CHEMISTRY

1. Reaction of $NaBH_4$ with $BF_3.O(C_2H_5)_2$ in diglyme at room temperature produces mainly
   (a) H_2
   (b) B_2H_6
   (c) $B_2H_3F_3$
   (d) $(CH_3OCH_2CH_2)_2O$

2. P_4O_{10} on reacting with water does **not** form
   (a) Tetra metaphosphoric acid
   (b) Phosphorus acid
   (c) Orthophosphoric acid
   (d) Pyrophosphoric acid

3. The pair of compounds containing peroxy (-O-O-) group is
   (a) H_2SO_3 and PbO_2
   (b) $HClO_4$ and $H_2S_2O_7$
   (c) P_2O_5 and MnO_2
   (d) H_2SO_5 and $H_2S_2O_8$

4. Which of the following is para magnetic?
   (a) $Cr(CO)_6$
   (b) $Fe(CO)_5$
   (c) $Ni(CO)_4$
   (d) $V(CO)_6$

5. A mixture of NaCl, NaBr and $K_2Cr_2O_7$ on heating with conc. H_2SO_4 produces redish brown vapours consisting of
   (a) $CrO_2Cl_2 + Br_2$
   (b) $CrO_2Cl_2 + CrO_2Br_2$
   (c) $CrO_3 + CrO_2Br_2$
   (d) $Br_2 + Cl_2O$

6. Among the following complex ions, the species containing Fe^{3+} in strongest ligand field is
   (a) $[Fe(CN)_6]^{3-}$
   (b) $[Fe(H_2O)_6]^{3+}$
   (c) $[Fe(F)_6]^{3-}$
   (d) $[Fe(NH_3)_6]^{3+}$

7. In the electrolytic purification of crude aluminium, the addition of fused cryolite and fluorspar to Al_2O_3 causes
   (a) Easy reduction of alumina to the metal
   (b) Lowering of the fusion temperature of Al_2O_3
   (c) Easy removal of the accumulated aluminium on the cell floor in the molten condition
   (d) Increase of the specific gravity of the electrolyte

8. During the extraction of iron from hematite, limestone is added to the blast furnance to
   (a) remove silica as slag
   (b) remove silica as gangue
   (c) reduce hematite
   (d) oxidize coke to carbon monoxide

9. Match the List-I (Metal) with List-II (Process of Extraction) and select the correct answer using the codes given below the lsits:

List-I (Metal)	List-II (Process of Extraction)
A. Aluminium	1. Blast furnace
B. Iron	2. Mond process
C. Nickel	3. Van Arkel process
D. Copper	4. Cyanide process
	5. Froth floatation

Code:

	A	B	C	D
(a)	4	5	3	2
(b)	5	1	2	3
(c)	A	B	C	D
	2	1	4	5
(d)	A	B	C	D
	3	5	2	1

10. Which one of the following high-spin complexes has the largest CFSE (Crystal field stabilization energy)?
    (a) $[Mn(H_2O)_6]^{2+}$
    (b) $[Cr(H_2O)_6]^{2+}$
    (c) $[Mn(H_2O)_6]^{3+}$
    (d) $[Cr(H_2O)_6]^{3+}$

11. Target nucleus A is converted to product nucleus B by (p, n) reaction: A(p, n) B.
    In this case
    (a) A and B are isotopes
    (b) A and B are isobars
    (c) A and B are isotones
    (d) A has higher atomic number than that of B

12. How many α–particles and β–particles are emitted in passing from $_{90}Th^{232}$ to $_{82}Pb^{208}$?
    (a) 4 α, 4β (b) 4 α, 6β
    (c) 6 α, 4β (d) 6 α, 6β

13. Which one of the following is a correct representation of tetraammine copper(II) hexacyanoferrate(III)?
    (a) $[Cu(NH_3)_6][Fe(CN)_6]$
    (b) $[Cu(NH_3)_4]_3[Fe(CN)_6]$
    (c) $[Cu(NH_3)_4][Fe(CN)_6]_2$
    (d) $[Cu(NH_3)_4]_3[Fe(CN)_6]_2$

14. The complex compound used in the chemotherapy of cancer is
    (a) cis – $[Pt^{IV}(NH_3)_4Cl_2]Cl_2$
    (b) cis – $[Pt^{IV}(NH_3)_2Cl_4]$
    (c) cis – $[Pt^{II}(NH_3)_2Cl_2]$
    (d) trans - $[Pt^{II}(NH_3)_2Cl_2]$

15. An example of a hexadentate ligand is
    (a) 2, 2'-bipyridyl
    (b) ethylene diaminetetraacetate ion
    (c) dimethyl glyoxime
    (d) iminodiacetate ion

16. Haemoglobin, a complex containing iron is a constitutent of blood. The oxidation state of iron in the complex is
    (a) Zero (b) +1
    (c) +2 (d) +3

17. The compound with zero dipole moment is
    (a) cis–2 butene
    (b) trans-2 butene
    (c) but-1-ene
    (d) 2-methyl-1-propene

18. Consider the following statements about intermolecular and intramolecular hydrogen bonds:
    1. Both types of H-bonds are temperature-dependent
    2. Intramolecular H-bond disappears on increasing the concentration
    3. Intramolecular H-bond disappears on decreasing the concentration
    4. The boiling points of compound having intramolecular H-bond are lower than that of those compounds which have intermolecular H-bond

    Which of the statements given

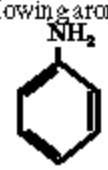
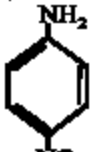
above are correct?
(a) 1, 2 and 4 (b) 3 and 4
(c) 1, 3 and 4 (d) 1 and 2

19. The bond dissociation energies (ΔH) of three alkyl halides are as follows:
CH_3Cl : 84 kcal/mol
$CH_2=CHCl$: 207 kcal/mol
$C_6H_5-CH_2Cl$: 166 kcal/mol
The cleavage of the C-Cl bond in the halide with least ΔH produces
(a) Two free radicals
(b) Two cations
(c) Two anions
(d) One cation and one anion

20. The electrophilic centre(s) in the molecule

$\overset{1}{CH_2}=\overset{2}{CH}-\overset{3}{CO}-\overset{4}{CH_3}$ is /are
(a) C_3 only (b) C_1 and C_3
(c) C_1 and C_2 (d) C_2 and C_4

21. Consider the basicity of the following aromatic amines:

1. 
2. 
3. 
4. 

