Question Booklet Sr. No.

1003

Roll No. .....

OMR Sheet No. .....

# Ph.D.–2005

## CHEMISTRY ENTRANCE TEST, MARCH 2020

Time : 2 Hours

Maximum Marks : **200**

Number of Pages in this Booklet : **20**

Number of Questions in this Booklet : **100**

### INSTRUCTIONS FOR THE CANDIDATES

(i) Check this booklet carefully for the sequence of pages and questions. If it is defective due to pages/questions missing or not in serial order or any other discrepancy it should be got replaced immediately from the invigilator within the period of 5 minutes. Afterwards neither the Question Booklet will be replaced nor any extra time will be given.

(ii) After this verification write your Roll No. and OMR Sheet Number on this Question Booklet.

(iii) **Use only Black or Blue ball point pen.**

(iv) This paper consists of **100** multiple choice type questions. Each question has four alternative answers (a), (b), (c) and (d). **Only one of these alternative answer is correct**. You are required to darken completely the circle of correct answer in the OMR Sheet.

(v) There is **no negative marking.**

(vi) Do not write anything other than relevant entries or put any mark on any part of the OMR Sheet, which may disclose your identity, otherwise you will render yourself liable to disqualification.

(vii) Use of electronic gadgets such as pager, cell phone, calculator and log table etc. is prohibited.

(viii) Rough Work may be done in the end of this booklet.

(ix) You have to **return the OMR Sheet** to the invigilator at the end of the examination compulsorily.

SEAL

## PART–I

1. The correct relationship between $\wedge^{\circ}_m$ and $\wedge^{\circ}_{eq}$, of $Al_2(SO_4)_3$ solution is

   (a) $\wedge^{\circ}_m = 6 \times \wedge^{\circ}_{eq}$ (b) $\wedge^{\circ}_m = \frac{\wedge^{\circ}_{eq}}{3}$

   (c) $\wedge^{\circ}_m = \frac{\wedge^{\circ}_{eq}}{6}$ (d) $\wedge^{\circ}_m = 3 \times \wedge^{\circ}_{eq}$.

2. Which is reduced most easily electrochemically?

   (a) $Fe^{3+}/Fe$ (b) $Fe^{3+}/Fe^{2+}$

   (c) $Fe^{2+}/Fe$ (d) None is reduced.

3. Cell constant is determined by using which standard solution?

   (a) NaCl (b) $Na_2SO_4$

   (c) HCl (d) KCl.

4. Which is correct for galvanic cell?

   (a) $E^{\circ}_{cell} = E^{\circ}_{red}$ (cathode) – $E^{\circ}_{red}$ (anode)

   (b) $E^{\circ}_{cell} = E^{\circ}_{ox}$(anode) + $E^{\circ}_{red}$ (cathode)

   (c) $E^{\circ}_{cell} = E^{\circ}_{ox}$(anode) – $E^{\circ}_{ox}$ (cathode)

   (d) All the above.

5. In concentration cells which is correct

   (a) $E^{\circ}_{cell} = E_{cell}$ (b) $E_{cell} = 0$

   (c) $E^{\circ}_{cell} = 0$ (d) None of these.

6. Oxidation state of chlorine in $CaOCl_2$ is

   (a) Zero (b) +1

   (c) –1 (d) +1 and –1.

7. At half neutralization which is correct

(a) $pH = pK_a$ (b) $pH = pK_a + 1$

(c) $pH = pK_a \pm 1$ (d) None of these.

8. Calomel electrode contains which compound?

(a) Mercuric nitrate (b) Mercuric chloride

(c) Mercurous chloride (d) None of these.

9. pH of 0.1 N $NH_4Cl$ solution ($pK_b = 4.74$) is

(a) 4.13 (b) 5.13

(c) 6.13 (d) 7.13

10. pH of $10^{-8}$ N HCl is

(a) 8 (b) 6

(c) 6.9 (d) cannot be predicted.

11. The brain of any computer system is

(a) ALU (b) Memory

(c) CPU (d) Control unit.

