# INDIAN INSTITUTE OF SCIENCE
# BANGALORE - 560012

## ENTRANCE TEST FOR ADMISSIONS - 2010

**Program : Research**
**Entrance Paper : Chemistry**
**Paper Code : CY**

Day & Date
**SUNDAY, 25TH APRIL 2010**

Time
**9.00 A.M. TO 12.00 NOON**

## INSTRUCTIONS

1. **This question paper consists of only multiple-choice questions. All questions carry one mark each.**
2. Answers are to be marked in the OMR sheet provided.
3. For each question, darken the appropriate bubble to indicate your answer.
4. Use only HB pencils for darkening the bubble.
5. Mark only one bubble per question. If you mark more than one bubble, the answer will be evaluated as incorrect.
6. If you wish to change your answer, please erase the existing mark completely before marking the other bubble.
7. There will be NEGATIVE marking. NEGATIVE marking for each wrong answer will be 1/3.
8. A periodic table is given at the end.
9. Some useful physical constants:

| | | |
|---|---|---|
| (A) Universal gas constant | $R$ = | $8.31451\ J\ mol^{-1}\ K^{-1}$ |
| | | $0.08206\ L\ atm\ mol^{-1}\ K^{-1}$ |
| (B) Planck's constant, | $h$ = | $6.626 \times 10^{-34}\ J.s$ |
| (C) Acceleration due to gravity | $g$ = | $9.8\ m\ s^{-2}$ |
| (D) Speed of light in vacuum | $c$ = | $2.998 \times 10^{8}\ m\ s^{-1}$ |
| (E) Avogadro's number | $N$ = | $6.023 \times 10^{23}\ mol^{-1}$ |
| (F) Boltzmann constant | $k$ = | $1.380 \times 10^{-23}\ J\ K^{-1}$ |
| (G) Electron charge | $e$ = | $1.602 \times 10^{-19}\ C$ |
| (H) Electron mass | $m_e$ = | $9.109 \times 10^{-31}\ Kg$ |
| (I) Permittivity of the vacuum | $\varepsilon_0$ = | $8.854 \times 10^{-12}\ F\ m^{-1}$ |
| (J) Faraday constant | $F$ = | $9.65 \times 10^{4}\ C\ mol^{-1}$ |
| (K) 1 Calorie | = | 4.184 J |
| (L) 1 atm | = | 760 Torr |
| (M) 1 eV | = | $1.6022 \times 10^{-19}\ J$ |

# CHEMISTRY

1. Temperature dependence of the rate constant for a reaction obeys the Arrhenius equation: $k = A \times e^{\left[\frac{-E_a}{RT}\right]}$. According to this equation, as T approaches infinity, $k$ will approach:

   (A) $A$
   (B) infinity
   (C) 1
   (D) 0

2. Among the following molecules, the one that is **NOT** infrared active is:

   **(A)** $C_2H_2$, acetylene
   (B) $CH_4$, methane
   (C) $N_2$, nitrogen molecule
   **(D)** $CO_2$, carbon dioxide

3. The molar entropy of a molecule that can have three distinct orientations at absolute zero is approximately:

   (A) 9.13 J $K^{-1}$
   (B) 5.76 J $K^{-1}$
   (C) 24.9 J $K^{-1}$
   (D) 3.96 J $K^{-1}$

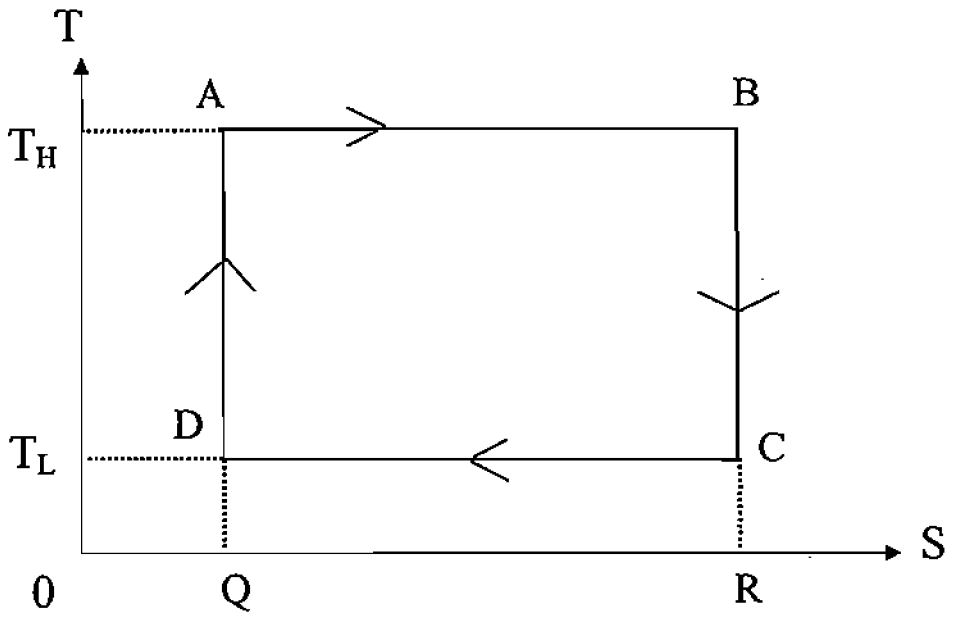
4. For the reaction of oxygen in equilibrium with ozone: $3O_2$ **(g)** $\leftrightarrow$ $2O_3$ (g), the number of intensive variables to be specified to describe the state of the system, is:

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

5. The atomic term symbol for the helium atom in its ground state is

   (A) $^3S_1$
   (B) $^3P_2$
   (C) $^3S_0$
   (D) $^1S_0$

6. The operation of a Carnot engine between a high temperature $T_H$ and a low temperature $T_L$ is shown next in terms of temperature T and entropy S of some working fluid.




Among the following statements about this figure, the one that is NOT TRUE is:

(A) The network done by the system is the area ABRQ – DCRQ.
(B) The step C → D corresponds to an isothermal expansion of the working fluid.
(C) The heat deposited by the system in the thermal reservoir at $T_L$ is the area DCRQ.
(D) Both the steps D → A and B → C describe adiabatic processes.

7. Among the following forms of carbon, the thermodynamically most stable one is:

(A) Carbon nanotube
(B) Fullerene
(C) Diamond
(D) Graphite

8. One mole of an ideal gas cxpands from 5 atm against a constant prcssure of 1 atm at 298 K. The magnitude of work done by the gas is:

(A) 1981 J
(B) 3988 J
(C) 991 J
(D) 7282 J

9. The total degeneracy for a $d^1$ ion in spherical symmetry ic:

(A) 2
(B) 3
(C) 5
(D) 10

10. A molecule has two $C_2$ axes perpendicular to each other. Hence,

(A) the molecule would have a non-zero dipole moment which may point either along one of the two axes.
(B) the molecule would have a non-zero dipole moment, which would point in the direction rnidway between the two axes, i.e. making an angle of 45° to each axis.
(C) the molecule has a non-zero dipole that would point in a direction perpendicular to the two axes.
(D) the molecule would have zero dipole moment.

11. Twenty four grams af zinc metal is dissolved in 1M HCl solution. The charge produced by the oxidation process is:

(A) 96500 Coulombs
(B) 70836 Coulombs
(C) 48250 Coulombs
(D) 35418 Coulornbs

12. The pH of 80 % ionised 0.01N acid solution is:

(A) 2.0969
(B) 0.2096
(C) 20.09
(D) 0.0269

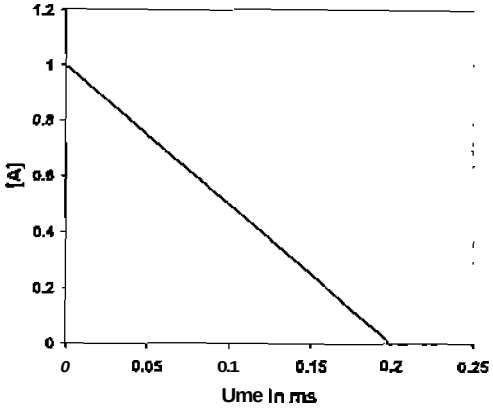
13. Given the standard cell potentials as below:

$AgCl + e = Ag + Cl^-$, $E^\circ = 0.2223$ V
$Ag^+ + e = Ag$, $E^\circ = 0.799$ V

The solubility product for the reaction; $AgCl = Ag^+ + Cl^-$ is:

(A) $2.80 \times 10^{-10}$
(B) $0.80 \times 10^{-10}$
**(C)** $28.0 \times 10^{-10}$
**(D)** $1.80 \times 10^{-10}$

