

**BOOKLET CODE**

**B**

**Invigilators Signature**

**ENTRANCE EXAMINATION – 2011**  
**M. Sc. Chemistry**

**TIME: 2 HOURS**

**MAXIMUM MARKS: 100**

**HALL TICKET NUMBER:**

**BOOKLET CODE:**

**INSTRUCTIONS**

1. Write your **HALL TICKET NUMBER** and the **BOOKLET CODE** in the space provided above and also in the **OMR ANSWER SHEET** given to you.
2. Make sure that pages numbered from 1 – 18 are present (excluding pages assigned for rough work).
3. There are 100 questions in this paper. All questions carry equal marks.
4. **There is negative marking. Each wrong answer carries -0.33 mark**
5. Answers are to be marked on the OMR answer sheet following the instructions provided there upon.
6. Hand over both the question paper booklet and OMR answer sheet at the end of the examination.
7. In case of a tie, the marks obtained in the first 25 questions (**PART-A**) will be used to determine the order of merit.
8. No additional sheets will be provided. Rough work can be done in the space provided at the end of the booklet.
9. Only non-programmable calculators are allowed.
10. Useful constants are provided on top of PART-A in the question paper.

## Booklet code B

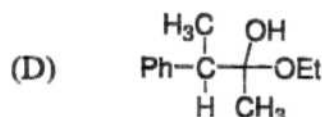
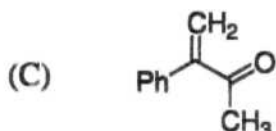
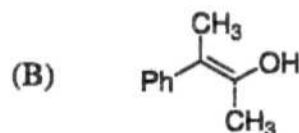
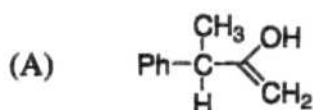
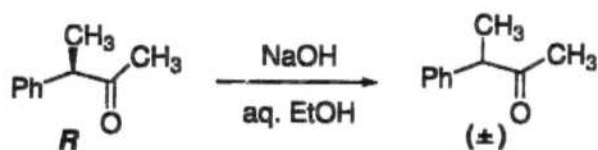
### Useful Constants:

Rydberg constant =  $109737 \text{ cm}^{-1}$ ; Faraday constant =  $96500 \text{ C}$ ; Planck constant =  $6.625 \times 10^{-34} \text{ J s}$ ;  
Speed of light =  $2.998 \times 10^8 \text{ m s}^{-1}$ ; Boltzmann constant =  $1.380 \times 10^{-23} \text{ J K}^{-1}$ ; Gas constant =  $8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ ;  
Mass of electron =  $9.109 \times 10^{-31} \text{ kg}$ ; Mass of proton =  $1.672 \times 10^{-27} \text{ kg}$ ; Charge of electron =  $1.6 \times 10^{-19} \text{ C}$ ;  
 $1 \text{ D} = 3.336 \times 10^{-30} \text{ C m}$ ;  $1 \text{ bar} = 10^5 \text{ N m}^{-2}$ ;  $RT/F = 0.059 \text{ V}$

### PART - A

- Which two colors of light cause the highest rate of photosynthesis?  
(A) Blue and green (B) Red and blue  
(C) Red and green (D) Green and yellow
- The remainder of  $\frac{x^4 + x^3 + x^2 + x + 1}{x - 1}$  is  
(A) 1 (B) 5 (C) 3 (D) 7
- Predict the sign of  $\Delta S$  for both of the following processes  
I.  $2 \text{ C (graphite)} + \text{O}_2 (\text{g}) \rightarrow 2 \text{ CO}_2 (\text{g})$   
II.  $\text{C}_4\text{H}_{10} (\text{g}) \rightarrow \text{C}_4\text{H}_{10} (\text{l})$   
(A)  $\Delta S$  should be negative for I and positive for II  
(B)  $\Delta S$  should be negative for I and negative for II  
(C)  $\Delta S$  should be positive for I and positive for II  
(D)  $\Delta S$  should be positive for I and negative for II
- The compounds  $\text{ZnO}$  and  $\text{FeO}$  show  
(A) stoichiometric and metal excess defects, respectively.  
(B) metal excess and stoichiometric defects, respectively.  
(C) metal deficiency and metal excess defects, respectively.  
(D) metal excess and metal deficiency defects, respectively.

