

BOOKLET CODE

C

Invigilator's Signature

**ENTRANCE EXAMINATION – 2010**  
**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 – 21 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. Calculators are allowed.
10. **Useful constants** are provided on top of **PART A** in the question paper.

## Useful Constants:

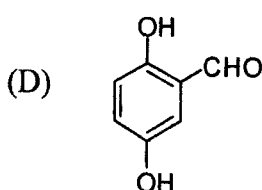
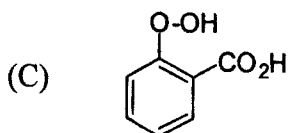
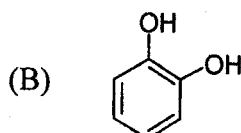
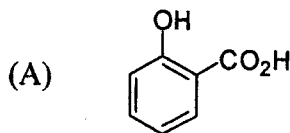
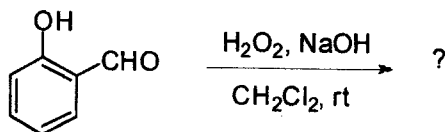
Rydberg constant =  $109737 \text{ cm}^{-1}$ ; Faraday constant =  $96500 \text{ Cmol}^{-1}$ ; Planck constant =  $6.625 \times 10^{-34} \text{ Js}$ ; Speed of light =  $2.998 \times 10^8 \text{ ms}^{-1}$ ; Boltzmann constant =  $1.380 \times 10^{-23} \text{ JK}^{-1}$ ; Gas constant =  $8.314 \text{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

## PART - A

1. The dipole moment of BrF is 1.29 D, and its bond length is 178 pm. What is the percent ionic character of the Br-F bond?

(A) 3.9      (B) 33      (C) 8.5      (D) 15

2. The major product obtained in the following transformation is



3. What is the charge required to make  $\text{V}(\text{CO})_6$  an 18-electron species?

(A) +1      (B) -1      (C) 0      (D) +2

4. If  $\frac{\log_{10} y}{\log_{10} x} = z$ , then

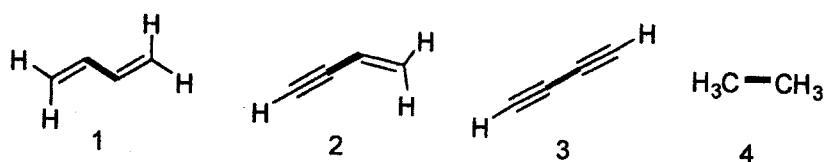
(A)  $\log_y x = z$       (B)  $\log_z x = y$       (C)  $\log_z y = x$       (D)  $\log_x y = z$

5. The following reaction is an example of



- (A) nucleophilic substitution      (B) electrophilic substitution  
 (C) free radical substitution      (D) nucleophilic addition
6. Which among the following is the strongest acid?  
 (A) Sulfuric acid  
 (B) Hydrobromic acid  
 (C) A solution of antimony pentafluoride in fluorosulfuric acid  
 (D) Fluorosulfuric acid
7. The critical solution temperature of water-phenol mixture at constant pressure is  
 (A) invariant      (B) bi-variant  
 (C) uni-variant      (D) tri-variant
8. Which of the following functions changes its magnitude most rapidly at  $x = 0$ ?  
 (A)  $e^{-x}$       (B)  $e^{-2x}$       (C)  $e^{-x^2}$       (D)  $e^{-2x^2}$
9. A capillary tube with an internal diameter of 0.2 mm is dipped into water. The surface tension of water is 73.6 dynes/cm. The height to which water rises in the capillary is  
 (A) 10 cm      (B) 100 cm      (C) 15 cm      (D) 20 cm
10. If the wave number of the O-H stretch vibration in the IR spectrum of  $\text{CH}_3\text{OH}$  is  $3300 \text{ cm}^{-1}$ , the wave number of the O-D stretch vibration of  $\text{CH}_3\text{OD}$  is  
 (A)  $3300 \text{ cm}^{-1}$       (B)  $2391 \text{ cm}^{-1}$       (C)  $2900 \text{ cm}^{-1}$       (D)  $1439 \text{ cm}^{-1}$

11. The decreasing order of C—C single bond length in the following compounds is



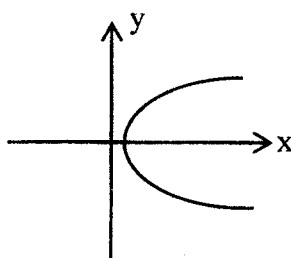
- (A) 1>2>4>3      (B) 3>1>2>4      (C) 4>1>2>3      (D) 2>1>3>4

12. An aqueous solution containing  $\text{NH}_4\text{Cl}$ ,  $\text{FeCl}_3$  and  $\text{MnCl}_2$  is treated with  $\text{NH}_4\text{OH}$  solution.