14. Concentration of the reagent A, [A], varies with time according to the graph shown next:




The order of *the* reaction is:

(A) not defined
(B) 1
(C) 2
(D) 0

15. The point group symmetry for the molecule $NH_3$ is:

(A) $D_{3h}$
(B) $C_3$
(C) $C_{3v}$
(D) $C_{3h}$

16. Among thc following statements, the one that is **NOT** truc for a catalyzed reaction is:

(A) The concenaation of the catalyst *does* not enter in to the cxpression for equilibrium.
(B) The enthalpy of reaction does not change in the presence of a catalyst.
(C) The activation energy does not change in the presence of a catalyst.
(D) Without the catalyst, the reaction can still proceed.

17. For the reaction: $2\ NH_3(g) \rightarrow 3\ H_2\ (g) + N_2\ (g)$, $\Delta H^o = 92.22$ kJ $mol^{-1}$ and $\Delta S^o =$ 198.75 J $K^{-1}$ $mol^{-1}$. With all reactants and products in thcir standard stare, this rcaction will bc spontaneous at:

(A) temperatures below 464 K
(B) temperatures above 464 K
(C) no temperature.
(D) all temperatures.

18. Among thc following groups of metals, the one having the lowest melting points is:

(A) alkaline earth
(B) transition
(C) alkali
(D) lanthanide

19. The composition of a sample of iron oxide is $Fe_{0.93}O$. The percentage of Fe in the +3 oxidation state in this sample is approximately:

(A) 0.07 %
(B) 7.0%
(C) 30.0%
(D) 15.1 %

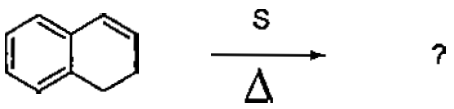
20. For the reaction $2P + 3Br_2 \rightarrow 2PBr_3$, the heat evolved is –243 kJ (AH). Hence, the enthalpy change when 2.63 g of P reacts with an excess of $Br_2$ will be:

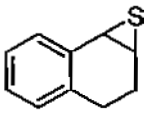
(A) 10.3 kJ
(B) 24.3 kJ
(C) 1.03 kJ
(D) 20.6 kJ

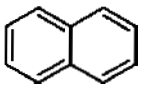
21. **The product of the reaction of anisole with sodamide is:**

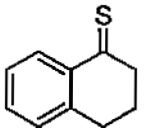
**(A)** m-anisidine
(B) *p*-anisidine
(C) 1,2-diaminobenzene
(D) 1,3-diaminobenzene

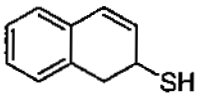
22. **The major product in the following reaction is:**




(A) 


(B) 

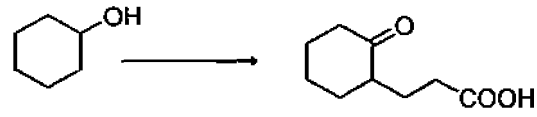
(C) 


(D) 


23. **Number of signals expected in proton decoupled $^{13}C$ NMR spectrum of 1,4-dihydroxynaphthalene and 1,8-dihydroxynaphthalene are:**

**(A)** **5** and **5**
(B) **5** and **6**
(C) **5** and **10**
(D) **10** and **6**

24. The reagents that can effect the following conversion are:



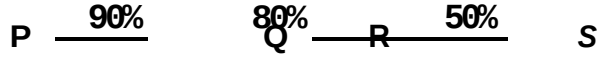

(A) (i) $CrO_3$, (ii) methyl acrylate, (iii) $H_2O/H^+$

(B) (i) $O_2$, (ii) methyl acrylate

(C) (i) $CrO_3$ (ii) pyrrolidine (iii) methyl acrylate, (iv) $H_2O/H^+$

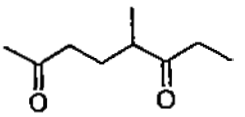
(D) (i) $H_2O_2$, (ii) methyl acrylate,

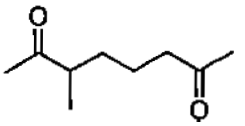
25. In the multi-step synthesis given below, the overall yield for the formation of S from P is:

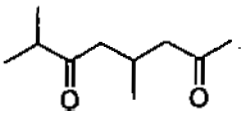


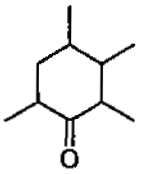

(A) 72 %
(B) 40 %
(C) 36 %
(D) 50 %

26. Among the following molecules, the one that yields 2,3,6-trimethylcyclohex-2-enone on treatment with dil. KOH is:

(A) 