12. Computer program that converts assembly language to machine language is

(a) Compiler (b) Assembler

(c) Interpretor (d) Comparator.

13. The section of CPU that selects, interprets and sees to the execution of program instructions is

(a) Control unit (b) Register unit

(c) ALU (d) Memory.



14. A modern digital computer has

(a) Extremely high speed (b) Large Memory

(c) Almost unlimited array (d) All the above.

15. Computer Program consists of

(a) System flow chart (b) Program flow chart

(c) Discrete logical steps (d) Algorithms written in Computer's Language.

16. Student's test in analytical chemistry refers to

(a) F-test (b) t-test

(c) Chi-Square-test (d) None of these.

17. In the Ilkovic Equation, Diffusion coefficient, $D^x$; $x$ is equal to

(a) 1 (b) 2

(c) $\frac{1}{2}$ (d) 3.

18. Chemical shift ($\delta$) of $^1H$ NMR in Benzene is at

(a) 8.27 (b) 7.27

(c) 9.27 (d) 6.27

19. The most commonly used nuclide material for generation of $\gamma$-rays in Mossbauer spectroscopy is

(a) $Fe^{57}$ (b) $C^{12}$

(c) $U^{235}$ (d) None of these.

20. In HPLC which of the following is generally used

(a) $N_2$ (b) $O_2$

(c) He (d) None of these.

21. TGA technique refers to

(a) Pressure and Volume (b) Pressure and Weight loss

(c) Temperature and Weight loss (d) None of these.

22. In the application of DTA and DSC which of the following parameters is measured for the glasses

(a) Transition Temperature (b) Concentration of the glass

(c) Solubility of the glass (d) None of these.

23. While taking IR spectrum of a compound nujol is used, the absorption bands (in $cm^{-1}$) of nujol mainly occurs around

(a) 4000, 400 (b) 3000, 1400

(c) 2000, 1800 (d) 1200, 1800.

24. Benzaldehyde and Acetophenone can be distinguished by using IR spectra, both show $>C=O$ stretching absorption around 1700 $cm^{-1}$, but benzaldehyde shows C–H Stretching absorption around

(a) 2000 $cm^{-1}$ (b) 4000 $cm^{-1}$

(c) 2800 $cm^{-1}$ (d) None of these.

25. In mass spectrometer which energy source is used

(a) X-rays (b) UV radiations

(c) Microwaves (d) Electron Bombardment.



26. Electronic spectroscopy is concerned with

(a) IR radiations (b) Microwaves

(c) UV-Visible radiations (d) X-rays.

27. Optical density or Absorbance is qual to

(a) $\frac{I_t}{I_o}$ (b) $\frac{I_o}{I_t}$

(c) $\log\frac{I_t}{I_o}$ (d) $\log\frac{I_o}{I_t}$.

28. Flame photometry can be used for the analysis of

(a) $Na^+$ (b) $K^+$

(c) $Ca^{2+}$ (d) All of these.

29. In conductometric titrations of acetic acid versus sodium hydroxide, the conductance (when sodium hydroxide is added from Burette)

(a) Decreases first and then becomes constant

(b) Decreases first and then increases

(c) Increases first and then decreases

(d) None of the above

30. Which has Minimum molar conductivity

(a) $Mg[Cr(NH_3)(NO_2)_5]$ (b) $[Cr(NH_3)_5(NO_2)_3]\ [Co(NO_2)_6]_2$

(c) $K[Co(NH_3)_2(NO_2)_4]$ (d) $[Cr(NH_3)_3(NO_2)_3]$.

31. $E^\circ_{cell}$ for Rusting of IRON is

(a) +3.24 V (b) –1.67 V

(c) +1.67 V (d) +1.10 V.

32. 0.25 g, of organic compound on Kjeldahl's analysis gave enough ammonia to just neutralize 10 cc of 0.5 M $H_2SO_4$, the % of nitrogen in the compound is

(a) 28 (b) 112

(c) 14 (d) 56.

