60411

ROLL No. | | | | | |

QN. BOOKLET No. **014**

TEST FOR POST GRADUATE PROGRAMMES

CHEMISTRY

Time: 2 Hours

Maximum Marks: 450

INSTRUCTIONS TO CANDIDATES

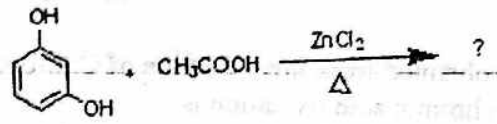
1. You are provided with a Question Booklet and an Optical Mark Reader (OMR) Answer Sheet to mark your responses. Do not soil your OMR Sheet. Read carefully all the instructions given on the OMR Sheet.
2. Write your Roll Number in the space provided on the top of **this page**.
3. Also write your Roll Number, Test Code, Test Centre Code, Test Centre Name, Test Subject and the date and time of the examination in the columns provided for the same on the **Answer Sheet**. Darken the appropriate bubbles with HB pencil.
4. The paper consists of 150 objective type questions. All questions carry equal marks.
5. Each Question has four alternative responses marked **A, B, C** and **D** and you have to **darken** the bubble fully by **HB pencil** corresponding to the correct response as indicated in the example shown on the Answer Sheet. Also write the alphabet of your response with ball pen in the starred column against attempted questions and put an '×' mark by ball pen in the starred column against unattempted questions as given in the example in the OMR Sheet.
6. Each correct answer carries **3** marks and each wrong answer carries **1** minus mark.
7. Please do your rough work only on the space provided for it at the end of this question booklet.
8. You should return the Answer Sheet to the Invigilator before you leave the examination hall. However Question Booklet may be retained with the Candidate.
9. Every precaution has been taken to avoid errors in the Question Booklet. In the event of such unforeseen happenings, suitable remedial measures will be taken at the time of evaluation.
10. Please feel comfortable and relaxed. You can do better in this test in a tension-free disposition.

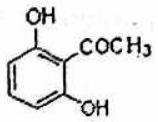
WISH YOU A SUCCESSFUL PERFORMANCE

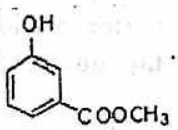
SEAL

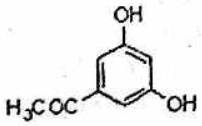
60411

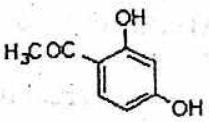
CHEMISTRY

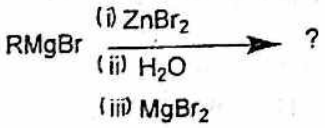
1. 

(A) 

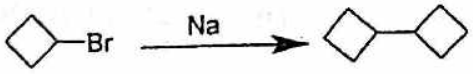
(B) 

(C) 

(D) 

2. 

(A) R-OH
(B) R-H
(C) R-Br
(D) R-R

3.  the name of the reaction is

(A) Wurtz reaction
(B) Franktand reaction
(C) Williamson's synthesis
(D) Kolbe's reaction

4. Among the following, which does not form enolates?

(A) Carboxylic acid
(B) Simple ketone
(C) 1,3-diketones
(D) 1,4-diketones

5. Among the following reaction, which involve carbene intermediate?

(A) Kolbe's reaction
(B) Riemer-Tiemann reaction
(C) Hoesch reaction
(D) Perkin reaction

6.  The reaction is called as

(A) Cycloaddition
(B) Diels-Alder
(C) Alder-ene
(D) Sigmatropic

7. One of the carboxylic acids obtained from the oxidation of Citral with alkaline permanganate, followed by chromic acid oxidation is

(A) malonic acid
(B) succinic acid
(C) laevulic acid
(D) p-isopropyl benzoic acid

8. Lindlar catalyst is used for

(A) the nitration of aromatic hydrocarbons
(B) the dehydration of secondary alcohols
(C) the partial reduction of alkynes to cis olefins
(D) the partial reduction of alkynes to trans olefins

9. Which of the following nitrogenous bases is not found in DNA?

(A) Guanidine
(B) Thymine
(C) Adenine
(D) Guanine

10. Allylic bromination of olefins is usually carried out with

(A) phenylmagnesium bromide
(B) N-bromosuccinimide
(C) α-bromo toluene
(D) pyridine perbromide

11. Two moles of acetone under the influence of sodium hydroxide will yield

(A) 4-hydroxy-4-methyl-2-pentanone
(B) 4-methyl-2-pentanone
(C) 4-hydroxy-2-pentanol
(D) 4-hydroxy-2-pentanal

12. Which one of the following is the organic solvent that prevents the greatest fire hazard?

(A) ethanol
(B) CCl_4
(C) kerosene
(D) $C_2H_5OC_2H_5$

13. The Hell-Volhard-Zelinsky reaction is used in

(A) synthesis of 1°-amines
(B) synthesis of α-bromo acids
(C) synthesis of β-bromo acids
(D) protection of the N-terminal group of the peptide

14. Ozonolysis of fatty acids is a technique used for determining

(A) number of OH groups
(B) number of –COOH groups
(C) ability to form soaps
(D) position of double bonds

15. The Hoffmann rearrangement has an intermediate that is electronically similar to that in the

(A) Pinacol rearrangement
(B) Claisen rearrangement
(C) Cope rearrangement
(D) Beckmann rearrangement