Which one of the following represents the correct increasing order of the basicity of the above amines?
(a) 2 < 1 < 4 < 3 (b) 1 < 2 < 3 < 4
(c) 4 < 3 < 1 < 2 (d) 2 < 3 < 4 < 1

22. Match List-I (Compound) with List-II (C-C Bond Length in Å) and select the correct answer using the codes given below the lists:

List-I (Compound)	List-II (C-C Bond Length in Å)
A. Ethane	1. 1.20
B. Ethylene	2. 1.40
C. Acetylene	3. 1.54
D. Benzene	4. 1.33

Codes:

	A	B	C	D
(a)	2	1	4	3
(b)	3	4	1	2
(c)	2	4	1	3
(d)	3	1	4	2

23. Which one of the following reactions does **not** involve carbocation intermediacy?

(a) $(CH_3)_3CBr + OH \longrightarrow (CH_3)_3C-OH$

(b) $(CH_3)_3COH \xrightarrow[85-90^\circ C]{20\%\ H_2SO_4} (CH_3)_2C=CH_2$

(c) $(CH_3)_3CCH_2Br \xrightarrow{EtOH} (CH_3)_2C=CHCH_3$

(d) $2CH_3CHO \xrightarrow{OH^-} CH_3CH(OH)-CH_2-CHO$

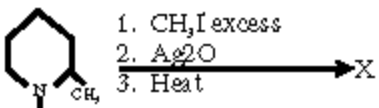
24. The boiling points of three isomeric pentanes-1, 2, and 3 are:
1. 9.5°C 2. 28°C
3. 36°C
1, 2 and 3 are respectively
(a) n-pentane, isopentane, neopentane
(b) isopentane, neopentane, n-pentane
(c) n-pentane, neopentane, isopentane
(d) neopentane, isopentane, n-pentane

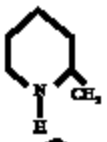
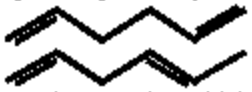
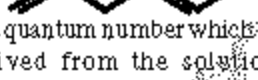
25. Addition of Br_2 to cis-2-butene yields
(a) meso-2, 3-Dibromobutane
(b) (±) 2, 3-Dibromobutane
(c) (+) 2, 3-Dibromobutane
(d) (-) 2, 3-Dibromobutane

26. Anti-Markownikoff's addition of HBr is not observed in
(a) Propene (b) 1-Butene
(c) 2-Butene (d) 2-Pentene

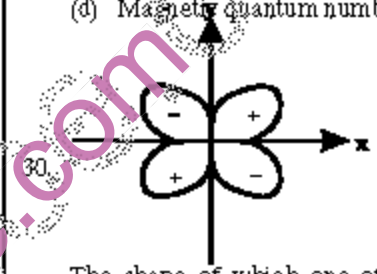
27. Polymerization using Ziegler-Natta catalysts is advantageous over free radical polymerization because
(a) it can lead to living polymers via anionic polymerization
(b) it permits step-reaction polymerization resulting in a highly cross-linked polymer
(c) it gives highly branched polymer with a high degree of crystallinity
(d) it gives linear polymer molecules permitting stereochemical control

28. In the reaction



the final product X is
(a) 
(b) 
(c) 
(d) 

29. The quantum number which is not derived from the solution of Schrodinger wave equation for hydrogen atom is
(a) Azimuthal quantum number
(b) Principal quantum number
(c) Spin quantum number
(d) Magnetic quantum number

30. 

The shape of which one of the orbitals corresponds to the angular wave function shown in the figure given above?
(a) $d_{x^2-y^2}$ (b) d_{xy}
(d) P_y (d) P_x

31. The 'd' orbital which has the maximum electronic probability density lying along two axes is known as
(a) $d_{x^2-y^2}$ (d) d_{z^2}
(d) d_{xy} (d) d_{xz}

32. Which one of the following pairs of species (atoms/ions) will have identical ground state electronic configuration?
(a) Li^+ and He^- (b) Cl^- and Ar
(c) Na and K (d) F^+ and Ne

33. Match the List-I (Atomic Number of Element) with List-II (Block to Which of the Element Belongs) and select the correct answer using the cosdes given below the lists:

List-I (Atomic Number of Element)	List-II (Block to Which the Element Belongs)
A. 24	1. p
B. 38	2. f
C. 49	3. s
D. 59	4. d

Codes:

	A	B	C	D
(a)				

	2	1	3	4
(b)	A	B	C	D
	4	3	1	2
(c)	A	B	C	D
	2	3	1	4
(d)	A	B	C	D
	4	1	3	2

34. The number of σ and π bonds between two carbon atoms in CaC_2 is
(a) Three σ bonds and no π bonds
(b) Two π bonds and one σ bond
(c) Two σ bonds and one π bond
(d) One π bond and one σ bond