33. $Fe^{3+} \xrightarrow{0.77\ V} Fe^{2+} \xrightarrow{-0.44\ V} Fe$

$E^\circ = x$

The value of x in volts will be

(a) + 0.036 (b) – 0.036

(c) + 0.108 (d) – 0.108.

34. Oxidation state of copper in chalcopyrite, Cu Fe $S_2$ is

(a) Zero (b) +2

(c) +1 (d) –1.

35. In NMR spectrum of Extra Pure ethyl alcohol (absolute), signal of H of OH will be

(a) Singlet (b) Doublet

(c) Triplet (d) Septet.

36. In EPR spectrum of Benzene Anion Redical, total number of peak/s will be

(a) One (b) Six

(c) Seven (d) Two.

37. In IUPAC nomenclature epoxides are called

(a) Oxiranes (b) Oxanes

(c) Oxides (d) None of these.

38. In HPLC technique, the alphabet 'P' refers to

(a) Pressure (b) Plane

(c) Performance (d) None of these.



39. TLC technique is concerned with

(a) Absorption (b) Diffusion

(c) Adsorption (d) None of these.

40. pH of 0.01 M acetic acid will be

(a) 2 (b) Less than 2

(c) between 2 to 5 (d) 7.

41. pH of Mixture of 100 cc of 0.1 M HCl and 100.1 cc of 0.1 M NaOH will be nearly equal to

(a) 7 (b) 11.7

(c) 10.7 (d) 9.7

42. pH of Sod. acetate solution at concentration 'c' ($p_c = -\log c$) is given by formula

(a) $pH = \frac{1}{2}pK_w + \frac{1}{2}pK_a + \frac{1}{2}p_c$ (b) $pH = \frac{1}{2}pK_w + \frac{1}{2}pK_a - \frac{1}{2}p_c$

(c) $pH = \frac{1}{2}pK_w - \frac{1}{2}pK_a + \frac{1}{2}p_c$ (d) None of these.

43. The pH of water at 90°C, if $K_w = 10^{-12}(M)^2$ is

(a) 7 (b) 8

(c) 6 (d) 12.

44. Buffer Mixture in the human blood is

(a) $CH_3COONa + CH_3COOH$ (b) $NH_4OH + NH_4Cl$

(c) $HCO_3^- + H_2CO_3$ (d) None of these.

45. In unconjugated alkene the lowest energy transition of $\pi \rightarrow \pi^*$ occurs in

(a) 100–120 nm (b) 120–140 nm

(c) 170–190 nm (d) None of these.

46. In gas chromatography, during separation of mixture of Benzene, toluene and xylene, the areas under the peak were noted to be 31.0, 14.5 and 53.2 cm respectively. The % composition of Benzene will be :

(a) 14.7 (b) 54.1

(c) 31.4 (d) 10.1.

47. Solvent Extraction technique is applicable efficiently when :

(a) Emulsion formation takes place

(b) Both liquids are Miscible

(c) One of the liquids is Immiscible with the other

(d) None of the above.

48. Donnan membrane is concerned with :

(a) HPLC (b) GC

(c) Ion exchange chromatography (d) None of these.

49. In IR spectroscopy the fundamental vibration frequency (ν) is given by :

(a) $2\pi\sqrt{\frac{k}{\mu}}$ (b) $\frac{1}{2}\sqrt{\frac{k}{\mu}}$

(c) $\frac{1}{2\pi}\sqrt{\frac{k}{\mu}}$ (d) None of these.

50. $D_2O$ Exchange is used in which spectroscopy :

(a) NMR (b) ESR

(c) Mossbauer (d) UV-visible.



## PART–II

51. In the thermodynamic literature which is correct statement?

(a) Diamond is more stable than Graphite

(b) Graphite is more stable than Diamond

(c) Both have same stability

(d) None of the above.

52. Basic hydrolysis of Ester is :

(a) Zero order reaction (b) First order reaction

(c) Second order reaction (d) None of these.

53. Which is correct statement for Activation Energy?

(a) It is always positive (b) It can be zero

(c) It can be negative (d) All are correct.