16. N,N-Dimethyl aniline reacts with nitrous acid to give

(A) Diazonium salts
(B) N-nitroso-N-methyl aniline
(C) p-nitroso-N-N-dimethyl aniline
(D) aniline

17. Pyrrole is less basic than pyridine because

(A) pyrrole has its electron pair as part of an aromatic sextet
(B) pyrrole behaves as a cyclic diene
(C) pyrrole is smaller than pyridine
(D) pyrrole can give off a proton

18. In practical organic chemistry $(CH_3)_4Si$ is used mainly for

(A) a solvent for IR spectra
(B) a solvent for UV spectra
(C) a spectroscopic standard for ^1H-NMR spectra
(D) making volatile derivatives of alcohol for mass spectra

19. The presence of N-methyl groups and their number may be determined by means of the following methods in alkaloids

(A) Herzig-Meyer method
(B) Hoffmann's exhaustive method
(C) Ziesel method
(D) Zerewitinoff method

20. Alkylnitrile on reduction produces

(A) 1°-amines
(B) esters
(C) nitroalkane
(D) alcohols

21. Which of the following is a Fenton's reagent?

(A) Br_2/CH_3COOH
(B) $AgOH/NH_4OH$
(C) $H_2O_2/Fe(OCOCH_3)_3$
(D) $Ac_2O/SOCl_2$

22. The Zinsberg test for differentiating 1°, 2° and 3° amines is based on the reaction of the amine with

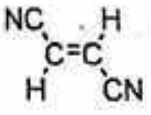
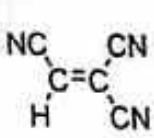
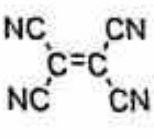
(A) $PhBr_2Cl$
(B) $PhSO_2Cl$
(C) PhCOPh
(D) PhMgBr

23. Arrange the order of nucleophilicity among the following:

R_2N^-, RO^-, R_3C^-, F^-

(A) $R_3C^- > F^- > RO^- > R_2N^-$
(B) $R_2N^- > F^- > RO^- > R_3C^-$
(C) $RO^- > R_2N^- > F^- > R_3C^-$
(D) $R_3C^- > R_2N^- > RO^- > F^-$

24. Arrange the reactivity order of the following dienophile towards cyclopentadiene in Diel's Alder reaction.

1. $CH_2=CH-CN$ 2.  3.  4. 

(A) 1<3<2<4
(B) 2<3<4<1
(C) 4<3<2<1
(D) 4<3<2<1

25. Among the halogens arrange the order of basicity

(A) $F^- > Cl^- > Br^- > I^-$
(B) $I^- > Cl^- > Br^- > F^-$
(C) $Cl^- > Br^- > I^- > F^-$
(D) $F^- > Br^- > Cl^- > I^-$

26. Arrange the following compounds inorder of increasing reactivity towards bromide ion under S_N1 reaction condition. 1. C_2H_5Cl, 2. $CH_2=CHCH_2Cl$, 3. $CH_2=CHCl$, 4. CH_3Cl

(A) 2>3>1>4
(B) 3>2>1>4
(C) 3>2>4>1
(D) 2>1>3>4

27. C_6H_5CHO is obtained by catalytic oxidation of $C_6H_5CH_3$ in presence of catalyst

(A) CrO_3
(B) MnO_2
(C) CH_3COOH
(D) H_2O_2

28. Aryl iodides when refluxed with copper powder, undergo coupling to form biaryls

(A) Wurtz-fitting reaction
(B) Ullmann reaction
(C) Paterno-Buchi reaction
(D) Wurtz reaction

29. Perkin reaction involves the condensation reaction between an aromatic aldehyde and

(A) aliphatic aldehyde
(B) aliphatic ketone
(C) aromatic aldehyde
(D) aliphatic anhydride

30. The unsaturated aldehydes $CH_3(CH=CH)nCH=O$ have UV absorption spectra that depends on the value of n. As the value of n increases, the λ

(A) increases
(B) decreases
(C) remains constant
(D) increases and then decreases

31. A part of light may be emitted as light of a longer wavelength when it is passed through a medium is called

(A) phosphorescence
(B) quenching
(C) fluorescence
(D) intersystem crossing

32. How many signals would be expected in NMR spectrum of each of the following compounds 1. CH_3Br, 2. CH_3CH_2Br 3. $CH_3CH(Br)CH_3$

(A) 1, 2 and 2
(B) 1,2 and 3
(C) 1, 1 and 2
(D) 1,2 and 1

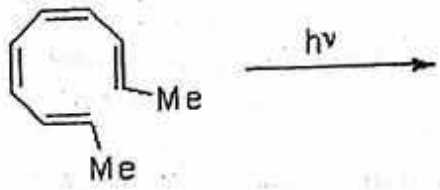
33. Table sugar is

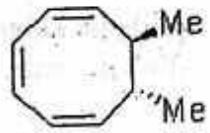
(A) a disaccharide consisting of D-glucose and D-fructose
(B) a monosaccharide
(C) a disaccharide consisting of 2-glucose units
(D) D-glucose