35. The ionic radii of K^+, Ca^{2+}, Cl^- and S^{2-} ions decrease in the order
(a) $Cl^- > S^{2-} > K^+ > Ca^{2+}$
(b) $K^+ > Ca^{2+} > Cl^- > S^{2-}$
(c) $S^{2-} > Cl^- > K^+ > Ca^{2+}$
(d) $Ca^{2+} > K^+ > Cl^- > S^{2-}$

36. The bonds found in the structural formula of carbon dioxide are
(a) O $\overset{\sigma}{=}$ C $\overset{\sigma}{=}$ O
(b) O $\overset{\sigma}{=}$ C $\overset{\sigma}{=}$ O
(c) O $\overset{\pi}{=}$ C $\overset{\pi}{=}$ O
(d) O $\overset{\sigma}{=}$ C $\overset{\pi}{=}$ O

37. Match List-I (Name of the Compound) with List-II (Structure/Geometry of the Molecule) and select the correct answer using the codes given below the lists:

List-I (Name of the Compounds)	List-II (Structure/Geometry of the Molecule)
A. Chlorine trifluoride	1. Triangular planar
B. Boron trifluoride	2. Triangular pyramidal
C. Nitrogen Trifluoride	3. T-shaped
D. Sulphur hexafluoride	4. Regular octahedral

Codes:

(a)	A	B	C	D
	2	1	3	4
(b)	A	B	C	D
	3	4	2	1
(c)	A	B	C	D
	2	4	3	1
(d)	A	B	C	D
	3	1	2	4

38. Among the following species, the one having the highest bond strength is
(a) O_2 (b) O_2^+
(c) O_2^- (d) O_2^{2-}

39. Match List-I (Molecule or Ion) with List-II (Hybridisation of the Central Atom in the Molecule) and select the correct answer using the codes given below the lists:

List-I (Molecule or Ion)	List-II (Hybridisation of the Central Atom in the Molecules)
A. XeF_4	1. dsp^2
B. H_2O	2. sp^3
C. PCl_5	3. sp^3d^2
D. $[Pt(NH_3)_4]^{2+}$	4. sp^3d

Codes:

(a)	A	B	C	D
	3	2	4	1
(b)	A	B	C	D
	1	4	2	3
(c)	A	B	C	D
	3	4	2	1
(d)	A	B	C	D
	1	2	4	3

40. Which one of the following is the redox reaction?
(a) $Pb(CH_3COO)_2 + Na_2CrO_4 \rightarrow PbCrO_4\downarrow + 2CH_3COONa$
(b) $Fe + 2HCl \rightarrow FeCl_2 + H_2\uparrow$
(c) $BaCl_2 + H_2SO_4 \rightarrow BaSO_4\downarrow + 2HCl$
(d) $Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$

41. In the reaction:
$HNO_3 + I_2 \rightarrow HIO_3 + NO_2 + H_2O$
Stoichiometric number of moles of HNO_3 and I_2 reacting will respectively, be
(a) 10 and 1 (b) 10 and 2
(c) 1 and 1 (d) 1 and 2

42. Chlorine gas reacts with aqueous KOH solution as per chemical equation:
$3Cl_2 + 6KOH \rightarrow 5KCl + KClO_3 + 3H_2O$
The reaction is an example of
(a) Neutralization reaction
(b) Substitution reaction
(c) Double decomposition reaction
(d) Disproportionation reaction

43. The number of faradays (F) of electricity required to convert one mole of MnO_4^- to one mole of Mn^{2+} ion is
(a) 4 (b) 5
(c) 6 (d) 7

44. HCN behaves as a very weak acid in aqueous medium whereas it acts as a strong acid in liquid ammonia because
(a) Electro negativity of oxygen is greater than that of nitrogen
(b) Ionization energy of oxygen is less than that of nitrogen
(c) Proton affinity of water is less than that of ammonia
(d) Dipole moment of water is greater than that of ammonia

45. The ratio ortho hydrogen: para hydrogen
(a) decreases with the increase of temperature
(b) increases with the increase of temperature
(c) is independent of temperature
(d) is highest at 100°C and then decreases

46. Which one among the following has the highest catenation power?
(a) O (b) S
(c) Se (d) Te

47. K, KO_2, Ca, CaH_2, Na, Na_2O_2, Li and Li_2O react with water.
Which of the following substances yield the same gaseous product?
(a) K and KO_2
(b) Ca and CaH_2
(c) Na and Na_2O_2
(d) Li and Li_2 and Li_2O

48. Consider the following compounds:
1. K_2CO_3 2. $MgCO_3$
3. $CaCO_3$ 4. $BeCO_3$
Which one of the following arrangements in the increasing order of their thermal stabilities is correct?
(a) 1<2<3<4 (b) 2<4<3<1
(c) 3<2<1<4 (d) 4<2<3<1

49. A solution of sodium in liquid ammonia is blue due to the presence of
(a) Sodium amide
(b) Solvated sodium atoms
(c) Solvated sodium ions
(d) Solvated electrons

50. The enthalpy of formation of CO_2 and H_2O are –395 kJ and –285 kJ

respectively and the enthalpy of combustion of acetic acid is -869 kJ. The enthalpy of formation of acetic acid is

(a) 235 kJ (b) 340 kJ
(c) 420 kJ (d) 491 kJ

51. In the case of neutralisation of weak acid with weak base in aqueous medium, the enthalpy of neutralization is low, because
(a) the reaction is slow
(b) the electrolytes are partially ionized
(c) a part of the energy evolved is utilized in the dissociation of the electrolytes
(d) the ions are solvated and hence more energy is required for effective collision