5. An intermediate in racemization of (*R*)-3-phenyl-2-butanone is



6. The value of  $(1)^i$  is

(A) -1

(B)  $i$

(C)  $e^{-2\pi}$

(D)  $e^{-\pi}$

7. Doubling all the coefficients in the equation for a cell reaction

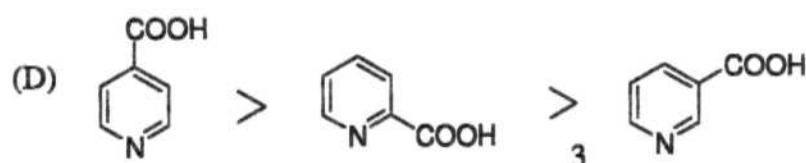
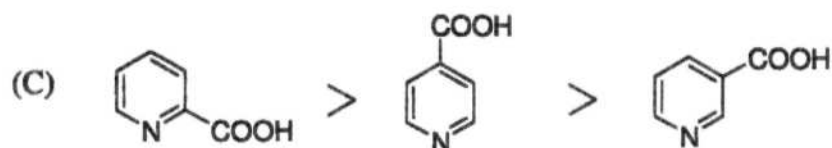
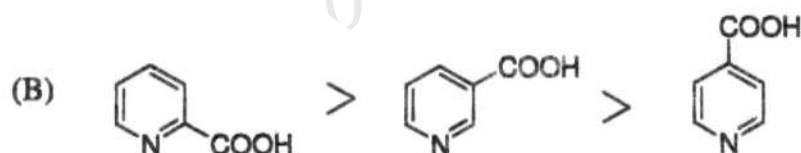
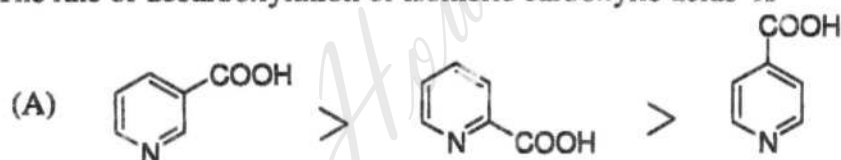
(A) doubles  $E^0$ , but does not change  $\Delta G^0$

(B) doubles  $\Delta G^0$ , but does not change  $E^0$

(C) does not change  $E^0$  or  $\Delta G^0$

(D) doubles both  $E^0$  and  $\Delta G^0$

8. The rate of decarboxylation of isomeric carboxylic acids is



## Booklet code B

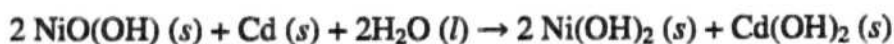
9. The packing efficiency in the hcp, bcc and simple cubic (sc) lattices are in the order

- (A) bcc > hcp > sc  
(B) hcp > bcc > sc  
(C) hcp > sc > bcc  
(D) sc > hcp > bcc

10. If  $\cos A = x$ ; then  $\cos 4A =$

- (A)  $4x$   
(B)  $8x^4 - 8x^2 + 1$   
(C)  $4x^4 - 4x^2 + 1$   
(D)  $2x^2 + 1$

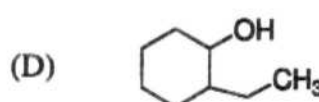
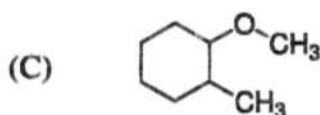
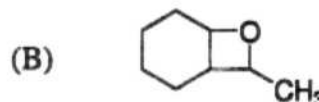
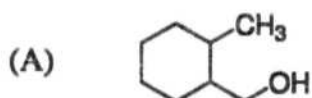
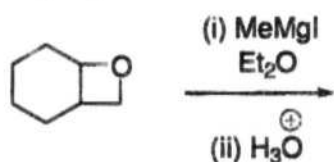
11. The nickel-cadmium cell has a standard potential of + 1.20 V. The cell reaction is



What is the standard free energy change for this reaction?

- (A) - 232 kJ  
(B) - 38.7 kJ  
(C) - 116 kJ  
(D) - 46.3 kJ

12. The major product of the following reaction is



13.  $\text{CuI}_2$  is unstable and it readily decomposes to

- (A) Cu and  $\text{I}^-$   
(B)  $\text{CuI}$  and  $\text{I}_2$   
(C) Cu and  $\text{I}_2$   
(D)  $\text{CuI}$  and  $\text{I}^-$

14. If two vertices of a cube chosen randomly are painted black and the remaining are painted white, what is the probability that the black vertices are adjacent i.e. connected by an edge?