54. $\Delta G^\circ$ for the process of Rusting of Iron is nearly equal to

(a) –76 kJ/mole (b) –161 kJ/mole

(c) –322 kJ/mole (d) None of these.

55. For boric acid, $H_3BO_3$, in water, which is correct ?

(a) It can accept $H^+$ (b) It can donate $H^+$

(c) It accepts $OH^-$ (d) None of these.

56. The mobility of $Na^+$ ion is $7.623 \times 10^{-8}$ $m^2$ $V^{-1}$ $s^{-1}$, the ionic conductivity of $Na^+$ ion is :

(a) $7.623\times10^{-4}\,ohm^{-1}m^2eq^{-1}$ (b) $7.623\times10^{-8}\,ohm^{-1}m^2eq^{-1}$

(c) $53.55\times10^{-4}\,ohm^{-1}m^2eq^{-1}$ (d) $73.55\times10^{-4}\,ohm^{-1}m^2eq^{-1}$.

57. Which is correct for MnO

(a) It is Ferromagnetic substance (b) It is Diamagnetic substance

(c) It is Ferrimagnetic substance (d) It is Antiferromagnetic substance.

58. Which is correct for half Life period for zero order reaction?

(a) $t_{1/2} = \frac{A_0}{K}$ (b) $t_{1/2} = \frac{K}{2A_0}$

(c) $t_{1/2} = \frac{A_0}{2}$ (d) $t_{1/2} = \frac{A_0}{2K}$.

59. pH of 0.1 N KCl solution will be nearly equal to :

(a) 1 (b) 13

(c) 7 (d) zero.

60. The transition from one liquid form to another liquid form in Helium is called :

(a) First order phase transition (b) Second order phase transition

(c) Third order phase transition (d) None of these.

61. Rate of reaction doubles when concentration of one of the components increased by a factor of 1.5 (The conc. of all other components are held constant), the order of reaction w.r.t. this component will be nearly equal to :

(a) 1.5 (b) 1.2

(c) 1.7 (d) 1.9.

62. The factor by which a reaction speeds up if the temperature changes from 500°C to 600°C and its $E_a$ is 300 kJ/mole, will be nearly equal to :

(a) 1024 (b) 512

(c) 210 (d) 310.



63. For first order reaction a graph is drawn between log $k$ and $\frac{1}{T}$, the value of tan $\theta = \frac{1}{2.303}$, then value of $E_a$ in calories will be equal to :

(a) $2.303 \times 2$ (b) $\frac{2}{2.303}$

(c) 4 (d) 2.

64. In presence of catalyst, $E_a$ is lowered by 2 kcal at 27°C so rate will be increased nearly :

(a) 20 times (b) 14 times

(c) 2 times (d) 28 times.

65. $k = Ae^{-E_a/RT}$, $k$ has smallest value under conditions of

(a) High Temp. and Large $E_a$ (b) High Temp. and Small $E_a$

(c) Low Temp. and Large $E_a$ (d) Low Temp. and Small $E_a$.

66. $PCl_5$ in the solid state exists as :

(a) Individual $PCl_5$ molecules (b) Mixture of $PCl_3$ and $Cl_2$

(c) Mixture of $PCl_4^+$ and $PCl_6^-$ (d) Mixture of $PCl_4^-$ and $PCl_6^+$.

67. In which Bond Angle is maximum :

(a) $Br_2O$ (b) $Cl_2O$

(c) $OF_2$ (d) $H_2O$.

68. Inorganic Benzene (Borazine) has molecular formula :

(a) $C_6H_6N_6$ (b) $B_6N_3H_6$

(c) $B_3N_3H_6$ (d) None of these.

69. Which is L-shaped species?

(a) $I_3^-$ (b) $ICl_2^-$

(c) $I_5^-$ (d) None of these.

70. In octahedral complex, the pair of d-orbitals during $d^2sp^3$ hybridization is :

(a) $d_{xz}, d_{x^2-y^2}$ (b) $d_{x^2-y^2}, d_{z^2}$

(c) $d_{xy}, d_{z^2}$ (d) None of these.