52. When hydrogen gas is subjected to Joule-Thomson effect at room temperature, it gets heated up instead of being cooled, because
(a) hydrogen is the lightest gas and hence can not be cooled
(b) in hydrogen, the van der Waals' force of attraction is small
(c) it is a real gas and hence behaves abnormally
(d) its Joule-Thomson coefficient is less than zero at room temperature

53. The Joule-Thomson experiment is an example of which of the following proceses?
1. Isothermal process
2. Isenthalpic process
3. Adiabatic process
4. Isochoric process

Select the correct answer using the codes given below:
(a) 1 and 2 (b) 2 and 3
(c) 1 and 4 (d) 2 and 4

54. The following equation represents the oxidation of glucose:

$$C_6H_{12}O_6(s)+6O_2(g)\longrightarrow 6CO_2(g)+6H_2O(l)$$

Following data is given :

Substance	ΔG_f° (kcal mol^{-1})
$C_6H_{12}O_6(s)$	–218
$CO_2(g)$	–94
$H_2O(l)$	–57

What is the standard free energy of the reaction, $\Delta G°$?
(a) 67 kcal mol^{-1}
(b) –67 kcal mol^{-1}
(c) –688 kcal mol^{-1}
(d) It can not be calculated, we must have ΔG_f° for $O_2(g)$

55. For which of the following reactions, the entropy change (ΔS) is negative?

1. $C(s)+H_2O(g)\longrightarrow CO(g)+H_2(g)$
2. $N_2(g)+2O_2(g)\longrightarrow 2NO_2(g)$
3. $N_2(g,10atm)\longrightarrow N_2(g,1atm)$
4. $O_2(g,1atm)\longrightarrow O_2(g,10atm)$

Select the correct answer using the codes given below:
(a) 1, 2 and 3 (b) 1 and 4
(c) 2 and 4 (d) 2 and 3

56. If the entropy of vaporization of a liquid is 110 JK^{-1} mol^{-1}, and its enthalpy of vaporization is 50,000 J mol^{-1}, the boiling point of the liquid is
(a) 354.5 K (b) 454.5 K
(c) 554.5 K (d) 654.5 K

57. What is the free energy change ΔG when 1 mol of water converted at 100°C and 1 atmosphere pressure is converted to steam at 100°C and 1 atmospheric pressure in a reversible manner?
(a) –970 cal (b) –26 cal
(c) zero (d) 970 cal

58. Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I	List-II
A. Ionic strength	1. $\frac{1}{2}\sum C_iZ_i^2$
B. Chemcial potential	2. $\left(\frac{\partial G}{\partial n_i}\right)_{T,P,n_j}$
C. Entropy of Mixing	3. $nRT\Sigma x_i \ln x_i$
D. Frre energy of mixing	4. $-nR\Sigma n_i \ln x_i$

Codes:

(a)	A	B	C	D
	3	2	4	1
(b)	A	B	C	D
	1	4	2	3
(c)	A	B	C	D
	3	4	2	1
(d)	A	B	C	D
	1	2	4	3

59. During the course of chemical reaction, the frequency factor A in the Arrhenius equation is direct related to
(a) The entropy change in the reaction
(b) The free energy change in the reaction
(c) The energy of activation in the reaction
(d) Change in entropy and free energy in the reaction

60. The half life for a given reaction was halved as the initial concentration was doubled. What is the order of the reaction?
(a) Zero order (b) First order
(c) Second order
(d) Fractional order

61. Consider the following statements:
An increase in the rate of a reaction for rise in temperature is due to
1. the increase in the number of collisions
2. the shortening of the mean free path
3. the increase in the number of activated molecules
4. the increase in pressure of the system.

Which of the statements given above are correct?
(a) 1 and 2 (b) 2 and 3
(c) 1 and 3 (d) 1, 3 and 4

62. A 5.0×10^{-3} molar solution of potassium permanganate has optical density of 1.5 at 680 mμ using a 10 mm cell. Its extinction coefficient is
(a) 0.75 lit mol^{-1} cm^{-1}
(b) 300.00 lit mol^{-1} cm^{-1}
(c) 7.50 lit mol^{-1} cm^{-1}
(d) 30.00 lit mol^{-1} cm^{-1}

63. High quantum yields of photochemical reactions are due to
(a) Lowering of activation energy
(b) high frequency of collision
(c) Accompanying side reactions
(d) Formation of free radicals

64. Consider the following statements:
The role of the catalyst is to
1. reduce the activation energy
2. increase the activation energy
3. increase the rate of attainment of equilibrium
4. decrease the rate of attainment of equilibrium

Which of the statements given above are correct?
(a) 2 and 4 (b) 1 and 4
(c) 1 and 3 (d) 2 and 3

65. The combination of SO_2 and O_2 to give SO_3 is catalyzed by NO. This

catalyst is adversely affected by the presence of a trace amount of As. Therefore, As acts as
(a) Auto catalyst
(b) Negative catalyst
(c) Promoter
(d) Catalytic poison

66. Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I	List-II
A. Stability of colliod	1. Protective efficiency
B. Purification of colloid	2. Peptization
C. Gold number	3. Flocculation
D. Formation of a sol	4. Tyndall effect
	5. Dialysis

Codes:

(a)	A	B	C	D
	3	5	1	2
(b)	A	B	C	D
	1	2	4	5
(c)	A	B	C	D
	3	2	1	5
(d)	A	B	C	D
	1	5	4	2

67. A silver iodide sol has been prepared by adding slight excess of KI solution to $AgNO_3$ solution having the same concentration as that of KI solution. The silver iodide sol particles are
(a) Positively charged
(b) Negatively charged
(c) Neutral
(d) Partially positively charged and partially negatively charged