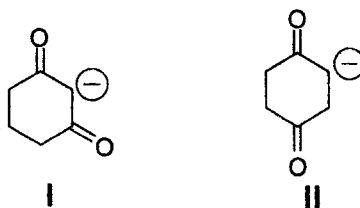
The observation is that

- (A) both  $\text{Fe}^{3+}$  and  $\text{Mn}^{2+}$  will precipitate as hydroxides.  
 (B) only  $\text{Fe}^{3+}$  will precipitate as hydroxide.  
 (C) only  $\text{Mn}^{2+}$  will precipitate as hydroxide.  
 (D)  $\text{NH}_4\text{Cl}$  will crystallize out from the solution.
13. The curve that passes through the intersection point of the two lines  $x + y = 1$  and  $y - x = 1$  is
- (A)  $y = x^2$       (B)  $y^2 = x$       (C)  $x^2 - y^2 = 1$       (D)  $x^2 + y^2 = 1$
14. A certain mass of gas occupies 5.50 liters at 300 K and 650 Torr. What will be its volume (liters) if it is cooled to 283 K and its pressure is increased to 980 Torr?
- (A) 3.44      (B) 2.44      (C) 1.54      (D) 6.47
15. The locus of points equidistant from (3, 0) and (5, 0) in the (X, Y) plane is
- (A)  $Y = 3$       (B)  $X = 4$       (C)  $Y = 4$       (D)  $X = 3$ .
16. Among the following, which one is a crystallographic point defect?
- (A) Edge dislocation      (B) Screw dislocation  
 (C) Schottky defect      (D) Stacking fault

17. An alkaloid contains C, H, N and O. Quantitative analysis of this compound showed the weight % of C, H and N to be, respectively, 70.8, 6.2, and 4.1. The empirical formula of the alkaloid is  
 (A)  $C_{71}H_6ON_4$     (B)  $C_{40}H_{42}O_8N_2$     (C)  $C_{141}H_{12}O_2N_8$     (D)  $C_{20}H_{21}O_4N$
18. The number of elements expected in the g-block of the periodic table is  
 (A) 14    (B) 18    (C) 22    (D) 26
19. Which equation represents the following figure?



- (A)  $x = 4y^2 + 2$     (B)  $y = 4x^2 + 2$   
 (C)  $x = 3y^2$     (D)  $y = 3x^2$
20. Choose the correct statement regarding the relative stabilities of the enolates **I** and **II**.

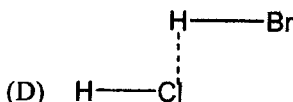
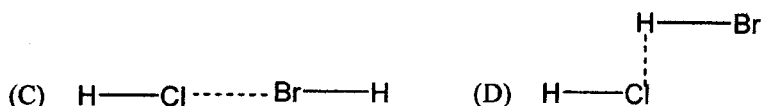
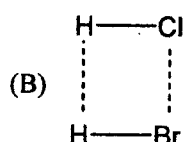
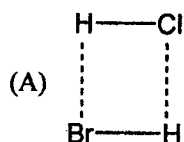


- (A) **I** is less stable than **II**  
 (B) **II** is less stable than **I**  
 (C) **I** and **II** have same stability  
 (D) No comparison of stability can be made
21. Which of the following compounds undergoes hydroiodination to give roughly equal quantities of two products?  
 (A) 1-butene    (B) 2-butene    (C) 2-methyl-2-butene    (D) 2-pentene

22. The curve  $y = x^2 + x - 30$  has a minimum at  
(A) -6    (B) -0.5    (C) 5    (D) -30.
23. Which of the following is *not suitable* as an antacid?  
(A) Sodium bicarbonate  
(B) Calcium carbonate  
(C) Sodium sulfate  
(D) Magnesium hydroxide
24. You are given ten one-rupee coins and asked to make a close packing on the desktop. The highest coordination number that can be achieved in two dimensions is  
(A) 4    (B) 6    (C) 8    (D) 9
25. Among  $\text{RbO}_2$ ,  $\text{AlO}_2^-$ ,  $\text{SrO}_2$  and  $\text{NO}_2^+$ , unpaired electron is present in  
(A)  $\text{NO}_2^+$     (B)  $\text{AlO}_2^-$     (C)  $\text{RbO}_2$     (D)  $\text{SrO}_2$

## PART - B

26. Which one among the given arrangements of one molecule of HCl and one molecule of HBr will have the lowest energy?



27. The determinant of the matrix  $\begin{pmatrix} 0 & 1 & 1 & 1 \\ 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{pmatrix}$  is