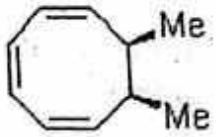
34. Congo red is

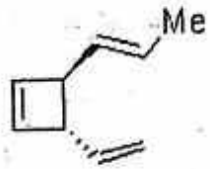
(A) nitro dye
(B) phthalein dye
(C) indigo dye
(D) azo dye

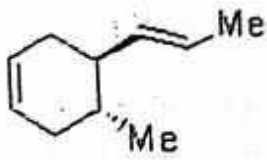
35. The following tetraene upon photolysis gives



(A) 

(B) 

(C) 

(D) 

36. DDT is

(A) Dichloro Diphenyl Trichloroethane
(B) Dichloro Diphenyl Trichloromethane
(C) Dichloro Diphenyl Tribromoethane
(D) Dibromo Diphenyl Trichloroethane

37. Enantiomers usually have different biological activities. This is because

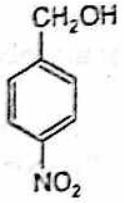
(A) enantiomers always show different chemical properties.
(B) biological medium generally has many chiral components.
(C) enantiomers have identical physical properties.
(D) enantiomers do not racemise under biological conditions

38. Which of the following compounds will undergo Cannizaro reaction?

(A) HCHO
(B) *p*- nitrobenzaldehyde
(C) 2-chloro-2-methylpropanal
(D) all of the above

39. What is the product of the reaction, *p*- nitrotoluene $\xrightarrow[H^+]{Fe}$?

(A) 

(B) 

(C) 

(D) 

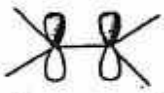
40. Which of the following molecules will have zero dipole moment?
(*i*) *o*-dichlorobenzene (*ii*) *m*-dichlorobenzene
(*iii*) *p*-dichlorobenzene (*iv*) 1,3,5- trichlorobenzene

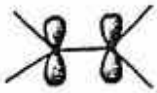
(A) *i* and *ii*
(B) *ii* and *iii*
(C) *iii* and *iv*
(D) *i* and *iii*

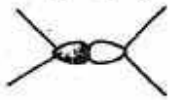
41. Which of the following statements about chirality is(are) correct?
(*i*) All alpha-aminoacids are chiral
(*ii*) All molecules with one asymmetric carbon atom are chiral
(*iii*) Chiral molecules always have one or more asymmetric carbon atoms
(*iv*) All molecules with two asymmetric carbon atoms are chiral.

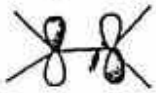
(A) only *ii*
(B) *i* and *ii*
(C) *i*, *ii* and *iii*
(D) *ii*, *iii* and *iv*

42. Which of the following is the correct representation of the π-bonding orbital of ethylene?

(A) 

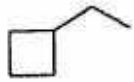
(B) 

(C) 

(D) 

43. Which of the following is not a structural isomer of cyclohexane?

(A) 

(B) 

(C) 

(D) 

44. Which of the following is a strained molecule?

(A) Cyclopropane
(B) Benzene
(C) Cyclodecane
(D) Pyridine-N-oxide

45. What product will be obtained if propene and 2-methylpropene are treated with hydrogen iodide?

(A) 1-iodopropane and 1-iodo-2-methylpropane
(B) 2-iodopropane and 2-iodo-2-methylpropane
(C) 2-iodopropane and 1-iodo-2-methylpropane
(D) 1-iodopropane and 2-iodo-2-methylpropane

46. Which of the following reactions is suitable for making neopentyl chloride?

(i) Reaction of chlorine with neopentane
(ii) Reaction of chlorine with neopentyl alcohol
(iii) Reaction of hydrogen chloride with neopentyl alcohol

(A) (i)
(B) (ii)
(C) (iii)
(D) (i) and (iii)

47. Select the reagent(s) suitable for converting benzoic acid to bezoyl chloride, $SOCl_2$; Cl_2; PCl_5; HCl.

(A) PCl_5
(B) $SOCl_2$ and Cl_2
(C) $SOCl_2$ and PCl_5
(D) Cl_2 and HCl

48. What product will be obtained when 2-chlorobutane is dehydrohalogenated?

(A) Only *cis*-2-butene
(B) Mainly *cis*-2-butene
(C) Only *trans*-2-butene
(D) Mainly *trans*-2-butene

49. How many ^1H NMR signals are expected for 1,3,5-trimethylbenzene ?

(A) 2
(B) 3
(C) 6
(D) 12

50. Which compound is aromatic?

(A) Cyclopentadiene
(B) Cyclopentadienyl cation
(C) Cyclopentadienyl anion
(D) Cyclopentadienyl radical

51. In which salt are the anion and cation iso-electronic?

(A) LiF
(B) NaCl
(C) KCl
(D) KBr

52. From each pair given below identify the ion which is larger in size.
$[Co^{2+}, Co^{3+}]$ $[Fe^{2+}, Zn^{2+}]$ $[Na^+, F^-]$ $[O^{2-}, S^{2-}]$

(A) $Co^{2+}, Zn^{2+}, F^-, S^{2-}$
(B) $Co^{3+}, Fe^{2+}, Na^+, S^{2-}$
(C) $Co^{2+}, Fe^{2+}, F^-, S^{2-}$
(D) $Co^{3+}, Zn^{2+}, Na^+, O^{2-}$

53. How many unpaired electrons are there in an atom of silver in its ground state?

(A) 0
(B) 1
(C) 2
(D) 4

54. If 22 g of N_2O_5 reacts with 10 g of water to produce 22 g of nitric acid, what is the percentage yield of nitric acid?