68. In coagulating a negatively charged lypohobic colloid very little amount of $AlCl_3$ is required in comparison to amount of NaCl required, because
(a) The molecular mass of $AlCl_3$ is more than that of NaCl
(b) The ionic charge of Al^{3+} is three times that of Na^+
(c) Al^{3+} ion is slightly smaller than Na^+ in size
(d) The charge density of Al^{3+} ion is more than that of Na^+

Directions :–

The following 10 (Ten) items consist of two statements: one labelled as the 'Assertion (A)' and the other as 'Reason (R)'. You are to examine these two statements carefully and select the answers to these items using the codes given below:

Codes:
(a) Both A and R are individually true and R is the correct explanation of A
(b) Both A and R are individually true but R is **not** the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

69. **Assertion (A)** : $KMnO_4$ and $K_2Cr_2O_7$ are intensely coloured compounds.
Reason (R) : Transition metal compounds having electrons in d-orbitals are coloured due to d-d transition.

70. **Assertion (A)** : Sodium metal can not be obtained by the electrolysis of its salt in aqueous solution.
Reason (R) : Sodium is above hydrogen in electro-chemical series and it reacts with water to produce sodium hydroxide and hydrogen.

71. **Assertion (A)** : The ligand field theory for complexes is also called adjusted crystal field theory.
Reason (R) : The results of ligand field theory and adjusted crystal field theory are same after adjusting some of the parameters in crystal field theory.

72. **Assertion (A)** : The carbon-halogen bond in an aryl halide is shorter than the carbon-halogen bond in an alkyl halide
Reason (R) : A bond formed of an sp^3 orbital should be shorter than the corresponding bond involving an sp^2 orbital.

73. **Assertion (A)** : In the addition of Grignard reagent to carbonyl compound, the R group of RMgX attacks carbonyl carbon
Reason (R) : The carbon-magnesium bond of the Grignard reagent is highly polar, carbon being negative relative to electropositive magnesium.

74. **Assertion (A)** : Cycloheptatrienyl cation shows unusual stability.
Reason (R) : All unsaturated compounds having $(4n + 2)\pi$ electrons show unusual stability.

75. **Assertion (A)** : Considering van der Waal's equation of state for a real gas $(P+n^2a/V^2)(V-nb)= nRT$; the constant 'a' for O_2 is much less than that for $H_2O(g)$.
Reason (R) : The molar mass of O_2 is almost twice that of H_2O.

76. **Assertion (A)** : When iodine is heated under atmospheric pressure condition, it transforms to vapour without passing through the liquid state.
Reason (R) : If the triple point pressure of a system is high and unless external pressure is applied to exceed the triple-point pressure, sublimation will take place.

77. **Assertion (A)** : The vapour pressure of 0.45 molar urea solution is more than that of 0.45 molar solution of sugar.
Reason (R) : Lowering of vapour pressure is directly proportional to the number of species present in the solution.

78. **Assertion (A)** : For a weak electrolyte, the plot of molar conductivity (Λ_m) against $\sqrt{c}$ (c is concentration in mol lit^{-1}) is nearly linear.
Reason (R) : The molar conductivity at infinite dilution (Λ°_m) for an electrolyte can be considered equal to the sum of the limiting molar conductivities of the individual ions.

79. Consider the following statements about base catalyzed dehydrohalogenation reactions of alkyl halides:
1. They are α-elimination reactions
2. They follow biomolecular elimination mechanism
3. They involve formation of an intermediate carbocation
4. The eliminating groups or atoms must have trans-periplanar geometry

Which of the statements given above are correct?
(a) 1, 3 and 4 (b) 2, 3 and 4
(c) 2 and 3 (d) 2 and 4

80. Match List-I (Reaction) with List-II (Reagent) and select the correct answer using the codes given below the lists:

List-I *(Reaction)*	List-II *(Reagent)*
A. Oppenauer oxidation	1. Peracides
B. Baeyer-Villiger oxidation	2. CrO_2Cl_2
C. Etard reaction	3. Red P+Br_2
D. Hell-Volhardt-Zelinsky reaction	4. Zn/Hg, HCl
	5. Acetone/ Al-isopropoxide

Codes:

(a)	A	B	C	D
	5	1	2	3
(b)	A	B	C	D
	2	3	4	1
(c)	A	B	C	D
	5	3	2	1
(d)	A	B	C	D
	2	1	4	3

81. Match List-I (Reaction) with List-II (Reagent) and select the correct answer using the codes given below the lists:

List-I *(Reaction)*	List-II *(Reagent)*
A. Wolff-Kishner reduction	1. NaCN
B. Wittig reaction	2. $Ph_3P=CH_2$
C. Benzoin condensation	3. Conc. NaOH
D. Cannizzaro reaction	4. N_2H_4/KOH
	5. NaOBr

Codes:

(a)	A	B	C	D
	4	3	1	2
(b)	A	B	C	D
	1	2	5	3
(c)	A	B	C	D
	4	2	1	3
(d)	A	B	C	D
	1	3	5	2

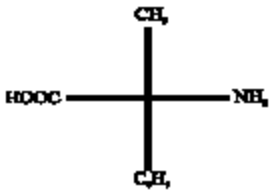
82. Consider the following statements about chirality:
1. Molecules which are not superimposable on their mirror images are achiral
2. A chiral molecule can have simple axis of symmetry
3. a carbon atom of which four different groups are attached is a chiral centre
4. a compound whose molecules are achiral exhibits optical activity

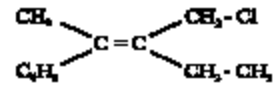
Which of the statements given above are correct?
(a) 1, 2 and 4 (b) 2, 3 and 4
(c) 2 and 3 (d) 1 and 4

83. Consider the following statements about dimethylcyclohexanes:
1. trans-1, 2-dimethylcyclohexane is more stable than the corresponding cis-isomer
2. cis-1, 3-dimethylcyclohexane is an optically inactive meso form
3. trans-1, 3-dimethylcyclohexane is more stable than the corresponding cis-isomer
4. cis-1, 2-dimethylcyclohexane is an unresolvable racemic mixture

Which of the statements given above are correct?
(a) 1, 2 and 3 (b) 1, 2 and 4
(c) 1, 3 and 4 (d) 2 and 4

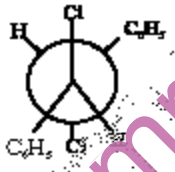
84. Consider the following molecules:

I. 