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

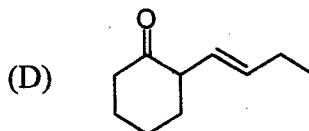
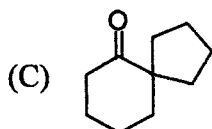
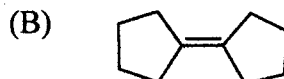
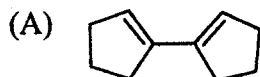
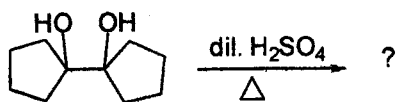
28. Crystals of an element possess a body-centered cubic (bcc) lattice structure. If the crystal undergoes a crystallographic transition to a face-centered cubic (fcc) lattice, the unit cell length will change by a factor of

(A)  $\sqrt{3}/\sqrt{2}$       (B)  $1/\sqrt{2}$       (C)  $\sqrt{3}$       (D)  $\sqrt{2}/\sqrt{3}$

29. An amino acid containing sulfur is

(A) proline      (B) cystine      (C) serine      (D) alanine

30. The product obtained in the following transformation is



31. Application of the condition of exactness of the differential,  $dE = TdS - PdV$ , leads to

(A)  $\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$

(B)  $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

(C)  $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$

(D)  $\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P$

32. For a molecule  $MX_3$  with zero dipole moment and M belonging to the second period, the orbitals on M involved in  $\sigma$ -bonding are of the type

- (A) pure p      (B) sp hybrid      (C)  $sp^3$  hybrid      (D)  $sp^2$  hybrid

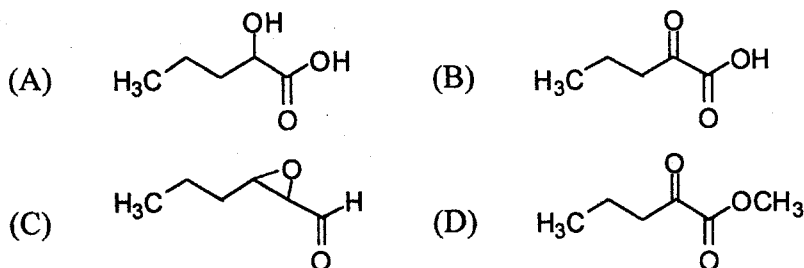
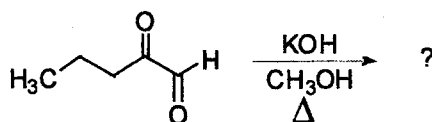
33. One mole of a perfect monatomic gas at 5.0 mbar pressure and occupying a volume of 1.66  $m^3$  undergoes isobaric expansion to a volume of 16.6  $m^3$ . The work done by the gas (kJ) and the temperature change (degree) during expansion are, respectively,

(A) + 3.8, +1000      (B) + 7.5, + 900

(C) -3.8, - 1000      (D) -7.5, + 900



34. The major product obtained in the following transformation is



35. The equation  $r = \Phi$ , where  $r$  is the distance of the point from the origin and  $\Phi$  is the angle of rotation from the  $x$  axis represents a

- (A) wave (B) monotonically decreasing function  
(C) circle (D) spiral

36. Which of the following is responsible for global warming?

- (A) UV radiation (B) Visible radiation (C)  $\alpha$ -Radiation (D) Infrared radiation

37. In normal silicates, each silicon atom is surrounded by

- (A) five oxygen atoms in a trigonal bipyramidal geometry  
(B) four oxygen atoms in a square planar geometry  
(C) four oxygen atoms in tetrahedral geometry  
(D) six oxygen atoms in octahedral geometry

38. Consider the following equilibrium:

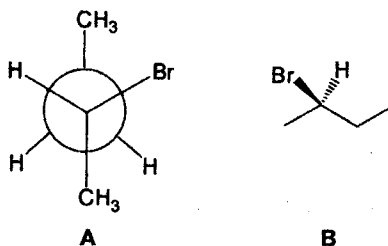


Given the following acids and their equilibrium constants ( $K_c$ ) at  $25^\circ\text{C}$ , which is the strongest acid?

- (A) HF,  $K_c = 3.5 \times 10^{-4}$  (B)  $\text{HNO}_2$ ,  $K_c = 4.5 \times 10^{-4}$   
(C) HOBr,  $K_c = 2.0 \times 10^{-9}$  (D)  $\text{HIO}_3$ ,  $K_c = 1.7 \times 10^{-1}$

