) also known as alcohol dehydrogenase
  - (D) all of the above
146. Nanoparticles of metal oxide is a good adsorbent due to :
- (A) small size
  - (B) high density
  - (C) high surface area
  - (D) small surface area

147. Photosynthetic combination of carbon dioxide and water in the presence of chlorophyll is :
- (A) an exothermic process                      (B) an enzymatic process
- (C) an endothermic process                      (D) all of these
148. Materials made up of carbon nanotubes are :
- (A) Extremely light                                  (B) Extremely heavy
- (C) Extremely weak                                  (D) All of these
149. The DNA sequencing is written by the use of the following four letters.
- (A) A, B, C, D    (B) A, C, D, E
- (C) A, G, T, C    (D) A, G, H, I
150. Tetracycline exists in blood plasma as complexes of metals. Select the *correct* metals from the following :
- (A) Lithium only    (B) Rubidium and manganese
- (C) Sodium only    (D) Calcium and magnesium