II. 

Which one of the following represents their correct configurational notation in terms of the Cahn-Prelog-Ingold system?

	I	II
(a)	R	S
(b)	S	E
(c)	R	Z
(d)	S	Z

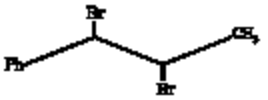
85. 

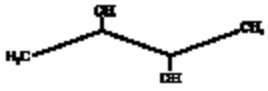
A.

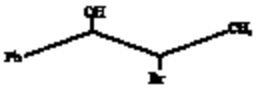
B.

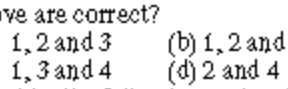
Which one of the following statements regarding the projections shown above (A and B) is correct?
(a) Both the projections represent the same configuration
(b) Both A and B are optically active
(c) Only A is optically active
(d) Only B is optically active

86. Which of the following compounds can be represented as threo and erythro isomers?

1. 

2. 

3. 

4. 

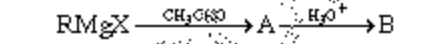
(a) 1 and 2 (b) 1 and 3
(c) 1 and 4 (d) 2 and 4

87. cis - trans isomerism is shown by
(a) $CH_3CH=CHCH_3$

(b) 

(c) $CH_3CH_2CH=CH_2$
(d) $(CH_3)_2C=C(CH_3)_2$

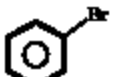
88. Consider the following sequence of reactions:



The compound B is a
(a) Carboxylic acid
(b) Primary alcohol
(c) Secondary alcohol
(d) Tertiary alcohol

89. The organolithium reagent required for preparing nonan-5-ol from ethyl formate in two steps is
(a) $C_5H_{11}Li$ (b) C_4H_9Li
(c) C_4H_9Li (d) C_2H_5Li

90. From which one of the following halides, a Grignard reagent can **not** be prepared?

(a) 

(b) $CH_2=CH-Cl$

(c) $CH_2-C\equiv CH$
 |
 Br

(d) $CH_2-C\equiv C-CH_3$
 |
 Cl

91. Consider the following statements about β – diketones:
1. They show keto-enol tautomerism
2. The enol form is capable of forming an intramolecular hydrogen bond
3. The methylene group flanked by two carbonyl groups can be easily alkylated

Which of the statements given above are correct?
(a) 1 and 2 (b) 1 and 3
(c) 2 and 3 (d) 1, 2 and 3

92. Consider the following statements about aromatic compounds:
1. They are planar compounds
2. They are annulenes having 4n-electrons
3. They sustain a ring current
4. They contain a delocalized π

electron cloud having (2n +4) π electrons

Which of the statements given above are correct?

(a) 2 and 3 (b) 1 and 3
(c) 1, 2 and 4 (d) 2, 3 and 4

93. Benzene reacts with methyl chloride in presence of anhydrous $AlCl_3$ to give toluene. The reaction is called
(a) Alkylation of benzene
(b) Friedal-Craft's reaction
(c) Methylation
(d) All of the above

94. The number of π electrons in anthracene according to Huckel rule is
(a) 12 (b) 14
(c) 10 (d) 20

95. Which one of the following descriptions correctly defines a fat?
(a) Fats are a mixture of sodium salts of long chain fatty acids
(b) Fats are carboxylic esters derived from glycerol
(c) Fats are carboyxlic esters derived from a mixture of simple alcohols
(d) Fats are sodium salts of alkylbenzene sulfonic acids

96. Consider the following statements about sucrose:
1. Hydrolysis of sucrose with dilute acid yields an equimolar mixture of D-glucose and D-fructose
2. Acid hydrolysis of sucrose is accompanied by a change in optical rotation
3. In sucrose, the glycosidic linkage is between C_1 of glucose and C_2 of fructose
4. Aqueous solutions of sucrose exhibit mutarotation

Which of the statements given above are correct?

(a) 1, 2 and 3 (b) 1 and 4
(c) 2, 3 and 4 (d) 2 and 4

97. The configurational description of the C_2 epimer of D-glucose is
(a) 2R, 3S, 4R, 5R
(b) 2S, 3S, 4R, 5R
(c) 2S, 3R, 4S, 5R
(d) 2R, 3S, 4R, 5S

98. In peptide chemistry phenyl isothiocyanate is used
(a) for identifying the C-terminal residue of a peptide chain
(b) for identifying the N-terminal residue of a peptide chain
(c) for protection of the amino group in peptide synthesis
(d) as a reagent for bringing about coupling between the carboxyl and amino groups in peptide synthesis

99. Kiliani-Fischer synthesis converts an aldopentose to a
(a) mixture of aldohexose and ketohexose
(b) mixture of aldohexoses differing in configuration at C_6
(c) mixture of aldohexoses differing in configuration at C_2
(d) single aldohexose