- (A)  $\frac{1}{2}$   
(B)  $\frac{3}{28}$   
(C)  $\frac{2}{7}$   
(D)  $\frac{3}{7}$

15. Which of the following is necessary for a process to be spontaneous ( $\Delta S$  = change in entropy)?

- (A)  $\Delta S_{\text{system}} > 0$  (B)  $\Delta S_{\text{universe}} > 0$   
 (C)  $\Delta S_{\text{system}} < 0$  (D)  $\Delta S_{\text{surroundings}} < 0$

16. The strongest Brønsted acid among the following is

- (A)  (B)   
 (C)  (D) 

17. A sample of water contains 200 ppm of  $\text{Ca}^{2+}$ . What is the molality of the solution with respect to  $\text{Ca}^{2+}$ ? Atomic weight of Ca is 40.

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

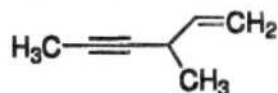
18. Consider the plot of the function  $y = 1/x$ . The tangent to this curve drawn at the point (1, 1), will cut the x-axis at:

- (A) (1, 0) (B)  $(\sqrt{2}, 0)$  (C)  $(1, \sqrt{2})$  (D) (2, 0)

19. X-ray diffraction study of a crystal with a simple cubic lattice structure shows diffraction from the (110) plane appearing at the Bragg angle  $\theta = 20^\circ$ . The angle at which the diffraction from the (220) plane will appear is

- (A)  $9.8^\circ$  (B)  $10^\circ$  (C)  $40^\circ$  (D)  $43^\circ$

20. The IUPAC name for the following compound is



- (A) 4-vinyl-2-pentyne (B) 3-methylhex-1-en-4-yne  
 (C) 3-methylhex-4-yn-1-ene (D) 4-methylhex-2-yn-5-ene



## Booklet code B

21. Which one among the following chlorides is dissociated to the least extent in aqueous solution?

- (A)  $\text{HgCl}_2$  (B)  $\text{ZnCl}_2$  (C)  $\text{BaCl}_2$  (D)  $\text{AlCl}_3$

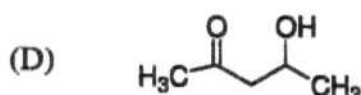
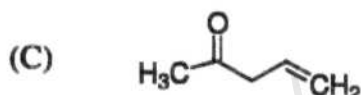
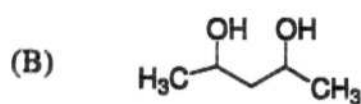
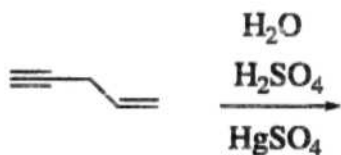
22. The sides of a triangle are of length 3.0, 4.0 and 5.0 cm. If the side with length 5.0 cm is the base, what is the height of the triangle?

- (A) 2.4 cm (B) 2.8 cm (C) 3.4 cm (D) 4.0 cm

23. Consider the equilibrium  $\text{X} \rightleftharpoons 2\text{Y}$  with equilibrium constant,  $K_C = 3.6 \text{ M}$  at  $25^\circ\text{C}$ . If the initial concentrations are  $[\text{X}]_0 = 1.0 \text{ M}$  and  $[\text{Y}]_0 = 0.0 \text{ M}$ , the equilibrium concentration of X at  $25^\circ\text{C}$ ,  $[\text{X}]_{\text{eq}}$  is

- (A) 0.33 M (B) 0.36 M (C) 0.40 M (D) 0.60 M

24. The major product expected from the following reaction is



25. Which of the following is not a crystalline substance?

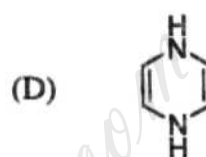
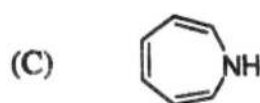
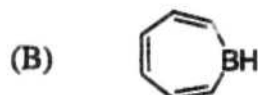
- (A) Graphite (B) Charcoal (C) Diamond (D)  $\text{C}_{60}$

## PART - B

26. How many milliliters of 2 M NaCl solution are required to make one litre of 0.4 M NaCl solution by adding water?

- (A) 5000 ml      (B) 800 ml      (C) 200 ml      (D) 20 ml

27. Which of the following compounds is aromatic?



28. A 0.01 M solution of a compound transmits 20 % of visible light when the absorbing path length is 1.5 cm. What is the molar extinction co-efficient of the substance? Solvent is assumed to be completely transparent.