(A) 32 %
(B) 69 %
(C) 87 %
(D) 100 %

55. 10 ml of 0.10 N sodium hydroxide is added to 20 ml 0.10 N sulphuric acid and the resultant solution is titrated against 0.10 N sodium hydroxide. What will be the titre value at the end point?

(A) 5 ml
(B) 10 ml
(C) 20 ml
(D) 30 ml

56. An aqueous solution of a substance gives a white precipitate when a few drops of sodium hydroxide are added. The precipitate dissolves when excess of sodium hydroxide is added. The substance may be,

(A) aluminium sulphate
(B) silver nitrate
(C) cadmium chloride
(D) mercuric chloride

57. What is the charge (n) on the silicate ion $Si_2O_7^{n}$?

(A) –2
(B) –4
(C) –6
(D) –7

58. Silver is extracted from the crude metal by leaching with a solution of NaCN in the presence of air. The role of NaCN is to,

(A) oxidize Ag to Ag^+
(B) form the complex $[Ag(CN)_4]^{3-}$
(C) form the complex, $[Ag(CN)_4]^{2-}$
(D) form the complex $[Ag(CN)_2]^-$

59. $CoCl_4^{2-}$ and $Co(H_2O)_6^{2+}$ have different colours. This is because

(A) they have Co in different oxidation states
(B) they have different coordination geometries
(C) they have different number of unpaired electrons
(D) all of the above

60. An AB_3 molecule with A as the central atom bonded to three B atoms may have the shape of an equilateral triangle or a triangular pyramid. Which one, among those given, is the most appropriate technique to distinguish between these two structures?

(A) measurement of dipole moment
(B) measurement of magnetic moment
(C) measurement of viscosity
(D) measurement of boiling point

61. Which molecule has zero bond order?

(A) H_2^+
(B) H_2
(C) HeH
(D) He_2

62. Which one among the chlorides, $ZnCl_2$, $HgCl_2$, $BaCl_2$, $AlCl_3$, is dissociated to the least extent in aqueous solutions?

(A) $ZnCl_2$ (B) $HgCl_2$
(C) $BaCl_2$ (D) $AlCl_3$

63. If you were to prepare $[Cr(oxalate)_2(OH_2)_2]^-$ ion, how many isomers, including geometrical and optical, can you expect to get?

(A) only one (B) two
(C) three (D) four

64. Identify the acids in the following two reactions:

$NOF + ClF_3 = NO^+ + ClF_4^-$

$XeO_3 + OH^- = HXeO_4^-$

(A) ClF_3 and XeO_3 (B) ClF_3 and OH^-
(C) NOF and OH^- (D) NOF and XeO_3

65. The magnetic moment of $Co(H_2O)_6^{3+}$ is zero and that of $Mn(CN)_6^{3-}$ is 2.9B.M. From this it may be concluded that

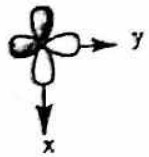
(A) both ions are high spin
(B) both ions are low spin
(C) $Co(H_2O)_6^{3+}$ is low spin, $Mn(CN)_6^{3-}$ is high spin
(D) $Co(H_2O)_6^{3+}$ is diamagnetic, $Mn(CN)_6^{3-}$ is high spin

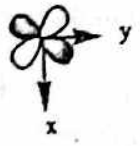
66. Which of the following molecules/ions have planar structures?

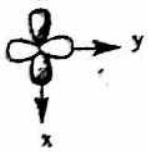
(*i*) NH_3 (*ii*) SO_4^{2-} (*iii*) CO_3^{2-} (*iv*) BF_3

(A) all four (B) *ii* and *iii*
(C) *iii* and *iv* (D) only *iv*

67. Which of the following is the correct representation of a $d_{x^2-y^2}$ orbital?

(A) 

(B) 

(C) 

(D) 

68. What is the precurser used for producing very pure silicon for the microchip industry?

(A) SiO_2 (B) $SiCl_4$
(C) SiC (D) $CaSiO_3$

69. Which of the following metals cannot displace hydrogen from steam?

(A) Au (B) Zn
(C) Mg (D) Sr

70. Which of the following is a valid Lewis structure for CO?

(A) :C-O: (B) :C=O:

(C) :C=O: (D) :C≡O:

71. Arrange the following in the order of acidic strength:
HOCl, $HOCl_2$, $HClO_3$ and $HClO_4$

(A) $HClO < HClO_2 < HClO_3 < HClO_4$
(B) $HClO < HClO_3 < HClO_2 < HClO_4$
(C) $HClO_4 < HClO_3 < HClO_2 < HClO$
(D) $HClO < HClO_4 < HClO_3 < HClO_2$

72. Mirror image isomerism is not possible with tetrahedral & square planar complexes of the type : $[Ma_4]$, $[Ma_3b]$ & $[Mab_3]$ because

(A) ligands around central metal ion strongly binded
(B) ligands around central metal ion exactly equivalent
(C) ligands around central metal ion weakly held
(D) ligands around central metal ion not equivalent

73. The rate of aquation of $[Co(NH_3)_5X]$ corresponding to the replacement of X^- with H_2O molecule depends on

(A) nature of central metal atom
(B) nature of X^-
(C) oxidation state of metal
(D) binding nature of H_2O molecule