(B) 

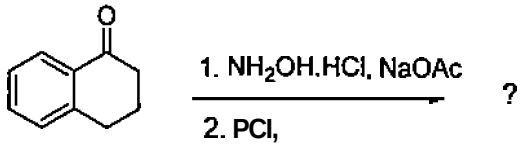
(C) 

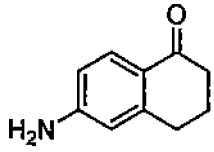
(D) 

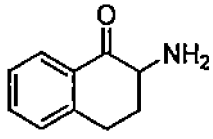
27. On heating, 1,3-butadiene reacts with elemental sulfur to yield:

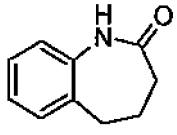
(A) thiophene
(B) 2,5-dihydrothiophene
(C) 2,3-dihydrothiophene
(D) tetrahydrothiophene

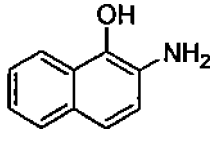
28. **The major product in the following reaction is:**




(A) 


(B) 

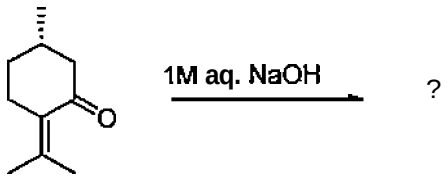

(C) 

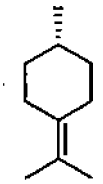

(D) 

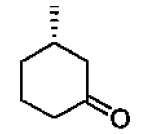

29. The **reagent of choice for the selective reduction of ketones in presence of an** ester **is:**

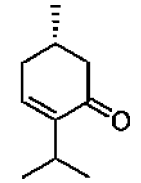
(A) lithium aluminium hydride
(B) sodium hydride
(C) hydrogen and palladium on carbon
(D) sodium borohydride

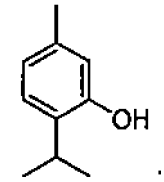
30. The major product obtained in the following reaction is:




(A) 

(B) 

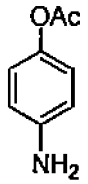
(C) 

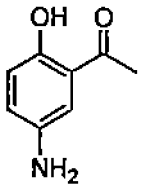
(D) 

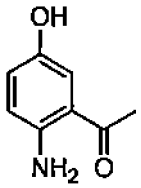

31. The biogenetic precursor for cholesterol is:

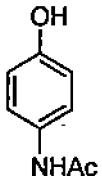
(A) mevalonic acid
(B) cyclopentaphenanthrene
(C) acetyl CoA
(D) fatty acid

32. Reaction of 4-aminophenol with one equivalent of acetylchloride in the presence of pyridine yields:

(A) 


(B) 

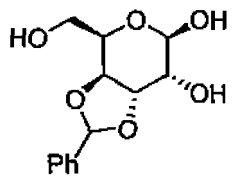

(C) 

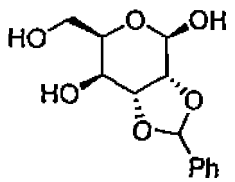

(D) 

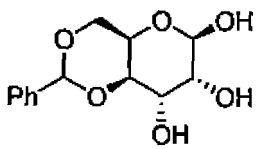

33. An organic compound of molecular formula $C_4H_8$ exhibits only a singlet at $\delta$ 1.9 ppm with reference to tetramethylsilane in $^1H$ NMR spectrum. The compound is:

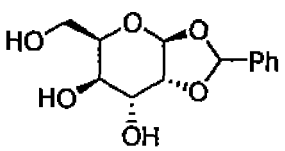
(A) 1-butene
(B) cis-2-butene
(C) cyclobutane
(D) trans-2-butene

34. Reaction of D-glucose with benzaldehyde in presence of acid yields:

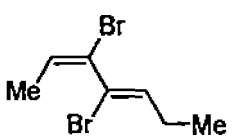
(A) 

(B) 

(C) 

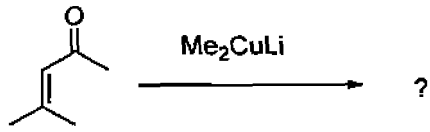
(D) 