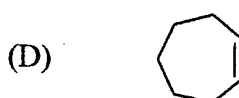
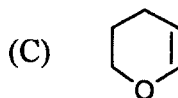
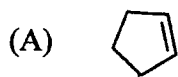
39. Given the relation  $f(2x) = 2f^2(x) - 1$ , the value of  $f(x)$  for which  $f(2x) = f(x)$  is  
(A) 0                      (B)  $1/2$                       (C) 1                      (D)  $3/2$
40. In the aluminothermit process, the function of aluminium is to act as  
(A) a flux    (B) a solder    (C) a reducing agent    (D) an oxidizing agent
41. Which one among the following set of arrangements is not feasible?
- |     | n | l | $m_l$ | $m_s$  |
|-----|---|---|-------|--------|
| (A) | 5 | 3 | 0     | $-1/2$ |
| (B) | 4 | 2 | -3    | $1/2$  |
| (C) | 3 | 2 | -2    | $1/2$  |
| (D) | 3 | 0 | 0     | $1/2$  |
42. The metal present in Gilman reagent is  
(A) Au    (B) Ag    (C) Zn    (D) Cu
43. Decomposition of dinitrogen pentoxide is described by the chemical equation  
 $2 \text{N}_2\text{O}_5 (\text{g}) \rightarrow 4 \text{NO}_2 (\text{g}) + \text{O}_2 (\text{g})$   
The rate of appearance of  $\text{NO}_2$  is equal to 0.560 mol/min at a particular moment, what is the rate of appearance of  $\text{O}_2$  at that moment?  
(A) 1.12 mol/min                      (B) 0.280 mol/min  
(C) 0.140 mol/min                      (D) 2.24 mol/min
44.  $^{14}\text{N}$ , upon bombardment with a neutron gives  $^{14}\text{C} + \text{X}$ . In another reaction,  $^{14}\text{N}$  upon bombardment with an  $\alpha$ -particle gives  $^{17}\text{O} + \text{Y}$ . X and Y are  
(A) positron and neutron, respectively  
(B) proton and neutron, respectively  
(C)  $\beta$ -particle and proton, respectively  
(D) both protons

45. The Newman projection and stereochemical structures of **A** and **B** are given below. The similarity between the two structures is that both



- (A) are enantiomers                      (B) have the same chirality *R*  
 (C) have the same chirality *S*        (D) are diastereomers
46. Potassium crystallizes in a body centered cubic lattice with  $a = 5.20 \text{ \AA}$ . The distance in  $\text{\AA}$  between the nearest neighbors, the number of nearest neighbors and the number of K atoms in the unit cell are, respectively,
- (A) 3.69, 8 and 2  
 (B) 4.50, 8 and 2  
 (C) 4.50, 6 and 4  
 (D) 3.69, 8 and 9
47. The integrating factor of the equation  $(2x^2 + y^2 + x)dx + xydy = 0$  is
- (A)  $x$       (B)  $e^x$       (C)  $\log x$       (D)  $\frac{1}{x}$
48. In acid medium, one mole of  $\text{KMnO}_4$  will be equivalent to
- (A) 2.0 moles of sulfite ion  
 (B) 2.5 moles of sulfite ion  
 (C) 5.0 moles of sulfite ion  
 (D) 0.4 moles of sulfite ion

49. Which of the following olefins will give the racemic alcohol after hydroboration reaction using  $B_2H_6$  in THF followed by oxidation with  $H_2O_2/NaOH$ ?



50. One mole of an ideal gas expands isothermally from 1.0 liter to 10.0 liter at 300 K. The work done by the gas is

- (A) 5757 J      (B) 5102 J      (C) 2501 J      (D) 1250 J

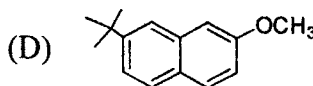
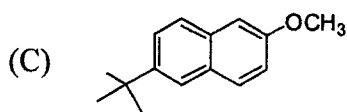
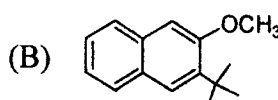
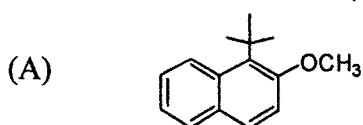
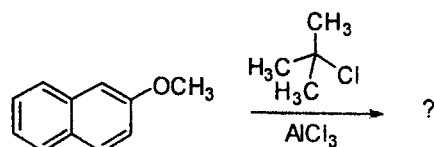
51. If  $f(x, y) = \sin(ax^2 + y)$ , then  $\frac{\partial f}{\partial x}$  is

- (A)  $\cos ax^2$       (B)  $2ax \cos ax^2$   
 (C)  $2ax \cos(ax^2 + y)$       (D)  $\cos(ax^2 + y)$

52. Choose the pair in which an effective acid base titration is not feasible.

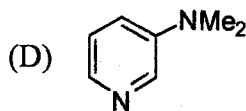
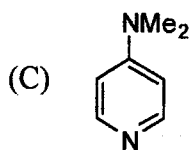
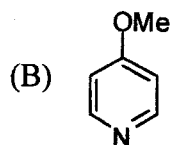
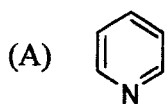
- (A) weak acid, strong base  
 (B) weak acid, weak base  
 (C) strong acid, strong base  
 (D) strong acid, weak base