- (A)  $46.6 \text{ M}^{-1}\text{cm}^{-1}$       (B)  $50.3 \text{ M}^{-1}\text{cm}^{-1}$       (C)  $22.3 \text{ M}^{-1}\text{cm}^{-1}$       (D)  $43.6 \text{ M}^{-1}\text{cm}^{-1}$

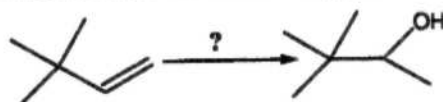
29. Which of the following atoms has the highest number of unpaired electrons in its ground state?

- (A) C      (B) N      (C) O      (D) F

30. Which of the following compounds has the highest boiling point?

- (A) Toluene      (B) Benzene  
(C) Mesitylene      (D) Cyclohexane

31. The best method for the following transformation is



- (A) acid mediated hydration      (B) hydroboration-oxidation  
(C) oxymercuration-demercuration      (D) ozonolysis-reduction

## Booklet code B

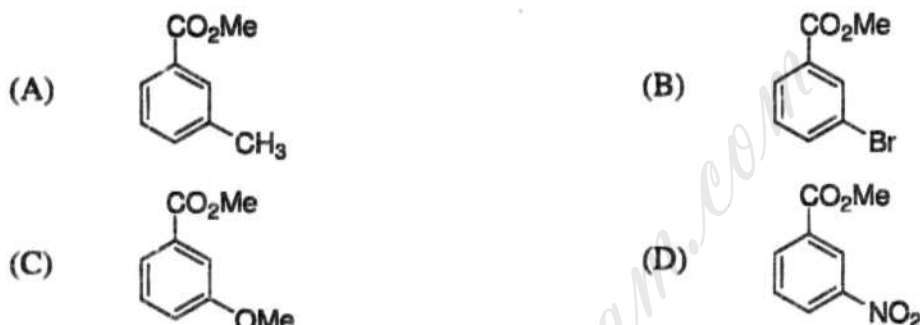
32. The concentration of  $\text{Ba}^{2+}$  in saturated  $\text{BaSO}_4$  solution at  $27^\circ\text{C}$  is  $1.04 \times 10^{-5} \text{ M}$ . What is the solubility product ( $K_{\text{sp}}$ ) for  $\text{BaSO}_4$  at this temperature?

- (A)  $1.04 \times 10^{-10} \text{ M}$  (B)  $2.08 \times 10^{-5} \text{ M}$   
(C)  $0.52 \times 10^{-10} \text{ M}$  (D)  $1.08 \times 10^{-10} \text{ M}$

33. What is the hybridization of sulfur in  $\text{SF}_4$ ?

- (A)  $\text{sp}^2$  (B)  $\text{sp}^3$  (C)  $\text{sp}^3\text{d}$  (D)  $\text{sp}^2\text{d}^2$

34. The ester that undergoes acid hydrolysis most readily is



35. If the half-life of a reaction is independent of its initial concentration, then the reaction may be categorized as

- (A) zeroth order (B) first order  
(C) second order (D) bimolecular

36. Which one of the following statements do not apply to interhalogen compounds?

- (A) Always obey octet rule (B) Could be cationic  
(C) Could be anionic (D) Could be neutral

37. The product obtained by the reaction of one equivalent of 1-bromo-3-chlorocyclobutane and two equivalents of Na is:





38. Which of the following pair has the lowest interfacial tension?  
 (A) *n*-decane/water (B) *n*-butane/water  
 (C) air/water (D) *n*-octyl alcohol/water
39. The gas pressure in an aerosol container is 1.5 atm at 25°C. Assuming an ideal behavior of the gas, if the container is heated to 450°C, the pressure would be close to  
 (A) 1.023 atm (B) 1.234 atm (C) 3.639 atm (D) 2.639 atm
40. The order of increasing dipole moment among H<sub>2</sub>S, H<sub>2</sub>O and BF<sub>3</sub> is  
 (A) BF<sub>3</sub> < H<sub>2</sub>S < H<sub>2</sub>O (B) H<sub>2</sub>O < H<sub>2</sub>S < BF<sub>3</sub>  
 (C) H<sub>2</sub>S < H<sub>2</sub>O < BF<sub>3</sub> (D) BF<sub>3</sub> < H<sub>2</sub>O < H<sub>2</sub>S
41. The graph of the equation  $4(x^2 - 4x) - 9(y^2 - 2y) - 29 = 0$  represents a  
 (A) parabola (B) ellipse (C) circle (D) hyperbola
42. Using Wade's rule predict the structure of B<sub>5</sub>H<sub>9</sub>  
 (A) closo (B) nido (C) arachno (D) scorpionato
43. In the S<sub>N</sub>1 solvolysis of the following primary alkyl chlorides in aqueous ethanol, the order of decreasing reactivity is
- CCCCl  
I