74. Which reagent may be used to precipitate barium from aqueous solutions?

(A) hydrochloric acid
(B) sulphuric acid
(C) silver nitrate
(D) ammonium chloride

75. A sample of water contains 200 ppm of Ca^{2+} in it. What is the molality of the solution with respect to Ca?

(A) 0.2 m
(B) 2 m
(C) 5×10^{-3} m
(D) 0.05 m

76. Coke is often used in extractive metallurgy. Its major role is,

(A) as an oxidizing agent
(B) as a reducing agent
(C) as a fuel
(D) to form slag

77. Dimethylglyoxime reagent is used to test for,

(A) Ca^{2+}
(B) Ni^{2+}
(C) Fe^{3+}
(D) Al^{3+}

78. Which compound can act as a Lewis acid as well as a Lewis base?

(A) H_2O
(B) $SnCl_2$
(C) NH_3
(D) BF_3

79. Two isomers are obtained for $Pt(NH_3)_2Cl_2$, while only one isomer is obtained for $Ni(NH_3)_2Cl_2$. This is because,

(A) the two complexes differ in the oxidation state of the metal
(B) the two complexes differ in the oxidation state of the metal as well as coordination number
(C) the two complexes differ in their coordination number
(D) the two complexes differ in their coordination geometry

80. Consider the following reaction:
$[Co(NH_3)_4Cl_2]^+ + H_2O \rightarrow [Co(NH_3)_4(H_2O)Cl]^{2+} + Cl^-$
The above reaction involves

(A) substitution
(B) substitution and reduction
(C) oxidation
(D) substitution and oxidation

81. What are the formal oxidation states of the iron atoms labeled (A) and (B) in the compound $Fe_4^{(A)}[Fe^{(B)}(CN)_6]_3$?

(A) $Fe^{(A)}$, 2+ and $Fe^{(B)}$, 3+
(B) $Fe^{(A)}$, 2+ and $Fe^{(B)}$, 4+
(C) $Fe^{(A)}$, 3+ and $Fe^{(B)}$, 3+
(D) $Fe^{(A)}$, 3+ and $Fe^{(B)}$, 2+

82. Arrange the following elements in increasing order of their first ionization energy:
Na, Ar, Mg, K

(A) K < Na < Mg < Ar
(B) Na < K < Mg < Ar
(C) Na < Mg < Ar < K
(D) Ar < Mg < K < Na

83. Which two of the following molecules/ions have planar structures?
(*i*) XeF_4 (*ii*) ClO_4^- (*iii*) $PtCl_4^{2-}$ (*iv*) MnO_4^-

(A) *i* and *iii*
(B) *i* and *ii*
(C) *ii* and *iii*
(D) *ii* and *iv*

84. In qualitative analysis, Ag is detected in the first group, while Pb is detected in both first and second groups. This is because,

(A) AgCl is much more soluble than $PbCl_2$.
(B) AgCl is much less soluble than $PbCl_2$.
(C) The solubilities of the chlorides are same, but traces of PbS is easily seen due to its black colour.
(D) AgS is soluble, but PbS is insoluble

85. Three examples of molecules/ions having linear geometry may be given as,

(A) CO_2, NCS^- and NO_2^+
(B) CO_2, NCS^- and NO_2
(C) NO_2, N_3^- and NCS^-
(D) ClO_2, CO_2 and NO_2^+

86. Which of the following metal ions could form both high and low spin complexes in an octahedral array of ligands?

(A) Cr^{3+}
(B) Mn^{3+}
(C) Cu^+
(D) Zn^{2+}

87. Which of the following is not a redox reaction?

(A) $2Rb + 2H_2O = 2RbOH + H_2$
(B) $Cr_2(SO_4)_3 + 6RbOH = 2Cr(OH)_3 + 3Rb_2SO_4$
(C) $2Ag^{2+} = Ag + Ag^{3+}$
(D) $2K_4[Fe(CN)_6] + Br_2 = 2K_3[Fe(CN)_6] + 2KBr$

88. Which of the following reagents will intensify the hydrolysis of $FeCl_3$ when added to its solution? HCl, NaOH, Na_2CO_3, NH_4Cl, H_2O

(A) HCl and NH_4Cl
(B) NH_4Cl
(C) NaOH and H_2O
(D) NaOH, Na_2CO_3 and H_2O

89. With which of the following compounds will $Zn(OH)_2$ react?
NaCl; H_2SO_4; KOH; $Fe(OH)_3$.

(A) NaCl and H_2SO_4
(B) H_2SO_4
(C) H_2SO_4 and KOH
(D) KOH and $Fe(OH)_3$

90. Why doesn't the Na^{2+} ion occur in ionic crystals?

(A) It would not be strongly attracted to an anion
(B) The energy for the second ionization of sodium is too large
(C) Insufficient lattice energy is released to compensate for the endothermic formation of gaseous Na^{2+} ions
(D) Both (B) and (C)

91. Which of the following elements is likely to occur in its native state?

(A) Cu
(B) Ca
(C) Hg
(D) Fe

92. Ions such as Cu^+, Ag^+, Zn^{2+}, Cd^{2+}, Hg^{2+} are colourless due to

(A) vacant d-orbitals
(B) half filled d-orbitals
(C) completely filled d-orbitals
(D) no d-orbitals involved