53. The major product obtained in the following transformation is



54. If  $\alpha$  and  $\beta$  are the roots of the equation,  $3x^2 + 2x + 1 = 0$ , then  $\frac{1}{\alpha} + \frac{1}{\beta}$  is equal to  
(A)  $-1/3$       (B)  $2/3$       (C)  $1 + i\sqrt{8}$       (D)  $-2$
55. Consider the three processes: (i) sublimation of a solid, (ii) cooling a sample of Co(s) from  $60^\circ\text{C}$  to  $25^\circ\text{C}$ , and (iii) combustion of charcoal to form  $\text{CO}_2(\text{g})$  and  $\text{H}_2\text{O}(\text{g})$ . The signs of  $\Delta H$  and  $\Delta S$  for the three processes (i), (ii), and (iii) are  
(A) (i)  $\Delta H > 0$  and  $\Delta S > 0$ ; (ii)  $\Delta H < 0$  and  $\Delta S < 0$ ; (iii)  $\Delta H < 0$  and  $\Delta S > 0$   
(B) (i)  $\Delta H > 0$  and  $\Delta S > 0$ ; (ii)  $\Delta H < 0$  and  $\Delta S > 0$ ; (iii)  $\Delta H < 0$  and  $\Delta S < 0$   
(C) (i)  $\Delta H < 0$  and  $\Delta S > 0$ ; (ii)  $\Delta H < 0$  and  $\Delta S < 0$ ; (iii)  $\Delta H > 0$  and  $\Delta S > 0$   
(D) (i)  $\Delta H < 0$  and  $\Delta S < 0$ ; (ii)  $\Delta H > 0$  and  $\Delta S > 0$ ; (iii)  $\Delta H < 0$  and  $\Delta S > 0$
56. The net charge on the amino acid residue of aspartic acid at physiological pH is  
(A)  $+1$       (B)  $0$       (C)  $-1$       (D)  $-2$
57. The number of lone pair of electrons around xenon in  $\text{XeF}_3^+$ ,  $\text{XeF}_4$  and  $\text{XeO}_3$  are, respectively,  
(A) 1, 2 and 1  
(B) 2, 2 and 1  
(C) 2, 1 and 2  
(D) 1, 2 and 2
58. A reaction follows the general rate law,  $\text{Rate} = k[\text{A}][\text{B}]^2$ . If the concentration of B is increased by a factor of 2, the rate of reaction will  
(A) increase by a factor of 4      (B) increase by a factor of 2  
(C) decrease by a factor of  $1/2$       (D) decrease by a factor of  $1/4$

59. The strongest nucleophile among the following is



60. The sum of the infinite series  $1 + 2x + 3x^2 + 4x^3 + \dots$  is ( $|x| < 1$ )

(A)  $\frac{1}{1-x}$       (B)  $\frac{1}{(1-x)^2}$       (C)  $\ln x$       (D)  $e^x$

61. If  $y = |x|$ ,  $\frac{dy}{dx}$  is

- (A) +1 for  $x > 0$  and -1 for  $x < 0$       (B) +1 for  $-\infty < x < \infty$   
 (C) -1 for  $-\infty < x < \infty$       (D) -1 for  $x > 0$  and +1 for  $x < 0$

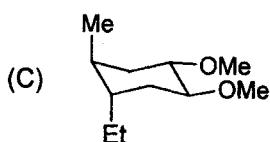
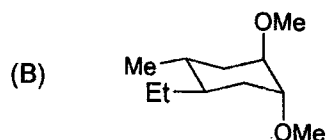
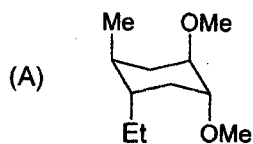
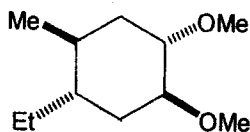
62. A supercritical fluid is a substance

- (A) that is in the liquid crystal state  
 (B) with zero viscosity  
 (C) existing at a temperature and pressure above its  $T_c$  and  $P_c$   
 (D) at its triple point

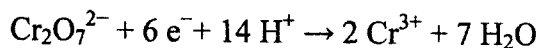
63. Among  $\text{Ni}(\text{CO})_4$ ,  $[\text{Ni}(\text{CN})_4]^{2-}$  and  $[\text{NiCl}_4]^{2-}$ ,