C=CCl  
II

COCCl  
III

CC(F)(F)CCl  
IV
- (A) I > II > III > IV (B) II > I > III > IV  
 (C) IV > III > II > I (D) III > II > I > IV
44. A solution of sulfuric acid contains 86 g of H<sub>2</sub>SO<sub>4</sub> per liter of solution. The normality of the solution is  
 (A) 2.0 N (B) 0.9 N (C) 1.8 N (D) 1.0 N

## Booklet code B

45. The equation of the normal line to  $y = x^3 - 2x^2 + 4$  at  $(2, 4)$  is

(A)  $y = -\frac{1}{4}x + \frac{9}{2}$

(B)  $y = 9x + 4$

(C)  $y = -4x + \frac{9}{2}$

(D)  $y = -9x + \frac{1}{4}$

46. The heat of reaction of both the reactions  $2 \text{KOH} + \text{H}_2\text{SO}_4 \rightarrow \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$  and  $\text{Mg}(\text{OH})_2 + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + 2 \text{H}_2\text{O}$  is  $-27.2 \text{ kcal/mol}$ . Hence the heat of reaction of  $3 \text{Ca}(\text{OH})_2 + 2 \text{H}_3\text{PO}_4 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + 6 \text{H}_2\text{O}$  would be

(A)  $-81.6 \text{ kcal/mol}$

(B)  $-27.2 \text{ kcal/mol}$

(C)  $-13.6 \text{ kcal/mol}$

(D)  $-68.0 \text{ kcal/mol}$

47. The standard equation of a circle passing through the points  $u (3, 8)$ ,  $v (9, 6)$  and  $w (13, -2)$  is

(A)  $(x - 2)^2 + (y - 3)^2 = 100$

(B)  $(x + 3)^2 + (y + 2)^2 = 100$

(C)  $(x - 2)^2 + (y + 3)^2 = 100$

(D)  $(x - 3)^2 + (y + 2)^2 = 100$

48. Acid is used in the standardization titration of  $\text{KMnO}_4$  against sodium oxalate because

(A) it helps in dissolving  $\text{KMnO}_4$ .

(B) it stabilizes permanganate ion.

(C) it facilitates the reduction of  $\text{Mn}^{7+}$  to  $\text{Mn}^{2+}$ .

(D) it helps in dissolving the  $\text{MnO}_2$  formed during titration.

49. Which of the following covalent compounds does not have any formally charged atom?



50. The two radial nodes in the  $3s$  radial function of H atom occur at the distances  $R_1$  and  $R_2$  from the nucleus. The three radial nodes in the  $4s$  orbital occur at  $R_3$ ,  $R_4$  and  $R_5$ . The order of these distances is given by

(A)  $R_3 < R_1 < R_4 < R_2 < R_5$

(B)  $R_1 < R_3 < R_4 < R_2 < R_5$

(C)  $R_3 < R_1 < R_2 < R_4 < R_5$

(D)  $R_3 < R_1 < R_4 < R_5 < R_2$

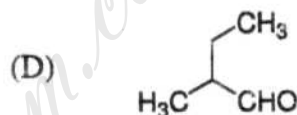
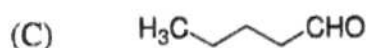
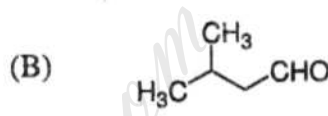
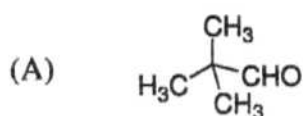
51. The oxidation number of carbon in dimethyl ether is

- (A) 1 (B) -1 (C) -2 (D) 2

52. The complex number  $-2 - 2\sqrt{3}i$  in polar form is given by

- (A)  $2e^{i2\pi/3}$  (B)  $4e^{i2\pi/3}$  (C)  $4e^{i3\pi/2}$  (D)  $4e^{i4\pi/3}$

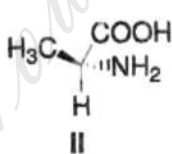
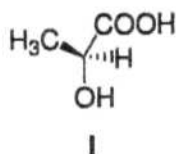
53. Compound I gives a strong infrared absorption at  $1730\text{ cm}^{-1}$ .  $^1\text{H}$  NMR spectrum indicates that it has two types of hydrogen atoms; one H atom appearing as singlet at  $\delta = 9.7$  ppm and 9 H atoms appearing as a singlet at  $\delta = 1.2$  ppm. The structure of I is