93. The order of oxidizing ability of F_2, Cl_2, Br_2, I_2 and O_2 is

(A) $Cl_2 > Br_2 > I_2 > F_2 > O_2$
(B) $I_2 > F_2 > O_2 > Cl_2 > Br_2$
(C) $Cl_2 > I_2 > Br_2 > F_2 > O_2$
(D) $F_2 > Cl_2 > Br_2 > I_2 > O_2$

94. How many moles of P_4O_{10} will react with one mole of water?

(A) 2 moles
(B) 6 moles
(C) 1/3 mole
(D) 1/6 mole

95. CuI_2 is unstable because, it readily decomposes to

(A) Cu and I^-
(B) Cu and I_2
(C) CuI and I_2
(D) CuI and I^-

96. Which one, among the given ions, has the highest polarizing power?

(A) Na^+
(B) Ca^{2+}
(C) Mg^{2+}
(D) Al^{3+}

97. In its reaction with aqueous solutions of Cu^{2+}, the cyanide ion is similar to,

(A) CO
(B) Cl^-
(C) I_2
(D) I^-

98. Which ligand can lead to linkage isomers?

(A) Azide
(B) Cyanate
(C) Oxalate
(D) Nitrate

99. Which among the following compounds / ions are diamagnetic?

$CuCl_6^{4-}$; Cu(SCN); $CoCl_4^{2-}$; $Ni(CO)_4$; $PdCl_4^{2-}$

(A) $CoCl_4^{2-}$ and $PdCl_4^{2-}$
(B) $CuCl_6^{4-}$, Cu(SCN) and $Ni(CO)_4$
(C) Cu(SCN) and $Ni(CO)_4$
(D) Cu(SCN), $Ni(CO)_4$, and $PdCl_4^{2-}$

100. How many isomers are possible for trifluorobenzene?

(A) Only one
(B) Two
(C) Three
(D) Four

101. A gas mixture contains 20% by mass of helium, 30% by mass of oxygen and rest nitrogen. The partial pressures of the three components in the mixture will have the following relationship

(A) helium > nitrogen > oxygen
(B) nitrogen > helium > oxygen
(C) helium > oxygen > nitrogen
(D) nitrogen > oxygen > helium

102. The speed of the electron in the ground state of the hydrogen atom is 2.2×10^{6} m/s. What is the wavelength associated with the electron?

(A) 3.3 nm
(B) 0.33 nm
(C) 3.0 nm
(D) 30 nm

103. An element crystallizes in a FCC lattice. How many atoms are there per unit cell?

(A) 1
(B) 2
(C) 3
(D) 4

104. A non-stoichiometric oxide of silver has composition $Ag_{1.8}O$. What percentage of Ag is present in the form Ag^{2+}?

(A) 11%
(B) 14%
(C) 20%
(D) 25%

105. For which one among the following reactions does ΔH° of the reaction represent an enthalpy of formation?

(A) $2\,H_2\,(g) + C(s) \rightarrow CH_4(g)$
(B) $2\,NO_2\,(g) \rightarrow N_2O_4\,(g)$
(C) $2\,N_2(g) + 3\,O_2(g) \rightarrow 2\,NO_2(g) + 2\,NO(g)$
(D) $CO_2\,(g) + H_2(g) \rightarrow H_2O(g) + CO(g)$

106. Consider the following three reactions:

$NH_4NO_3(s) = N_2O(g) + 2H_2O(g)$
$2H_2(g) + O_2(g) = 2H_2O(g)$
$2H_2(g) + O_2(g) = 2H_2O(l)$

Which statement regarding the entropy changes (ΔS) in the above reactions is correct?

(A) $\Delta S_1 > \Delta S_2 > \Delta S_3$
(B) $\Delta S_1 > \Delta S_2 = \Delta S_3$
(C) $\Delta S_1 < \Delta S_2 < \Delta S_3$
(D) $\Delta S_1 > \Delta S_2 < \Delta S_3$

107. CsF adopts the NaCl crystal structure. If the unit cell edge is of length 4.02 Å, what is the shortest distance between the cation and anion in the crystal?

(A) 2.01 Å
(B) 2.84 Å
(C) 3.48 Å
(D) 4.02 Å

108. The atomic volume of a deuterium atom is ..... the atomic volume of a hydrogen atom.

(A) half
(B) two times
(C) three times
(D) same as

109. Consider the given statements with reference to the reaction,
$2H_2 + O_2 = 2H_2O$.

(*i*) it is an exothermic reaction
(*ii*) it is an endothermic reaction
(*iii*) the reaction proceeds rapidly as soon as the two gases are mixed at room temperature
(*iv*) the reaction does not take place when the two gases are mixed at room temperature.

Which of the above statements are **true**?