- (A)  $\text{Ni}(\text{CO})_4$  and  $[\text{NiCl}_4]^{2-}$  are planar while  $[\text{Ni}(\text{CN})_4]^{2-}$  is tetrahedral  
 (B)  $[\text{Ni}(\text{CN})_4]^{2-}$  and  $[\text{NiCl}_4]^{2-}$  are planar while  $\text{Ni}(\text{CO})_4$  is tetrahedral  
 (C)  $\text{Ni}(\text{CO})_4$  and  $[\text{Ni}(\text{CN})_4]^{2-}$  are planar while  $[\text{NiCl}_4]^{2-}$  is tetrahedral  
 (D)  $[\text{Ni}(\text{CN})_4]^{2-}$  is planar while  $\text{Ni}(\text{CO})_4$  and  $[\text{NiCl}_4]^{2-}$  are tetrahedral

64. The preferred conformation of the compound given below is



65. According to the following half reaction, the molarity corresponding to a 0.4N solution of  $\text{Na}_2\text{Cr}_2\text{O}_7$  is



- (A) 0.4M      (B) 0.1M      (C) 0.067M      (D) 2.4M

66. The complex number  $(1+i)^2$  in polar form corresponds to

- (A)  $r = \sqrt{2}, \theta = \pi/4$       (B)  $r = 2, \theta = \pi/4$   
 (C)  $r = \sqrt{2}, \theta = \pi/2$       (D)  $r = 2, \theta = \pi/2$

67. Consider a relatively weak acid with  $\text{pK}_a = 3.90$ . A base is added to this acid in order to obtain a buffer with  $\text{pH} = 4.12$ . Which of the following is closest to correct acid: base ratio in the buffer?

- (A) 3.12      (B) 0.623      (C)  $3.1 \times 10^3$       (D) 0.603

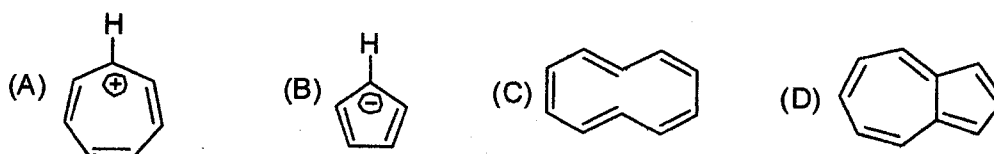
68. The line segments corresponding to  $2x - 5y + 8 = 0$  and  $x + 3y - 7 = 0$  constitute the diameters of a circle of area 616 sq. units. The equation of the circle is

- (A)  $(x-2)^2 + (y-1)^2 = 196$       (B)  $(x-1)^2 + (y-2)^2 = 196$   
 (C)  $(x-1)^2 + (y-2)^2 = 616$       (D)  $(x-2)^2 + (y-1)^2 = 616$

69. A condensation (step-growth) polymer among the following is
- (A) Polystyrene
  - (B) Polyvinyl chloride
  - (C) Poly(ethylene terephthalate)
  - (D) Polypropylene
70. Which one of the following salts will be attracted most strongly by a magnet?
- (A)  $\text{MnSO}_4$     (B)  $\text{CoSO}_4$     (C)  $\text{ZnSO}_4$     (D)  $\text{CuSO}_4$
71. The proton NMR spectrum of 3-pentanone shows
- (A) one triplet and one quartet
  - (B) one singlet and one doublet
  - (C) one quartet and one doublet
  - (D) one singlet
72. The formal oxidation number of carbon in formaldehyde is
- (A) -2    (B) 0    (C) 2    (D) 4
73. 72 g of ozone gas contained in a closed vessel at 1.0 atm pressure and 700 K temperature decomposes completely to oxygen gas. The pressure in the vessel changes to
- (A) 0.67 atm    (B) 1.0 atm    (C) 1.5 atm    (D) 2.0 atm
74. Three vectors, A, B, and C are defined as:  $A = 2\hat{i} + 3\hat{j} - 4\hat{k}$ ,  $B = \hat{i} - 2\hat{j} + 2\hat{k}$  and  $C = 3\hat{i} - 3\hat{j} - \hat{k}$ . Their vector triple product is given by
- (A)  $31\hat{i} - 32\hat{j} - 8\hat{k}$     (B)  $31\hat{i} - 32\hat{j} + 12\hat{k}$   
(C)  $30\hat{i} - 32\hat{j} - 8\hat{k}$     (D)  $31\hat{i} - 22\hat{j} - 8\hat{k}$
75. Which one of the following ions does not interfere with the brown ring test for the nitrate ion?
- (A)  $\text{NO}_2^-$     (B)  $\text{Br}^-$     (C)  $\text{I}^-$     (D)  $\text{Cl}^-$



76. Which one of the following is not aromatic?



77. The carbonyl stretching band of ketones is usually observed around

- (A)  $1200\text{ cm}^{-1}$  (B)  $1700\text{ cm}^{-1}$  (C)  $2200\text{ cm}^{-1}$  (D)  $3600\text{ cm}^{-1}$