54. In a titration experiment, the end point indicates

- (A) neutralization point (B) completion of precipitation  
(C) exact equivalence point (D) apparent equivalence point

55. The structures I and II, shown below, correspond to:



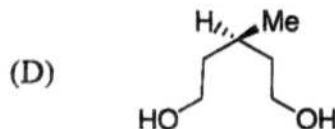
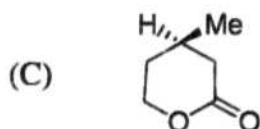
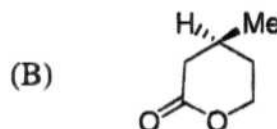
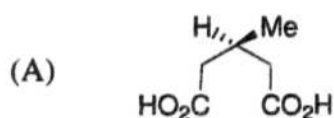
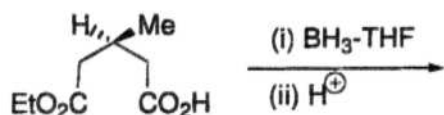
- (A) *S*-lactic acid and *S*-alanine (B) *R*-lactic acid and *R*-alanine  
(C) *R*-lactic acid and *S*-alanine (D) *S*-lactic acid and *R*-alanine

56. An extensive property of a thermodynamic system among the following is

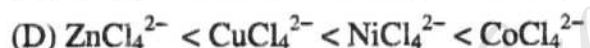
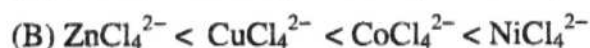
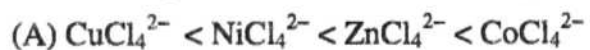
- (A) Pressure (B) Volume (C) Temperature (D) Concentration

## Booklet code B

57. The product obtained in the following transformation is



58. The number of unpaired electrons in the complex ion is in the order



59. If  $F(x) = x^{1/x}$  then  $\lim_{x \rightarrow \infty} F(x) =$

(A) 1

(B) 0

(C)  $\infty$

(D) e

60. The metal ion involved in the water oxidation process at the active site of photosystem II is

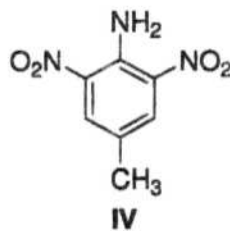
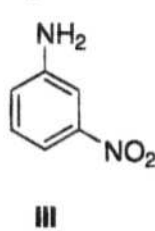
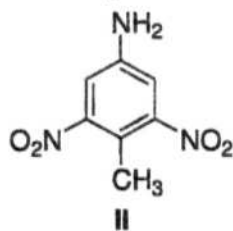
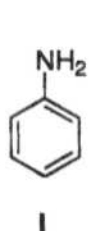
(A) Mn

(B) Mg

(C) Mo

(D) Fe

61. The order of basicity of the following substituted anilines is



(A) I > II > III > IV

(B) IV > III > I > II

(C) IV > II > I > III

(D) IV > I > III > II

**Booklet code B**

62. According to crystal field theory, the 9<sup>th</sup> electron of the metal centre in square planar  $[\text{Cu}(\text{NH}_3)_4]^{2+}$  resides in  
 (A)  $d_{x^2-y^2}$  (B)  $d_{xy}$  (C)  $d_{z^2}$  (D)  $d_{xz}$
63. The rotation of pure  $R(+)$ -Limonene is  $+123.0^\circ$ . Calculate the % of the (+) isomer in a sample showing a rotation of  $+109^\circ$ ?  
 (A) 8.6 (B) 77.2 (C) 82.9 (D) 94.3
64. An ideal gas undergoes isothermal and reversible expansion from its initial volume to some final volume at 300 K drawing in 90 kJ of heat. The change in the Gibbs free energy of the gas is  
 (A) 300 J (B) 0 J (C) 150 J (D) -300 J
65. For  $0 \leq x \leq 1$ ,  $\lim_{n \rightarrow \infty} \int_0^1 n x e^{-n x^2} dx =$   
 (A)  $\frac{1}{2}$  (B)  $\infty$  (C) 0 (D) 2
66. The magnetic quantum number of the last electron in the atom with atomic number 21 is  
 (A) 4 (B) 3 (C) 1 (D) 2
67. If the number  $e^{9i}$  is marked as a point on the complex plane, what is the distance of the point from the origin?  
 (A) 1 (B) 3 (C) 9 (D)  $\tan^{-1} 9$
68. What is the electronic configuration of  $\text{V}^{3+}$ ?  
 (A)  $[\text{Kr}]3d^2$  (B)  $[\text{Ar}]3d^2$  (C)  $[\text{Ar}]3d^3$  (D)  $[\text{Kr}] 3d^3$
69. The hybridization that is common for at least one of the carbon atoms in hydrogen cyanide, carbon disulfide, allene and carbon monoxide is  
 (A)  $sp^3$  (B)  $sp^2$  (C)  $sp$  (D)  $dsp^3$