71. Which biomolecule contains a non-transition metal ion?

(a) Vitamin $B_{12}$ (b) Haemoglobin

(c) Chlorophyll (d) None of these.

72. In Sulfur trioxide, $S_3O_9$, each sulfur is surrounded by how many oxygen atoms :

(a) 3 (b) 4

(c) 2 (d) 5.

73. In square Pyramid compound having $dsp^3$ hybridization, '$d$'-orbital involved is

(a) $d_{z^2}$ (b) $d_{xy}$

(c) $d_{x^2-y^2}$ (d) Any d-orbital.

74. Symmetry point group of trans $N_2F_2$ molecule is :

(a) $C_{2v}$ (b) $C_2$

(c) $C_{2\lambda}$ (d) $D_{2\lambda}$.



75. The lowest energy electronic level for the nitrogen atom is :

(a) $^4S_{1/2}$ (b) $^4S_{3/2}$

(c) $^1S_{3/2}$ (d) None of these.

76. Fullerene, $C_{60}$ contains :

(a) 20-hexagons and 10 Pentagons of C-atoms

(b) 20-hexagons and 12 Pentagons of C-atoms

(c) 12-hexagons and 20 Pentagons of C-atoms

(d) None of these.

77. Bond orders of Ni–C and C–O in $Ni(CO)_4$ (from spectroscopic data) respectively are :

(a) 2.6 and 1.3 (b) 2.6 and 2.6

(c) 1.3 and 2.6 (d) 1.3 and 1.3.

78. Which is Metallo-enzyme :

(a) Cytochrome – $Ca^{2+}$ (b) Cytochrome P–450

(c) $Na^+$–$K^+$ (d) None of these.

79. Which has $p_\pi - d_\pi$ Bonding

(a) Trisilylamine (b) Hexamine

(c) Nitrogen trifluoride (d) None of these.

80. Chlorophyl contains :

(a) Ca (II) (b) Mg (II)

(c) Co (II) (d) Fe (II).

**81.** Which is explosive in nature?

(a) Hydroxylamine (b) Hydrozine

(c) Sodium Azide (d) None of these.

**82.** Ziegler–Natta catalyst contains metal :

(a) Gold (b) Zirconium

(c) Tungsten (d) Titanium.

**83.** The pair having Similar Geometry is :

(a) $BF_3$, $NH_3$ (b) $CO_2$, $SO_2$

(c) $H_2O$, $C_2H_2$ (d) $NH_3$, $PH_3$.

**84.** Which is correct :

(a) if $\Delta G^\circ < 0$, then $K = 0$, reaction is at Equilibrium

(b) if $\Delta G^\circ < 0$, then $K > 1$, forward reaction is favoured

(c) if $\Delta G^\circ < 0$, then $K < 1$ backward reaction is favoured

(d) None of the above.

**85.** The compound which is not hydrolysed is

(a) $P_2O_5$ (b) $BaO_2$

(c) $Mg_3N_2$ (d) $CaC_2$ .

**86.** Which can be possible in chemical equilibrium?

(a) $K_p = K_c$ (b) $K_p > K_c$

(c) $K_c > K_p$ (d) All are possible.



**87.** Mercury poisoning occurs easily with the amino acid :

(a) Glycine (b) Alanine

(c) Valine (d) Cystine.

**88.** The compound which obeys 18-electron rule is :

(a) $Mn(CO)_5$ (b) $Fe(CO)_4$

(c) $V(CO)_6$ (d) $Cr(CO)_6$.

**89.** D-Glucose and D-Mannose are respectively :

(a) C4 and C4 epimers (b) C2 and C4 epimers

(c) C2 and C2 epimers (d) None of these.

**90.** Meso tartaric acid has configurational descriptions of

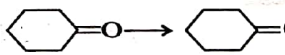
(a) 2R, 3R (b) 2R, 3S

(c) 2S, 3S (d) 3R, 2R.

**91.** The strongest oxidising agent in the following is

(a) $F_2$ (b) $O_2$

(c) $Br_2$ (d) $Au^{3+}$ .