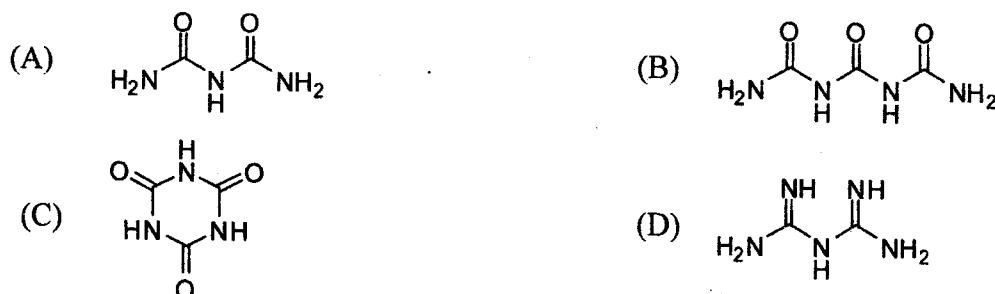
78. The solubility product of AgBr at  $25^\circ\text{C}$  is [ $E^0_{\text{AgBr(s)}/\text{Br}^-} = 0.071\text{ V}$  and  $E^0_{\text{Ag}^+/\text{Ag}} = 0.799\text{ V}$  at  $25^\circ\text{C}$ ]

- (A)  $4.58 \times 10^{-13}$  (B)  $6.28 \times 10^{-7}$   
 (C)  $9.12 \times 10^{-2}$  (D)  $4.58 \times 10^{-15}$

79. The mole percentages of  $\text{N}_2$ ,  $\text{O}_2$ , and Ar in dry air are, respectively, 78, 21 and 1. The average molecular weight of air is

- (A) 29.0 (B) 92.0 (C) 59.0 (D) 18.0

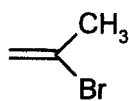
80. The characteristic violet color of biuret test is used to identify urea in a qualitative analysis. The structure of biuret is



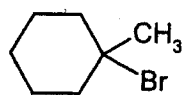
81. The soldering material used by electricians is an alloy of

- (A) Cu and Pb (B) Zn and Cu (C) Sn and Pb (D) Fe and Zn

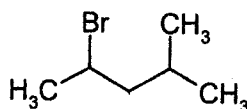
82. The order of decreasing rate of solvolysis with aqueous ethanol (fastest  $\rightarrow$  slowest) for the following bromides is



(I)



(II)



(III)

- (A) II > I > III      (B) I > II > III      (C) II > III > I      (D) I > II > III

83. A three digit number divisible by 3 is to be formed using the numbers 0, 1, 2, and 3, without repetition. The total number of ways this can be done is

- (A) 6      (B) 10      (C) 12      (D) 15

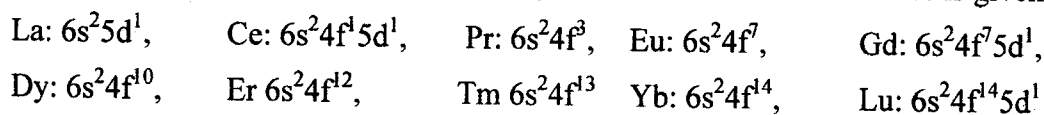
84. The correct order for increasing thermal stabilities among  $K_2CO_3$ ,  $MgCO_3$ ,  $BeCO_3$  and  $CaCO_3$  is

- (A)  $K_2CO_3 < MgCO_3 < CaCO_3 < BeCO_3$   
 (B)  $BeCO_3 < MgCO_3 < CaCO_3 < K_2CO_3$   
 (C)  $BeCO_3 < MgCO_3 < K_2CO_3 < CaCO_3$   
 (D)  $MgCO_3 < CaCO_3 < BeCO_3 < K_2CO_3$

85. If a general point in the Cartesian coordinate system is represented by  $(x, y, z)$ , and if a line is drawn from  $(0, 0, 0)$  to  $(1, 1, 0)$  then what is the angle between this line and the  $z$  axis?

- (A)  $0^\circ$       (B)  $45^\circ$       (C)  $90^\circ$       (D)  $180^\circ$

86. The most probable outer electronic configuration for several lanthanides is given below.



The elements that can have +2 as a stable oxidation state are

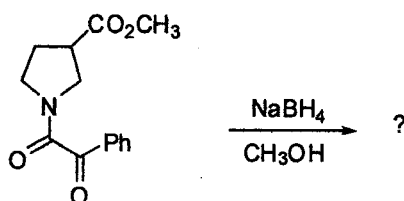
- (A) Gd and Dy      (B) Pr and Er      (C) La and Lu      (D) Eu and Yb