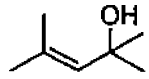
35. The IUPAC name for the following molecule *is:*

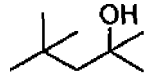


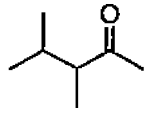
(A) (2E,4Z)-3,4-dibromo hepta-2,4-diene
(B) (2Z,4E)-3,4-dibromo hepta-2,4-diene
(C) (2Z,4Z)-3,4-dibromo hepta-2,4-diene
(D) (2E,4E)-3,4-dibromo hepta-2,4-diene

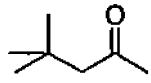
36. The product formed in the following reaction is:




(A) 


(B) 


(C) 


(D) 

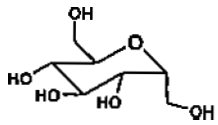

37. Among the following aldehydes, the one that does NOT undergo Cannizzaro reaction is:

(A) formaldehyde
(B) acetaldehyde
(C) benzaldehyde
(D) pivalaldehyde (trimethylacetaldehyde)

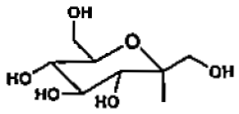
38. *R*-2-octyl tosylate is solvolyzed in 80% aqueous acetone under ideal $S_N1$ conditions. The product(s) will be:

(A) R-2-octanol and S-2-octanol in a 1:1 ratio
(B) R-2-octanol and *S*-2-octanol in a 2:1 ratio
(C) *R*-2-octanol only
(D) S-2-octanol only

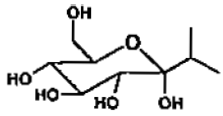
39. Among the following molccules, the conformation is stabilized only by anomenc effect for:



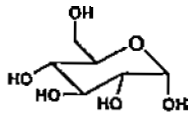
a)



b)



c)

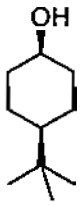


d)

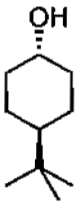
(A) a
(B) b
(C) c
(D) d

40. Major product obtained in the reduction of 4-*tert*-butyl cyclohexanone with $NaBH_4$ is:

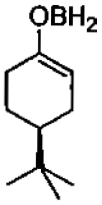
(A)



(B)

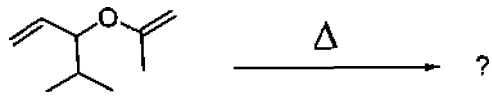


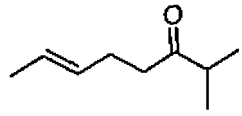
(C)

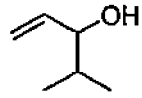


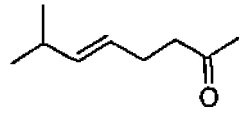
(D)

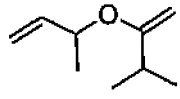
41. The product obtained in the following conversion is:



(A) 

(B) 

(C) 

(D) 

42. For the preparation of 1 litre each of 1 M NaOH and 1 M KOH solutions, the quantities of NaOH and KOH required are, respectively:

(A) 40 g and 47.6 g
(B) 40 g and 56 g
(C) 20 g and 56 g
(D) 40 g and 28 g

43. Zinc selenide crystallizes in zincblende structure. The numbers of atoms of Zn and Se present in its unit cell are:

(A) 8
(B) 6
(C) 4
(D) 12

44. The role of $Br_2$ in the reaction $H_2O + Br_2 \rightarrow HOBr + HBr$ is:

(A) reducing agent
(B) oxidizing agent
(C) neither oxidizing nor reducing agent
(D) both oxidizing and reducing agents

45. Among the following complexes, the one ihat undergoes $Z_{in}$ distortion is:

(A) $[Ni(CO)_4]$
(B) $[CuCl_4]^{2-}$
(C) $[Cr(H_2O)_6]^{2+}$
(D) $[Cu(NH_3)_6]^{2}$

46. The ground state for the $V^{3+}$ ion in a tetrahedral environment is:

(A) $^3T_1$
(B) $^3T_2$
(C) $^3A_2$
(D) $^3E$

47. Treatment of $Mo(CO)_6$ with $Na^+C_5H_5^-$ results in:

(A) $Na[Mo(\eta^1\text{-}C_5H_5)(CO)_4] + 2CO$
(B) $Na[Mo(\eta^5\text{-}C_5H_5)(CO)_3] + 3CO$
(C) $Na[Mo(\eta^3\text{-}C_5H_5)(CO)_2] + 4CO$
(D) $Na[Mo(\eta^5\text{-}C_5H_5)(CO)] + 5CO$