100. Match List-I with List-II and select the correct answer using the codes given below the lists:

List-I	List-II
A. $n \rightarrow \pi^*$ transition	1. Bathochromic shift
B. $\sigma \rightarrow \sigma^*$ transition	2. Forbidden transition
C. $\pi \rightarrow \pi^*$ transition	3. Occurs in the vacuum UV region
D. Extended conjugation	4. Strong absorption with high ε value

Codes:

(a)	A	B	C	D
	4	1	2	3
(b)	A	B	C	D
	2	3	4	1
(c)	A	B	C	D
	4	3	2	1
(d)	A	B	C	D
	2	1	4	3

101. Consider the carbonyl stretching frequency in the infrared spectra of the following compounds:

$CH_3-CO-NH-CH_3$ I

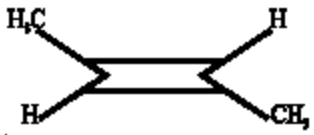
$C_6H_5-CO-NH-CH_3$ II

$CH_3-CO-NH-C_6H_5$ III

Which one of the following is the correct increasing order of the carbonyl stretching frequency?

(a) I < II < III (b) II < I < III
(c) I < III < II (d) III < II < I

102. The number of signals that appear in the ^1H-NMR spectrum of



is
(a) Five (b) Two
(c) Three (d) Eight

103. Consider the proton NMR spectrum of the following compound:

$\underset{(I)}{CH_2}-\underset{(II)}{CHCl_2}$

Which one of the following correctly represent the multiplicities of the signals due to the protons marked I and II respectively?
(a) Doublet, Singlet
(b) Singlet, Doublet
(c) Doublet, Triplet
(d) Triplet, Doublet

104. the compressibility factor for hydrogen at room temperature and at any range of pressure is
(a) less than 1 (b) equal to 1
(c) greater than I (d) zero

105. A gas can be liquefied at a temperature T K and pressure P provided that
(a) $T = T_c$ and $P < P_c$
(b) $T < T_c$ and $P > P_c$
(c) $T > T_c$ and $P > P_c$
(d) $T < T_c$ and $P < P_c$

106. If the average speed of N_2 molecules at 300 K is 515 m/s, the average speed of CO at 600 K would be approximately,
(a) 515 m/s (b) 1030 m/s
(c) 258 m/s (d) 725 m/s

107. The mean free path (λ) of a gas is given by the expression

$$\lambda = \frac{1}{\sqrt{2}\pi n \sigma^2}$$

where n is the number of molecules per unit volume of the gas and σ is the collision diameter. The mean free path is
(a) independent of temperature but dependent on pressure
(b) independent of pressure but dependent on temperature

(c) independent of concentration
(d) dependent on both pressure and temperature

108. An equilibrium mixture for the reaction

$$2A_2B(g) \rightleftharpoons 2A_2(g) + B_2(g)$$

had 0.5, 0.1 and 0.4 moles of A_2B, A_2 and B_2 in a two litre vessel respectively. The equilibrium constant (K) is
(a) 0.004 mol lit^{-1}
(b) 0.008 mol lit^{-1}
(c) 0.016 mol lit^{-1}
(d) 0.032 mol lit^{-1}

109. When a liquid is in equilibrium with its vapour, the thermodynamic criterion for equilbrium is
(a) Entropy of the liquid phase is greater than entropy in the vapour phase
(b) Enthalpy of the liquid phase is less than enthalpy in the vapour phase
(c) Chemical potential in the liquid phase is equal to the chemical potential in the vapour phase
(d) Gibbs free energy of the two phases is different

110. Consider the following:
1. Sodium chloride
2. Sodium nitrate
3. Sodium bromide
Which is the correct increasing order of the solubility of silver chloride in 0.1 M solution of the above compounds?
(a) 1 < 2 < 3 (b) 2 < 3 < 1
(c) 3 < 1 < 2 (d) 1 < 3 < 2

111. Solution A is prepared by dissolving 1.80 gm of glucose in 100 ml of water and solution B is prepared by dissolving 1.2 gm of acetic acid in 200 ml of water.
Which one of the following is correct?
(a) The osmotic pressure of A (π_A) = osmotic pressure of B (π_B)
(b) $\pi_A = \pi_B$
(c) $\pi_A < \pi_B$
(d) $\pi_A = 2\pi_B$

112. Freezing point lowering expression is $\Delta T_f = K_f m$
where $K_f = RT_f^2/1000\Delta H_f$
which of the following are assumed?
1. The solution is dilute (ideal)
2. The ΔH_f (latent heat of fusion of pure solvent) is independent of temperature between the actual and normal freezing point
3. The solid-phase consists of pure solvent
Select the correct answer using the codes given below:
(a) 1 and 2 (b) 2 and 3
(c) 1 and 3 (d) 1, 2 and 3

113. If the molar solubility of $La(OH)_3$ at 298 K is x, the solubility product K_{sp} is
(a) $3x^3$ (b) $9x^2$
(c) $27x^3$ (d) $27x^4$

114. Match List-I (Term) with List-II (Unit) and select the correct answer using the codes given below the lists:

List-I (Term)	List-II (Unit)
A. Dissociation constant of acetic acid	1. mol lit^{-1}
B. Ionic product of water	2. mol^2 lit^{-2}
C. Expansion coefficient	3. lit mol^{-1}cm^{-1}
D. Gas constant	4. lit mol^{-1} atm deg^{-1}

Codes:

(a)	A	B	C	D
	1	2	3	4
(b)	A	B	C	D
	3	2	1	4
(c)	A	B	C	D
	1	4	3	2
(d)	A	B	C	D
	3	4	1	2