87. A fused five- and six-membered carbocyclic ring is an integral part of

- (A) quinidine      (B) cholesterol      (C)  $\alpha$ -pinene      (D) chlorophyll

88. Bromine has a heat of vaporization of  $30.91 \text{ kJmol}^{-1}$  and its boiling point is  $59^\circ \text{C}$ . What is the entropy of vaporization of bromine?
- (A)  $-301 \text{ Jmol}^{-1}\text{K}^{-1}$                       (B)  $10.7 \text{ Jmol}^{-1}\text{K}^{-1}$   
(C)  $-93.1 \text{ Jmol}^{-1}\text{K}^{-1}$                       (D)  $93.1 \text{ Jmol}^{-1}\text{K}^{-1}$
89. Choose the statement that is **incorrect**.
- (A) Many  $\text{S}_{\text{N}}2$  reactions are slowest in protic (hydroxylic) solvents.  
(B)  $\text{S}_{\text{N}}2$  reactions are the slowest in polar aprotic (nonhydroxylic) solvents  
(C)  $\text{S}_{\text{N}}1$  reactions are subject to large solvent effects.  
(D)  $\text{S}_{\text{N}}1$  reactions are favored by polar protic (hydroxylic) solvents.
90. A workshop contains 10 white, 5 black and 6 red cars to be repaired. If 4 cars are taken out at random, the probability that they consist of two white, one black and one red car is
- (A) 0.0251                      (B) 0.0521                      (C) 0.0125                      (D) 0.0512
91. If 22 g of  $\text{N}_2\text{O}_5$  reacts with 10 g of water to produce 22 g of nitric acid, the percentage yield of nitric acid is
- (A) 32                      (B) 69                      (C) 87                      (D) 100
92. If the vertices of a quadrilateral are A (0, 0), B (0, 3), C (4, 3) and D (4, 0) then ABCD is
- (A) a square                      (B) a parallelogram  
(C) a rectangle                      (D) a trapezoid
93. If sum of a series is defined as,  $S_n = 1 + 2 + 4 + 8 + 16 + \dots + 2^n$ , the value of  $S_{20}$  is:
- (A)  $2^{21} - 1$                       (B)  $2^{20}$                       (C)  $20!$                       (D)  $2^{20} + 20^2$

94. The product obtained in the following transformation is



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

95. The boiling point of 0.1 M glucose solution under 1 atm pressure is  $100.02^\circ\text{C}$ . The boiling point of 0.25 M  $\text{K}_2\text{SO}_4$  solution under 1 atm pressure would be

- (A)  $100.5^\circ\text{C}$       (B)  $100.6^\circ\text{C}$       (C)  $101.4^\circ\text{C}$       (D)  $100.15^\circ\text{C}$

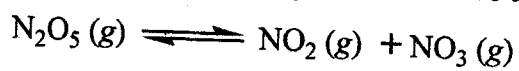
96. Two van der Waals gases (A and B) have the same values of 'a' but different values of 'b'. The correct statement among the following is

- (A) Both are equally compressible  
 (B) Gas with lower 'b' value is more compressible  
 (C) Gas with higher 'b' value is more compressible  
 (D) Neither A nor B is compressible.

97. Liquids A and B form an ideal solution at all mixing ratios. At  $50^\circ\text{C}$ , a solution containing 1 mole of A and 2 moles of B has a total vapor pressure of 110 mm Hg. When 1 mole of A is added to this solution, the total vapor pressure changed to 105 mm Hg. If 1 mole of B is now added to this solution containing 2 moles of A and 2 moles of B, the total vapor pressure (in mm Hg) will be

- (A) 106      (B) 108      (C) 110      (D) 112

98. Which change in the system will drive the equilibrium to the left in the reaction below?



- (A) an increase in the amount of  $\text{N}_2\text{O}_5$       (B) a decrease in the amount of  $\text{NO}_3$   
(C) an increase in pressure      (D) an increase in volume.
99. For the reaction  $2\text{HI} \rightarrow \text{H}_2 + \text{I}_2$ , the values of rate constants are  $1.2 \times 10^{-3}$  and  $3.0 \times 10^{-5}$   $\text{dm}^3\text{mol}^{-1}\text{sec}^{-1}$  at 700 K and 629 K, respectively. The activation energy of the reaction is  
(A)  $40.0 \text{ kcalmol}^{-1}$     (B)  $54.0 \text{ kcalmol}^{-1}$     (C)  $45.5 \text{ kcalmol}^{-1}$     (D)  $54.5 \text{ kcalmol}^{-1}$
100. The valence electronic configuration of two atoms with atomic numbers  $Z_1$  and  $Z_2$  are  $3s^23p^3$  and  $4s^24p^5$ , respectively. The difference  $Z_2 - Z_1$  is  
(A) 8      (B) 10      (C) 18      (D) 20
-