(A) (*i*) and (*iii*)
(B) (*i*) and (*iv*)
(C) (*ii*) and (*iii*)
(D) (*ii*) and (*iv*)

110. The relative acid strengths of HCl and HBr can not be measured in water because

(A) both are weaker acids than H_2O
(B) both are stronger acids than H_2O
(C) water has a high dielectric constant
(D) both Br^- and Cl^- form strong hydrogen bonds with H_2O

111. In the Bragg's law equation $n\lambda = 2d \sin\theta$, d refers to

(A) lattice spacing
(B) wave length
(C) diffraction order
(D) density

112. From the given bond energy data, calculate the heat of combustion (in kJ mole^{-1}) of methane (Bond energy in kJ mole^{-1}: C-H 413; O=O 497; C=O 743; O-H 463)

(A) 263
(B) –263
(C) 692
(D) –692

113. Which of the following four quantities are state functions?
enthalpy (H); entropy (S); heat absorbed (q); work done (w)

(A) H and q
(B) q and w
(C) only S
(D) H and S

114. If ΔH represents enthalpy change and ΔE change in internal energy, which of the following is true for the isothermal expansion of an ideal gas?

(A) $\Delta H > \Delta E$
(B) $\Delta H < \Delta E$
(C) $\Delta H = \Delta E$
(D) $\Delta E = \Delta H + RT$

115. How does the volume (V) of an ideal gas change when its temperature and pressure are both doubled?

(A) V does not change
(B) V increases four-fold
(C) V is doubled
(D) V is halved

116. An equimolar mixture of hydrogen and oxygen is enclosed in a closed vessel at 100°C and 0.2 atm. pressure. The gas is ignited and the temperature brought back to 100°C. What will be the pressure of the gas (in atm.)?

(A) 0.2
(B) 0.15
(C) 0.075
(D) 0.25

117. Under what condition, can one apply the rate law $d[C]/dt=k[B]$ to the reaction, A+B→C ?

(A) when the concentration of [A] is half that of [B]
(B) when the concentration of [A] is in large excess
(C) when the concentration of [B] is in large excess
(D) when A and B are at the same concentration

118. A decomposition reaction, $2A \rightarrow B+C$ is second order in A. This means

(A) the plot of [A] versus time is linear
(B) the plot of log [A] versus time is linear
(C) the plot of 1/[A] versus time is linear
(D) the plot of $1/[A]^2$ versus time is linear

119. The freezing points of unimolal solutions of HCN and glucose are nearly same. This means

(A) HCN is almost fully associated in solution
(B) HCN is almost fully dissociated in solution
(C) about 50% of the HCN molecules are dissociated
(D) almost all of HCN molecules exist as hydrogen bonded dimers

120. Solubility of AgCl (S) is determined in the following four aqueous solvents: pure water, 0.01 M $CaCl_2$, 0.01 M NaCl, and 0.01 M $AgNO_3$.
What is the correct relationship between the four solubilities?

(A) S (pure water) > S ($AgNO_3$) > S ($CaCl_2$) > S (NaCl)
(B) S (pure water) > S ($AgNO_3$) = S (NaCl) > S ($CaCl_2$)
(C) S (pure water) > S ($CaCl_2$) > S (NaCl) > S ($AgNO_3$)
(D) S ($CaCl_2$) > S (NaCl) = S ($AgNO_3$) > S (pure water)

121. In each of the following pairs of solutions, the two aqueous solutions are separated by a semi-permeable membrane.
(i) A = 1.0 M NaCl, B = 1.5 M KCl
(ii) C = 3.0 M $CaCl_2$, D = 3.5 M NaBr
(iii) E = 5.0 M sucrose, F = 4.0 M NaCl

In which direction will solvent flow in each case?

(A) $A \rightarrow B$, $C \rightarrow D$, $F \rightarrow E$
(B) $B \rightarrow A$, $D \rightarrow C$, $E \rightarrow F$
(C) $A \rightarrow B$, $D \rightarrow C$, $F \rightarrow E$
(D) $A \rightarrow B$, $D \rightarrow C$, $E \rightarrow F$

122. Which one of the following molecules does not have a dipole moment?

(A) CO
(B) HBr
(C) CH_3Cl
(D) XeF_4

123. One mole of an ideal gas (C_p=29.234 JK^{-1} mol^{-1}) is expanded vertically and adiabatically from 1dm^3. If the initial temperature is 750K, the final temperature will be

(A) 1000K
(B) 750K
(C) 300K
(D) 100K

124. For the reaction $2A + B \rightarrow C + 2D$ which is first order in A and also first order in B, the rate is given by

(A) $K[A]^2[B]$
(B) $K[A][B]^2$
(C) $K[A]^2$
(D) $K[A][B]$

125. For an ideal gas following adiabatic reversible expansion, a plot of log P verses log V is linear with a slope equal to

(A) $1/\gamma$
(B) $-1/\gamma$
(C) γ
(D) $-\gamma$

126. What happens in a fuel cell?

(A) Electrical energy is used to drive a reaction
(B) Thermal energy is converted to electrical energy
(C) Electrical energy is converted to mechanical energy
(D) Chemical energy is converted to electrical energy

127. The enthalpy of formation of CsCl crystal may be written as follows:
ΔH_f = ΔH of vaporisation of Cs(s) + (1/2) ΔH of dissociation of $Cl_2(g)$ + ΔH of ionisation of Cs(g) + ΔH of electron attachment of Cl(g) + U.
In the above equation, the enthalpy term, U corresponds to the reaction,

(A) $Cs(s) + (1/2)\,Cl_2(g) = CsCl(s)$
(B) $Cs(g) + Cl(g) = CsCl(s)$
(C) $Cs^+(g) + Cl^-(g) = CsCl(s)$
(D) $Cs(g) + Cl(g) = CsCl(g)$

