OPSC
Asst. Chemist
Previous Year Paper
(OAC) Paper-II
05 Jan, 2025

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T.B.C. : AC-II-23/24

Sl. No. 21185

TEST BOOKLET

ASSISTANT CHEMIST

(PAPER - II)

(PHYSICAL & INORGANIC CHEMISTRY)

Test Booklet Series

A

K-24

Time Allowed : 1½ Hrs. | **Maximum Marks : 100**

INSTRUCTIONS TO CANDIDATES

1. IMMEDIATELY AFTER COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET DOES NOT HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET OF SAME SERIES ISSUED TO YOU.
2. ENCODE CLEARLY THE TEST BOOKLET SERIES **A, B, C** OR **D**; AS THE CASE MAY BE, IN THE APPROPRIATE PLACE IN THE ANSWER SHEET USING BALL POINT PEN (BLUE OR BLACK).
3. You have to enter your **Roll No.** on the Test Booklet in the Box provided along side. **DO NOT** write *anything else* on the Test Booklet.
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5. This Test Booklet contains **100** items (questions). Each item (question) comprises four responses (answers). You have to select the correct response (answer) which you want to mark (darken) on the Answer Sheet. In case, you feel that there is more than one correct response (answer), you should mark (darken) the response (answer) which you consider the best. In any case, choose ***ONLY ONE*** response (answer) for each item (question).
6. You have to mark (darken) all your responses ***ONLY*** on the **separate Answer Sheet** provided, by **using BALL POINT PEN (BLUE OR BLACK).** See instructions in the Answer Sheet.
7. All items (questions) carry equal marks. All items (questions) are compulsory. Your total marks will depend only on the number of correct responses (answers) marked by you in the Answer Sheet. **There shall be negative marking for each wrong answer/response with deduction of 25% (one-fourth) of marks allotted to a particular question.**
8. Before you proceed to mark (darken) in the Answer Sheet the responses to various items (questions) in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your **Admission Certificate**.
9. After you have completed filling in all your responses on the Answer Sheet and after conclusion of the examination, you should hand over to the Invigilator the *Answer Sheet* issued to you. You are allowed to take with you the candidate's copy / second page of the Answer Sheet along with the **Test Booklet**, after completion of the examination, for your reference.
10. Sheets for rough work are appended in the Test Booklet at the end.

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1. Carbon Monoxide has 10 bonding electrons and 4 anti-bonding electrons. Therefore it has bond order of :-

(A) 3

(B) 7

(C) 1

(D) 5/2

2. The bond Order of HCl molecule is:

(A) 0

(B) 1

(C) 2

(D) 3

3. Among the following molecules or ions, which one has high bond order and has shortest bond length?

(A) O_2^+

(B) O_2^{2-}

(C) O^{2-}

(D) O_2

4. According the molecular orbital theory, the species among the following does not exist is:

(A) O_2

(B) H^{2-}

(C) He_2

(D) None

5. Which one of following gases are commonly released during forest fire:

I-CO_2 II-CH_4 III-N_2O IV-SO_2

(A) I & II

(B) I, II & III

(C) I, III & IV

(D) I, II, III & IV

6. Which of the following is not a green house gas:

(A) CO_2

(B) CH_4

(C) Oxygen

(D) Hydrochlorofluorocarbon

7. According to the environmental protection agency (EPA), which of the following is the largest source of SO_2 emission:

(A) Locomotive using fossil fuels

(B) Ships using fossil fuels

(C) Extract of metals from ores

(D) Power plants using fossil fuels

8. For the preparation of boranes in Stock's method following reactions takes place:

(A) Reaction of magnesium boride with HCl or H_3PO_4

(B) Reaction of C_2H_5I on sodium amalgam

(C) Reaction of magnesium boride on $KMnO_4$

(D) Reaction of C_2H_5I on $KMnO_4$

9. In presence of weak Lewis bases like ethers, amines etc. B_5H_{11} give :

(A) B_2H_4 and B_2H_6

(B) B_6H_{10} and $2B_2H_6$

(C) B_4H_6CO & BH_3CO

(D) B_2H_6 and H_2

10. Bromine monofluoride is:

(A) Colourless gas

(B) Reddish yellow gas

(C) Reddish brown liquid

(D) Lemon-yellow crystalline Solid

11. The shape of ICl molecule is:

(A) Distorted and octahedral

(B) Distorted and trigonal bipyramidal

(C) Square pyramidal

(D) Distorted and linear

12. Photochemical Smog is also known as:

(A) London type Smog

(B) Los Angeles type Smog

(C) U.S. type Smog

(D) Chinese type Smog

13. The sound of _____ decibels creates headache:

(A) 100

(B) 80

(C) 120

(D) 160

14. Identify the health effects related to the noise pollution:

1) Speech interference

2) Hearing loss

3) hypertension

4) insomnia

(A) 1, 2, & 3 only

(B) 2, 3 & 4 only

(C) 1, 2 & 4 only

(D) All

15. Green muffler's is related to:

(A) Soil Pollution

(B) Air Pollution

(C) Noise Pollution

(D) Water Pollution

16. Day time noise standard prescribed for residential area in India is:

(A) 75 dB

(B) 65 dB

(C) 55 dB

(D) 50 dB

17. The point group for BCl_3 molecule is:

(A) D_{2h}

(B) C_{2v}

(C) D_{3h}

(D) C_{3v}

18. H_2O molecule have:

(A) No symmetry

(B) One C_2 axis, two σ planes & C_{2v} point group

(C) Two C_2 axis, one σ planes & C_{3v} point group

(D) Three C_3 axis and three σ planes

19. Phosphorous pentachloride belongs to point group:

(A) C_{3v}

(B) C_{2v}

(C) C_{3h}

(D) D_{3h}

20. Which of the following are the components of brass alloy?

(A) Copper, iron and lead

(B) Copper, lead and zinc

(C) Zinc, manganese and aluminum

(D) Copper, silicon and nickel

21. Two substances are soluble in each other for the entire range of composition n both solid and liquid states. The system is described as;

(A) Binary phase system

(B) Multiple phase system

(C) Isomorphous system

(D) Unary phase system

22. Which of the following is an example of binary isomorphous system?

(A) Cu-N

(B) Fe-C

(C) Pb-Ag

(D) S-Al

23. Fermi energy level for intrinsic semiconductors lies at:

(A) Close to valence band

(B) Close to conduction band

(C) Middle of the band gap

(D) None

24. Which of the following elements has a negative value of magnetic susceptibility?

(A) Iron

(B) Oxygen

(C) Aluminum

(D) Gold

25. Which of the following is used as a filler in rubber industry?

(A) Wood flour

(B) Mica

(C) Calcium carbonate

(D) Carbon black

26. The appearance of the double peak in d^1 configuration is attributed to:

(A) Nephelauxetic effect

(B) John Teller distortion

(C) Low CFSE

(D) None of these

27. The intense red color of $[Fe(bpy)_3]^{2+}$ is due to:

(A) Metal to ligand charge transfer (LMCT)

(B) Ligand to metal charge transfer (LMCLT)

(C) Inter-valence charge transfer

(D) d-d transition

28. Which of the following is not a reducing agent?

(A) $Na/lq.NH_3$

(B) $LiAlH_4$

(C) Bu_3SnH_4

(D) O_3

29. What is the composition of soda glass?

(A) Barium silicate and sodium silicate

(B) Silica, potassium oxide and barium oxide

(C) Silica, calcium carbonate and sodium carbonate

(D) Sodium, potassium and lead silicate

30. F 'Q' s the molar (Canonical) partition function, then the Work function 'Al' is given by:

(A) $A = RT \ln Q$

(B) $A = -RT \ln Q$

(C) $A = \ln Q / RT$

(D) $A = RT / \ln Q$

31. The spectroscopic ground state term symbols of ferrous ions $[Fe(H_2O)]^{2+}$ and $[FeCl_4]^{2-}$, respectively. Are:

(A) $^5T_{2g}$ and $^5T_2$

(B) $^5T_{2g}$ and ^5E

(C) ^5E_g and $^5T_2$

(D) ^5E_g and ^5E

32. Three bands in the electrons spectrum of $[Cr(NH_3)^6]^{3+}$ are due to following transitions:

1) $^4A_{2g} \rightarrow {}^4T_{1g}$

2) $^4A_{2g} \rightarrow {}^4T_{2g}$

3) $^4A_{2g} \rightarrow {}^2E_g$

Identify the correct statement about them:

(A) Intensity of (1) is lowest

(B) Intensity of (3) is lowest

(C) Intensity of (1), (3) and (2) are similar

(D) Intensity of (2) and (3) are similar

33. Which law of thermodynamics states that energy cannot be created or destroyed?

(A) First law

(B) Second law

(C) Third law

(D) Zeroth law

34. What is the standard state of a gas?

(A) 1 atm pressure

(B) 1 atm pressure and 25°C

(C) 1 atm pressure and 0°C

(D) 1 bar pressure

35. Which thermodynamic function represents the total energy of a system?

(A) Enthalpy

(B) Entropy

(C) Internal energy

(D) Free energy

36. The change in which of the following is used to determine spontaneity of a process?

(A) Enthalpy

(B) Entropy

(C) Free energy

(D) Internal energy

37. What is the significance of the Debye-Huckel Limiting Law?

(A) It describes the activity coefficients of strong electrolytes

(B) It explains the standard states for gases

(C) It defines the laws of thermodynamics

(D) It relates to the entropy of mixing

38. In photochemistry, what does Lambert-Beer's law describe?

(A) The energy of photons

(B) The relationship between absorbance and concentration

(C) The quantum yield of a reaction

(D) The speed of light

39. What is actinometry used for in photochemistry?

(A) Measuring quantum yield

(B) Determining reaction mechanisms

(C) Measuring the intensity of light

(D) Measuring photochemical equilibrium

40. Which method is NOT used for studying fast kinetics?

(A) Flow method

(B) Relaxation method

(C) Flash photolysis

(D) Calorimetry

41. The Nernst equation is used to calculate:

(A) Cell potential at non-standard conditions

(B) Standard reduction potentials

(C) Electrode charge density

(D) Corrosion rates

42. Which model describes ion-solvent interactions in electrolyte solutions?

(A) Debye-Huckel-Onsager model

(B) Debye-Huckel-Bjerrum model

(C) Stern model

(D) Helmholtz model

43. The Helmholtz layer is associated with:

(A) Electrochemical cells

(B) Electrode interfaces

(C) Crystallographic defects

(D) X-ray diffraction

44. The Tafel plot is used in electrochemistry to determine:

(A) Corrosion rates

(B) Overpotentials

(C) Standard reduction potentials

(D) Activity coefficients

45. Which law describes the angles between crystal faces?

(A) Law of rational indices

(B) Law of constancy of interfacial angles

(C) Bragg's law

(D) Miller indices

46. Bragg's law is fundamental to:

(A) Electrochemistry

(B) Thermodynamics

(C) Photochemistry

(D) X-ray diffraction

47. Which element is not typically associated with high electrical conductivity?

(A) Metals

(B) Insulators

(C) Semiconductors

(D) Superconductors

48. The band theory of solids helps explain:

(A) Crystal defects

(B) Electrical conductivity

(C) Phase transitions

(D) Electrochemical reactions

49. Miller indices are used to describe:

(A) Crystal lattice points

(B) Interfacial angles

(C) Symmetry operations

(D) Atomic positions in a unit cell/ orientation of planes or set of parallel planes of atoms in crystal

50. Which system is characterized by a liquid-2liquid equilibrium phase diagram?

(A) NaC1

(B) CsCl

(C) Benzene-water

(D) Iron-carbon

51. What does the Debye-Huckel theory specifically address?

(A) Activity coefficients of electrolytic solutions

(B) Enthalpy changes in reactions

(C) Quantum yields in photochemistry

(D) Crystal structures

52. The Gouy-Chapman model relates to:

(A) Symmetry operations

(B) Electrode interfaces

(C) Phase diagrams

(D) X-ray diffraction

53. Which one of the following is not an example of a point group in crystallography is:

(A) Cubic

(B) Tetragonal

(C) 4mm

(D) Monoclinic

54. Superconductors are characterized by:

(A) High resistance

(B) Zero electrical resistance

(C) Semiconducting properties

(D) Strong magnetic fields

55. The term "phase transition" refers to:

(A) A change in temperature

(B) A change in pressure

(C) A change in state of matter

(D) A change in chemical composition

56. Ehrenfest classification is used for:

(A) Electrode potentials

(B) Crystallography

(C) Phase transitions

(D) Reaction kinetics

57. The Debye-Huckel-Bjerrum model is an extension of which theory?

(A) Activity coefficients

(B) Phase diagrams

(C) Electrochemical cells

(D) Photochemistry

58. What does the law of rational indices state?

(A) The angles between crystal faces are constant

(B) The ratio of lattice plane indices are simple whole numbers/the intercepts of the natural faces of a crystal form with the unit cell axes are inversely proportional to the prime integers, h, k, l