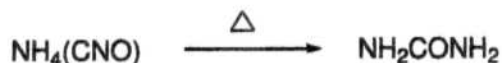


## Booklet code B

70. Which one among the given functions has the smallest slope at  $x = 1$ ?

- (A)  $2x^2 - 3$  (B)  $2x^2 - 1$  (C)  $2x^2 - 2x$  (D)  $2x^2 - x$

71. The intermediate acid involved in the following reaction is



- (A) uric acid (B) cyanuric acid (C) thiocyanic acid (D) cyanic acid

72. 50 mL of 0.04 M HCl solution was mixed with 50 mL of 0.02 M  $\text{AgNO}_3$  solution, stirred and filtered. The pH of the filtered solution is

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

73.  $(1 + 2i)^{-1}$  is equal to

- (A)  $1 - 2i$  (B)  $(1/5) - (2/5)i$   
(C)  $(1/3) - (2/3)i$  (D)  $-(1/3) + (2/3)i$

74. Which of the following fluorides is angular?

- (A)  $\text{SnF}_2$  (B)  $\text{ZnF}_2$  (C)  $\text{BeF}_2$  (D)  $\text{XeF}_2$

75. The more reactive dienophile among the following for the reaction with cyclopentadiene is



76. The two strands of double helical DNA are associated by hydrogen bonds between adenine (A) and thymine (T), and between guanine (G) and cytosine (C). The numbers of hydrogen bonds between A-T and G-C pairs, respectively are:

- (A) one, two (B) two, two (C) three, two (D) two, three

77. The intermediate involved in Curtius rearrangement is

- (A) carbenium ion (B) carbanion  
(C) nitrene (D) carbene

78. An organic compound on decomposition at 500°C and 1 atm. pressure released 2 mL each of carbon monoxide, nitrogen and water vapour. The empirical formula of the molecule is

- (A) CHNO (B) CH<sub>2</sub>NO (C) CH<sub>2</sub>N<sub>2</sub>O (D) CH<sub>2</sub>N<sub>2</sub>O<sub>2</sub>

79.  $\frac{d}{dt} \exp[t^2] =$

- (A)  $2t \exp(t^2)$  (B)  $\exp(t^2)$   
(C)  $1/t^2$  (D)  $(1/2t) \exp(t^2)$

80. Nessler's reagent is prepared by mixing a solution of KI with a solution of 'X' and then adding KOH solution. Here 'X' is

- (A) ZnCl<sub>2</sub> (B) HgCl<sub>2</sub> (C) AlCl<sub>3</sub> (D) TiCl<sub>4</sub>

81. According to the equation  $2 \text{Fe}^{3+} + 2\text{I}^- \longrightarrow \text{I}_2 + 2 \text{Fe}^{2+}$

how many grams of iodine can be produced by reacting 7.4 mols of Fe<sup>3+</sup> and 7.0 mols of I<sup>-</sup>? [At. Wt. of iodine is 127]

- (A)  $8.9 \times 10^2$  g (B)  $9.1 \times 10^2$  g (C)  $9.4 \times 10^2$  g (D)  $17.8 \times 10^2$  g

82. The most appropriate spectroscopy for the identification of a nitrile group is

- (A) IR (B) <sup>1</sup>H NMR (C) UV (D) ESR

83. If the units for rate are M s<sup>-1</sup>, what are the units for the rate constant, k, for a zeroth-order reaction?