128. Which of the following statements about the Bohr model is false?

(A) It explains the spectrum of the hydrogen atom
(B) The stability of the electron in its orbit is due to an ad hoc assumption
(C) The model can be readily extended to the helium atom
(D) The angular momentum of the electron is proposed to be quantised

129. How many maxima are there in the plot of radial probability distribution function of a $3p$ orbital?

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

130. The Gibbs-Helmholtz equation describes,

(A) the temperature dependence of equilibrium constant
(B) the relation between free energy change and emf of a galvanic cell
(C) the temperature dependence of entropy change
(D) the temperature dependence of free energy change

131. What is meant by critical temperature (T_c) of a gas ?

(A) The temperature above which the gas behaves like an ideal gas
(B) The temperature above which the gas can not be liquified
(C) The temperature below which the van der Waals equation applies
(D) The temperature at which 1 mole of the gas can be confined to 22.4 l by a pressure of 1 atm.

132. Where does the triple point of water lie?

(A) At 0°C and 1 atm
(B) At 100°C and 1 atm
(C) At 1 atm, but below 0°C
(D) Below 0°C and below 1atm

133. At what temperature does an aqueous solution containing 3×10^{23} molecules of a non-electrolyte in 250 g of water freeze?

(A) 269.3 K (B) 271.1 K
(C) 273.0 K (D) 276.3 K

134. How will the potential of a zinc electrode change if the solution of the zinc salt in which it is immersed is diluted 10 times?

(A) It will decrease by 59 mv (B) It will decrease by 30 mv
(C) It will increase by 59 mv (D) It will increase by 30 mv

135. In the electrolysis of a cupric chloride solution, the mass of the cathode increased by 3.2 g. What occurred at the copper anode?

(A) 112 ml of chlorine was liberated
(B) 560 ml of oxygen was liberated
(C) 3.2 g of Cu^{2+} passed into the solution
(D) 6.4 g of Cu^{2+} passed into the solution

136. Which of the following intermolecular forces is important only at shortest distances between interacting particles?

(A) Ion-ion
(B) Ion-dipole
(C) London dispersion forces
(D) Ion-induced dipole

137. At 1atm external pressure, water can exist at 100°C as

(A) only a solid
(B) solid and liquid
(C) gas
(D) both liquid and gas

138. Under what conditions can we absolutely say a system is at equilibrium, at constant pressure and temperature

(A) $\Delta H=0$
(B) $\Delta H>0$
(C) $\Delta G=0$
(D) $\Delta G>0$

139. Which of the following substances might stabilize a colloidal suspension of oil in water?

(A) Octane, C_8H_{18}
(B) Sodium bicarbonate, $NaHCO_3$
(C) Sodium stearate, $NaCO_2(CH_2)_{16}CH_3$
(D) $COCl_2$

140 Which of the following is not affected when a catalyst influences a gaseous chemical reaction?

(A) Forward and reverse reaction rates
(B) Initial reaction rate
(C) Value of equilibrium constant
(D) Value of activation energy

141. The zero point energy of a harmonic oscillator is

(A) $h\omega$ (B) Zero
(C) $1/2\ h\omega$ (D) $2/3\ h\omega$

142. The following mechanism was proposed for the photolysis of HI into H_2 and I_2

$HI + h\nu \rightarrow H + I$
$HI + HI \rightarrow H_2 + I$
$2I \rightarrow I_2$
The overall quantum yield of the reaction is

(A) 0.5 (B) 1
(C) 2 (D) 4

143. According to Maxwell distribution, as temperature increases, the fraction of the molecules moving about with root mean square speed

(A) decreases (B) increases
(C) remain unaffected (D) tends to infinity

144. The entropy change associated with the freezing of 1 mole of water at 0°C and 1 atm (heat of fusion under these conditions is 6.0 KJ/m) is

(A) −6 J/K (B) −22 J/K
(C) +22 J/K (D) +6 J/K

145. ΔH and ΔE for the reaction Fe_2O_3 (s) + $3H_2$ (g) → 2Fe (s) + $3H_2O$ (l) at constant temperature are related as

(A) $\Delta H = \Delta E$ (B) $\Delta H = \Delta E + RT$
(C) $\Delta H = \Delta E + 3RT$ (D) $\Delta H = \Delta E - 3RT$

146. The tendency of Cu to change into Cu^{2+} ions is extensively low due to its

(A) electropositive nature
(B) higher electrode potential
(C) negative electrode potential
(D) outermost electronic level

147. What is the total number of orbitals associated with the principal quantum number, $n = 4$?

(A) 3
(B) 4
(C) 16
(D) 24

148. What changes will increase the equilibrium concentration of product C in the system, $A(g) + B(g) = C(g)$, if the ΔH° of the reaction is negative?

Choose from the following conditions:

(i) the addition of a catalyst
(ii) the addition of an extra amount of substance B
(iii) raising of the temperature
(iv) lowering of the temperature

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

149. Which of the following molecules does not satisfy the Huckel $4n+2$ rule?

(A) Benzene
(B) Phenanthrene
(C) Cyclopentane
(D) Chlorobenzene

150. Which of the following is a stable free radical?

(A) Isopropyl
(B) Trichloromethyl
(C) Phenyl
(D) Triphenylmethyl

****