**92.**  ;

This reaction is :

(a) Wolff-Kishner reaction (b) Wittig reaction

(c) Favorskii reaction (d) Fries Rearrangement .

**93.** In Reimer-Tiemann reaction the species that attacks on Benzene ring is

(a) $CCl_2^+$ (b) $\ddot{C}Cl_2$

(c) $\overline{C}Cl_3$ (d) $CHCl_3$.

94. In Baeyer-Villiger reaction ketone is converted into

(a) Carboxylic acid (b) Amide

(c) Alkane (d) Ester.

95. In Knoevenagel reaction the compound formed is

(a) $\alpha, \beta$ – unsaturated acid (b) $\alpha, \beta$ – unsaturated ester

(c) $\beta$ – keto acid (d) $\beta$ – keto ester.

96. Conditions of Clemmensen reduction are :

(a) Mg – Hg, $H_2O$ (b) Mg – Hg, Conc. HCl

(c) Zn – Hg, Conc. HCl (d) Zn – Hg, $H_2O$

97. In MPV reduction, which is formed?

(a) 1° – alcohol (b) 2° – alcohol

(c) 3° – alcohol (d) Aldehyde.

98. In Reformatsky reaction, the final product is :

(a) $\alpha$ – hydroxy carboxylic acid (b) $\beta$ – hydroxy carboxylic acid

(c) $\beta$ – hydroxy ester (d) None of these.

99. A tragic accident that occurred in Bhopal in 1984 was caused by Leakage of :

(a) $CH_3CN$ (b) $CH_3NC$

(c) $CH_3NCO$ (d) HCN.

100. Which is Ascending reaction ?

(a) Wolff-Kishner (b) Friedel-Craft

(c) Clemmensen Reduction (d) None of these.



ROUGH WORK

ROUGH WORK

SEAL

Note:- Discrepancy if any may be brought to the notice of Chairman, Department of Chemistry, K.U.K on given E-mail ID before 5.00PM on 12th March, 2020. [E-mail ID :- Chemdeptt.kuk@gmail.com].

ANSWER KEY OF PH.D. (CHEMISTRY) 2020 BOOKLET: A

| QNO. | ANS | QNO. | ANS | QNO. | ANS | QNO. | ANS | QNO. | ANS | QNO. | ANS | QNO. | ANS | QNO. | ANS | QNO. | ANS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | A | 11 | C | 21 | C | 31 | C | 41 | D | 51 | B | 61 | C | 71 | C | 81 | C | 91 | A |
| 2 | B | 12 | B | 22 | A | 32 | D | 42 | B | 52 | C | 62 | C | 72 | B | 82 | D | 92 | B |
| 3 | D | 13 | A | 23 | B | 33 | B | 43 | C | 53 | D | 63 | D | 73 | C | 83 | D | 93 | B |
| 4 | D | 14 | D | 24 | C | 34 | C | 44 | C | 54 | C | 64 | D | 74 | Discrepancy in Question | 84 | B | 94 | D |
| 5 | C | 15 | D | 25 | D | 35 | C | 45 | C | 55 | C | 65 | C | 75 | B | 85 | B | 95 | B |
| 6 | D | 16 | B | 26 | C | 36 | C | 46 | C | 56 | D | 66 | C | 76 | B | 86 | D | 96 | C |
| 7 | A | 17 | C | 27 | D | 37 | A | 47 | C | 57 | D | 67 | A | 77 | C | 87 | D | 97 | B |
| 8 | C | 18 | B | 28 | D | 38 | C | 48 | C | 58 | D | 68 | C | 78 | B | 88 | D | 98 | C |
| 9 | B | 19 | A | 29 | B | 39 | C | 49 | C | 59 | C | 69 | C | 79 | A | 89 | C | 99 | C |
| 10 | C | 20 | C | 30 | D | 40 | C | 50 | A | 60 | B | 70 | B | 80 | B | 90 | B | 100 | B |

Key checked with original key and
with question booklet and jumbling chart.
Original answer booklets and answer key received

Signature 3/9/2020