115. Which of the following will act as buffer solution?
1. 100 ml of 0.1 M NaOH + 100 ml of 0.1 M acetic acid
2. 100 ml of 0.1 M NaOH + 200 ml of 0.1 M acetic acid
3. 200 ml of 0.1 M NH_3 + 100 ml of 0.1 M HCl
4. 100 ml of 0.1 M HCl + 100 ml of 0.1 M Sodium acetate
Select the correct answer using the codes given below:
(a) 1 and 2 (b) 2 and 3
(c) 3 and 4 (d) 1 and 3

116. Consider the following statements:
The ionic conductivity of Na^+ ions is greater than that of the Li^+ ions in aqueous medium, because
1. the ionic radius of Na^+ ion is greater than that of Li^+ ion.
2. the velocity of Na^+ ion is greater than that of Li^+ ion.
3. the Li^+ ion is more solvated than Na^+ ion in water.
4. Li^+ ion and Na^+ ion have different electron densities.
Which of the statements given above are correct?
(a) 1 and 3 (b) 2 and 3
(c) 3 and 4 (d) 2 and 4

117. The limiting molar conductivities at infinite dilution (Λ_m°) at 298 K for KOH, KNO_3 and NH_4NO_3 are 239, 125 and 128 S cm^2 mol^{-1} respectively. If a 0.1 M solution of NH_4OH has a molar conductivity of 24 S cm^2 mol^{-1}, the degree of dissociation α is
(a) 0.024 (b) 0.24
(c) 0.10 (d) 0.05

118. The standard electrode potentials of $Ni^{2+}|Ni$ and $Co^{2+}|Co$ are –0.25 and –0.28 volts respectively. The voltage of the cell $Co|Co^{2+}(a=1)\|Ni^{2+}(a=1)|Ni$ is
(a) +0.03 V (b) –0.03 V
(c) +0.53 V (d) –0.53 V

119. The chemical reaction

$$Zn(S) + 2HCl(1M) = ZnCl_2(1M) + H_2(1\text{ atm})$$

$\Delta H^\circ = -153$ kJ mol^{-1}
$\Delta S^\circ = -17.3$ JK^{-1} mol^{-1}
can be carried out reversibly in a voltaic cell.
If the standard enthalpy and entropy changes for the reaction at 298 K are those given above, the maximum electric work available from the reaction at this temperature per mol of H_2 produced is approximately equal to
(a) 5 kJ (b) 148 kJ
(c) 153 kJ (d) 158 kJ

120. Match List-I (Scientist) with List-II (Contribution) and select the

correct answer using the codes given below the lists:

List-I (Scientist)	List-II (Contribution)
A. Michaelis Menton	1. Effect of temperature on the reaction rate
B. Arrhenius	2. Enzyme catalysis
C. Eyring	3. Photochemical reaction
D. Einstein	4. Transition state theory
	5. Collision theory

Codes:

(a)	A	B	C	D
	2	4	5	3
(b)	A	B	C	D
	3	1	4	2
(c)	A	B	C	D
	2	1	4	3
(d)	A	B	C	D
	3	4	5	2

Answers

1.	b (Cotton & Wilkin Page 234)		
2.	b (Cotton & Wilkin)		
3.	d (Cotton & Wilkin)		
4.	b (J. D. Lee)		
5.	a (Cotton & Wilkin)		
6.	a (J. D. Lee)		
7.	b (J. D. Lee)		
8.	d (J. D. Lee)		
9.	b	10. b	11. b
12.	c	13. c	14. c
15.	b	16. c	17. b
18.	d	19. a	20. a
21.	a	22. b	23. d
24.	d	25. a	26. c
27.	d	28. a	29. c
30.	b	31. b	32. b
33.	c	34. b	35. c
36.	b	37. d	38. d
39.	d	40. b	41. d
42.	c	43. b	44. c
45.	b	46. b	47. a
48.	a (Cotton & Wilkinson)		
49.	d	50. d	51. c
52.	b (Puri & Sharma)		
53.	b		
54.	c (Puri & Sharma)		
55.	d	56. *	57. b
58.	d	59. c	60. b
61.	c	62. *	63. d
4.	c	65. d	66. a
67.	a	68. b	69. a
70.	a	71. a	72. c
73.	a	74. a	75. b
76.	a	77. c	78. d
79.	a		
80.	c (Jerry March)		
81.	c	82. c	
83.	a (Jerry March)		
84.	b	85. c	86. *
87.	a	88. c	89. b
90.	c	91. a	92. b
93.	c (Soloman)		
94.	b (Jerry & March)		
95.	b	96. a	
97.	c		
98.	c (Jerry & March)		
99.	c	100. c	101. c
102.	b	103. c	104. a
105.	b		
106.	b (Atkins)		
107.	c	108. c	109. d
110.	d (Atkins)		
111.	b	112. d	113. d
114.	a		
115.	b (Atkins)		
116.	a	117. a	118. d
119.	c	120. c	

EXPLANATION:

2. (b) P_4O_{10} does not give phosphorus acid on reacting with H_2O

20. (a) $CH_2 = CH - \overset{O}{\overset{|}{C}}{}^{+} - CH_3$

23. (d) Aldol condensation does not involve carbocation intermediacy

30. (b) d_{xy} point in between the axis

54. (c)
$$\Delta G^{\circ} = \left[\Delta G_f^{\circ}\right]_{Products} - \left[\Delta G_f^{\circ}\right]_{Reactants}$$
$$= [(6\times -94) + (6\times -57)] - [1\times -218]$$
$$= -564 - 342 + 218$$
$$= -906 + 218$$
$$= -688K\ Cal\ mol^{-1}$$