- (A) s<sup>-1</sup> (B) M s<sup>-1</sup> (C) M<sup>-1</sup>s<sup>-1</sup> (D) M<sup>-1</sup>

## Booklet code B

84. The function with a finite range is  
(A)  $e^x$  (B)  $e^{x^2}$  (C)  $e^{x^3}$  (D)  $e^{-x^2}$
85. How many grams of copper will be produced when 27 g of aluminium is added to excess cupric sulphate solution? [At. wts.; Al = 27, Cu = 63.5]  
(A) 63.50 (B) 90.50 (C) 95.25 (D) 122.25
86. Given that  $^{18}\text{F}$  undergoes 90 % radioactive decay in 366 min., the half life ( $t_{1/2}$ ) for  $^{18}\text{F}$  is  
(A) 220 min. (B) 110 min. (C) 154 min. (D) 3473 min.
87. The phenolic compound among the following is:  
(A) Ibuprofen (B) Paracetamol (C) Penicillin (D) Camphor
88. What is the hydroxide ion concentration of a solution that has a pH of 11.20?  
(A)  $6.31 \times 10^{-12}$  M (B) 11.20 M (C)  $1.58 \times 10^{-3}$  M (D) 2.80 M
89. For all values of  $x$  which determinant among the following is zero?  
(A)  $\begin{vmatrix} x & 1 \\ 1 & x \end{vmatrix}$  (B)  $\begin{vmatrix} 1 & x \\ x & x^2 \end{vmatrix}$  (C)  $\begin{vmatrix} 1 & x \\ x & 1 \end{vmatrix}$  (D)  $\begin{vmatrix} 1 & x^2 \\ x & 1 \end{vmatrix}$
90. The conductivity of sodium dodecyl sulfate (SDS) solution exhibits a sharp transition around 8 mM concentration. This is because:  
(A) SDS precipitates beyond 8 mM concentration.  
(B) SDS undergoes hydrolysis above 8 mM concentration.  
(C) SDS forms a gel above 8 mM concentration.  
(D) SDS forms micelles above 8 mM concentration.
91. Assuming the additivity of covalent radii [C 0.77 Å, Br 1.14 Å], and assuming the distance between adjacent carbon atoms in the ring as 1.40 Å, the distance between the centres of bromine atoms in 1,2-dibromobenzene is  
(A) 3.31 Å (B) 3.42 Å (C) 4.20 Å (D) 2.28 Å

92. The number of stereoisomers for  $\text{CHD}=\text{CH}-\text{CH}=\text{CHD}$  is  
 (A) 4 (B) 8 (C) 2 (D) 6
93. The entropy change associated with the expansion of one mole of an ideal gas from an initial volume of  $V$  to a final volume of  $2.50 V$  at constant temperature is ( $R$  = gas constant)  
 (A)  $\Delta S = -R \ln 2.50$  (B)  $\Delta S = -2.50 R \ln (V_f/V_i)$   
 (C)  $\Delta S = 2.50 R \ln (V_f/V_i)$  (D)  $\Delta S = R \ln 2.50$
94. The smallest among the following integrals is  
 (A)  $\int_0^1 e^{-x^2} dx$  (B)  $\int_0^1 e^{-x} dx$  (C)  $\int_0^1 e^{-x^3} dx$  (D)  $\int_0^1 e^{-x^4} dx$
95. The quaternary structure of human hemoglobin is a  
 (A) dimer of two myoglobin dimers.  
 (B) tetramer of identical subunits.  
 (C) tetramer of four different subunits.  
 (D) tetramer of two different subunits.
96. The number of isomers having non-zero dipole moment for  $\text{PCl}_2\text{F}_3$  in the trigonal bipyramidal geometry is  
 (A) 2 (B) 3 (C) 1 (D) 0
97. The most appropriate reagent for the conversion of  $\text{RCO}_2\text{Me}$  into  $\text{RCH}_2\text{OH}$  is  
 (A)  $\text{NaBH}_4$  (B)  $\text{NaH}$  (C)  $\text{LiBH}_4$  (D)  $\text{Pd/C}$  and  $\text{H}_2$
98. Which of the following statements must be true for the entropy of a pure solid to be zero?  
 (I) The temperature must be 0 K.  
 (II) The solid must be crystalline, not amorphous.  
 (III) The solid must be perfectly ordered.  
 (IV) The solid must be an element.  
 (A) I (B) I and II (C) I, II and III (D) I, II, III and IV

**Booklet code B**

99. The function with exactly two minima and one maximum, among the following is

- (A)  $x^4 - x^2 - x$       (B)  $x + x^2 - x^4$       (C)  $x^3 - x^2 - x$       (D)  $x + x^2 - x^3$

100. Collagen is

- (A) an  $\alpha$ -helical structural protein.  
(B) a coiled-coil protein found in hair.  
(C) a cross-linked globular protein.  
(D) a triple-helical fibrous protein.