(C) The symmetry elements of a crystal are fixed

(D) The electron density around ions is uniform

59. In corrosion, which method is not a common prevention technique?

(A) Coating

(B) Anodic protection

(C) Tafel plot

(D) Cathodic protection

60. Which of the following is an insulator?

(A) Copper

(B) Silicon

(C) Rubber

(D) Graphite

61. What is used to measure the potential difference in an electrochemical cell?

(A) Voltmeter

(B) Ammeter

(C) Ohmmeter

(D) Galvanometer

62. The concept of "activity" in thermodynamics refers to:

(A) Concentration of reactants

(B) Effective concentration of a species/chemical potential of a species

(C) Rate of reaction

(D) Free energy change

63. Fugacity is a corrected measure of:

(A) Pressure

(B) Temperature

(C) Volume

(D) Entropy

64. Photo stationary state is achieved when:

(A) The rate of photochemical reactions is zero

(B) The rate of formation and destruction of a species are equal

(C) All reactants are consumed

(D) Light intensity is constant

65. Which crystal system has the highest symmetry?

(A) Monoclinic

(B) Tetragonal

(C) Orthorhombic

(D) Cubic

66. Solid-state reactions can be studied using:

(A) X-ray diffraction

(B) NMR spectroscopy

(C) IR spectroscopy

(D) UV-Vis spectroscopy

67. The term "enthalpy" is defined as:

(A) Internal energy of a system

(B) Heat content of a system at constant pressure

(C) Free energy of a system

(D) Disorder of a system

68. The behavior of Cl_2 is closest to ideal gas behavior at:

(A) 100°C and 10.0 atm

(B) 0 °C and 0.50 atm

(C) 200 °C and 0.50 atm

(D) –100°C and 10.0 atm

69. The CORRECT expression that corresponds to reversible and adiabatic expansion of an ideal gas is;

(A) $\Delta U = 0$

(B) $\Delta H = 0$

(C) $\Delta S = 0$

(D) $\Delta G = 0$

70. Assuming ideal gas behavior, the density of O_2 gas at 300 K and 1.0 atm is _____ gL–1

(A) 1.29

(B) 1.31

(C) 1.45

(D) 1.64

71. At a certain wavelength, liquid P transmits 70%, whereas liquid Q transmits 30% of the incident light when separately placed in a spectrophotometric cell (path length = 1 cm). In a binary mixture of liquids P and Q (assume non - interacting liquids), the absorbance in the same cell is 0.25. The volume fraction of liquid P in the binary mixture is _____ (Round off to two decimal places).

(A) 0.43

(B) 0.55

(C) 0.63

(D) 0.74

72. The intensity of a monochromatic visible light is reduced by 90% due to absorption on passing through a 5.0 mM solution of a compound. If the path length is 4 cm, then the molar extinction coefficient of the compound in $M^{-1}cm^{-1}$ is _____

(A) 50

(B) 60

(C) 70

(D) 80

73. The standard Gibbs free energy change for the reaction $H_2O(g) \rightarrow H_2(g) + \frac{1}{2} O_2(g)$

at 2500 K is +118 kJ mol^{-1}. The equilibrium constant for the reaction is [Given : R = 8.314 J $K^{-1}mol^{-1}$]

(A) 0.994

(B) 1.006

(C) 3.42×10^{-3}

(D) 292.12

74. The fact that the fluorescence wavelength is often much longer than the irradiation wavelength (Stokes shift) is a consequence of which phenomenon?

(A) low extinction coefficients (Lambert-Beer law)

(B) vertical transitions (Kasha's rule)

(C) high ISC rates (El Sayed rule)

(D) the Franck-Condon principle

75. At a certain wavelength, the fluorescence quantum yield and observed fluorescence lifetime of Tryptophan in water are $\phi_F = 0.20$ and $\tau_O = 2.6$ ns respectively. Rate constant will be equal to _____.

(A) $0.52 \times 10^{-7}s^{-1}$

(B) $7.7 \times 10^{7}s^{-1}$

(C) $3 \times 10^{-9}s^{-1}$

(D) $0.52 \times 10^{7}s^{-1}$

76. The fluorescence life time of a molecule in solution is 10 ns. If the fluorescence quantum yield is 0.1, the rate constant of fluorescence decay is:

(A) $1 \times 10^{9}s^{-1}$

(B) $1 \times 10^{8}s^{-1}$

(C) $1 \times 10^{7}s^{-1}$

(D) $1 \times 10^{6}s^{-1}$

77. Which of the following ligands can bring out the highest oxidation state in a transition: metal?

(A) F^-

(B) Cl^-

(C) Br^-

(D) I^-

78. Which of the following is the strongest reducing agent in aqueous solution?

(A) Radium

(B) Sodium

(C) Lithium

(D) Potassium

79. The structures of XeF_2 and XeO_2F_2 respectively are:

(A) Trigonalbipyramidal and see-saw

(B) Linear and trigonalbipyramidal

(C) Linear and see-saw

(D) See-saw and tetrahedral

80. The metallic radii are abnormally high for the following elements:

(A) Gd, Lu

(B) Eu, Yb

(C) Sm, Tm

(D) Nd, Ho

81. Crystal field splitting energy value of octahedral (O_h) and tetrahedral (T_h):

(A) $\Delta_t = 1/2\Delta_o$

(B) $\Delta_t = 9/4\Delta_o$

(C) $\Delta_o = 9/4\Delta_t$

(D) $\Delta_o = 4/9\Delta_t$

82. The spin only magnetic moment values for $[Fe(CN)_6]^{4-}$ and $[FeF_6]^{3-}$ respectively are:

(A) 1.73 and 5.92 BM

(B) Zero and 5.92 BM

(C) Zero and 1.73 BM

(D) 1.73 and 1.73 BM

83. The number of P-O-P bonds in cyclo tri metaphosphoric acid $(HPO_3)_3$ is:

(A) 2

(B) 0

(C) 3

(D) 4

84. The formula of Nessler's reagent is:

(A) K_3HgI_4

(B) $KHgI_3.H_2O$

(C) Cu_2HgI_4

(D) K_2HgI_4

85. Poisonous nature of CO is due to:

(A) Undergoes combustion and form CO_2 with the liberation of heat

(B) Low solubility in water

(C) Formation of complex with hemoglobin

(D) Powerful reducing agent and acidic in nature

86. The geometrical structure of $[PCl_4]^+$ and $[PCl_6]^-$ ions are:

(A) Octahedral and tetrahedral respectively

(B) Tetrahedral and octahedral respectively

(C) Both tetrahedral

(D) Both octahedral

87. Which of the following compounds has the electron pair geometry as trigonal bipyramidal with three equatorial positions occupied by lone pairs of electrons:

(A) XeF_6

(B) $[Pt(NH_3)_2Cl_2]$

(C) XeF_2

(D) $K[PtCl_3(C_2H_4)]$

88. Oxidation number of K in KO_2:

(A) –1

(B) +1

(C) –2

(D) +2

89. The melting point of Zn is lower than that of Cu because:

(A) Cu has a bcc structure

(B) the atomic volume of Cu is higher

(C) the electrons of Cu are involved in metallic bonding

(D) the *s*-as well as *d*-electrons of Cu are involved in metallic bonding

90. The following ions are coloured: Cu^+, Ti^{4+}, Co^{2+} and Fe^{2+}:

(A) Cu^+, Ti^{4+}, Co^{2+} and Fe^{2+}

(B) Co^{2+}, Fe^{2+}

(C) Ti^{4+}, Co^{2+}

(D) Cu^+, Ti^{4+}

91. Which of the following metal ions has tendency to act as an oxidizing agent:

(A) Sm^{2+}

(B) Gd^{3+}

(C) Ce^{4+}

(D) Lu^{3+}

92. The number of ions are produced from the $Co(NH_3)_6Cl_3$ complex in solution:

(A) 6

(B) 4

(C) 3

(D) 2

93. Which of the following is not a chelating agent?

(A) Oxalato

(B) Glycinato

(C) Ethylenediamine

(D) Thiosulphate

94. Lanthanide contraction is caused due to:

(A) The appreciable shielding on outer electrons by *4f* electrons from the nuclear charge

(B) The imperfect shielding on outer electrons by *4f* electrons from the nuclear charge

(C) The same effective nuclear charge from Ce to Lu

(D) The appreciable shielding on outer electrons by *5d* electrons from the nuclear charge

95. The correct order of atomic radii in group 13 elements is:

(A) B < Al < Ga < In < Tl

(B) B < Ga < Al < Tl < In

(C) B < Al < In < Ga < Tl

(D) B < Ga < Al < In < Tl

96. Which of the following compound having the similar structure to graphite:

(A) B_4C

(B) BH_3

(C) B_2H_6

(D) BN

97. The ionic mobility of alkali metal ions in aqueous solution is maximum for:

(A) Li^+

(B) Na^+

(C) K^+

(D) Rb^+

98. Lattice energy of an ionic compounds depends upon:

(A) Packing of ions only

(B) Charge and size of the ion

(C) Size of the ion only

(D) Charge on the ion only

99. Catenation property is maximum in:

(A) Phosphorus

(B) Carbon

(C) Sulphur

(D) Nitrogen

100. The total number of lone pairs of electrons in N_2O_3 is:

(A) 4

(B) 6

(C) 8

(D) 10

SPACE FOR ROUGH WORK

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