48. The reaction:

$$[Ir(H)_2Cl(CO)(PPh_3)_2] \rightleftharpoons [IrCl(CO)(PPh_3)_2] + H_2$$

is an example for:

(A) oxidative addition
(B) substitution
(C) insertion
(D) reductive elimination

49. The smallest cation among $Na^+$, $Mg^{2+}$, $Al^{3+}$, $Si^{4+}$ is:

(A) $Mg^{2+}$
(B) $Na^+$
(C) $Al^{3+}$
(D) $Si^{4+}$

50. The two main isotopes of poiassium are $^{39}K$ and $^{41}K$. The atomic mass of potassium may be used as 39.1. The abundances of the isotopes are:

(A) 95% $^{39}K$ and 5% $^{41}K$
(B) 90% $^{39}K$ and 10% $^{41}K$
(C) 5% $^{39}K$ and 95% $^{41}K$
(D) 10% $^{39}K$ and 90% $^{41}K$

51. The metal ions that have the highest mobility in biological media are:

(A) Zn(II) and Ni(II)
(B) Fe(II) and Cu(II)
(C) Na(I) and K(I)
(D) Mg(II) and Ca(II)

52. Hemerythrin belongs to the group of:

(A) non-herne iron protein
(B) binuclear copper protein
(C) herne-iron protein
(D) non-heme non-iron protein

53. Among the following bonds, the least stable one is:

(A) S-S
(B) C=C
(C) P-P
(D) S=S

54. The number of isomers possible for octahedral $[CrCl_2(H_2O)_4]^+$ and octahedral $[CoCl_2(en)_2]^+$ are, respectively,:

(A) two and two
(B) three and three
(C) two and three
(D) three and two

55. The cis-platin is:

(A) diamagnetic.
(B) paramagnetic.
(C) ferromagnetic.
(D) anti-ferromagnetic.

56. Among the following organometallic compounds, the one that follows the 18-electron rule is:

(A) $[Ni(\eta^5\text{-}C_5H_5)_2]$
(B) $[Ru(\eta^6\text{-}C_6H_6)_2]$
(C) $[Cr(\eta^6\text{-}C_6H_6)_2]$
(D) $[Co(\eta^5\text{-}C_5H_5)_2]$

57. Among the following oxides, the one having a norrnal spinel structure is:

(A) CuO
(B) $Co_3O_4$
(C) $Fe_3O_4$
(D) $TiO_2$

58. Arnong the following complexes, the one having a metal-metal quadruple bond is:

(A) $[Re_2Cl_8]^{4-}$
(B) $[Cu_2(OAc)_4]$
(C) $[Mo_2(OR)_6]$
(D) $[Ru_2Cl(OAc)_4]$

59. Among thc following complexes, the one that is expected to show three d-d bands in the electronic spectrum is:

(A) $[Mn(H_2O)_6]^{2+}$
(B) $[FeCl_4]^-$
(C) $[Ti(H_2O)_6]^{3+}$
(D) $[Ni(H_2O)_6]^{2+}$

60. One hundred gram of $CaCO_3$ contains (N is the Avogadro's number):

(A) 50N protons
(B) N protons
(C) 5N protons
(D) 25N protons

61. Among the following pairs of ions/molecules, the one having similar shapes is:

(A) $CO_2$ and $H_2O$
(B) $BF_3$ and $H_3C^+$
(C) $CCl_4$ and $PtCl_4$
(D) $NH_3$ and $BF_3$

62. The number of orbitals present in the $n = 4$ atomic shell is:

(A) 64
(B) 32
(C) 16
(D) 8

63. There are two containers having two moles of Ar each at a temperature of 298 K and a pressure of 1 bar. Both are heated such that they gain 1 KJ of energy each. First container was heated at constant V and the second container was heated at constant P. The final temperatures in the two containers will respechvely be:

(A) 298 K and 350 K
(B) 350 K and 400 K
(C) 338 K and 322 K
(D) 350 K and 350 K

64. The molecular weight of an ideal gas having a density of 1.5 $g\ L^{-1}$ at 100 °C and 600 Torr is:

(A) 45.9 g/mol
(B) 4.59 g/mol
(C) 5.82 g/mol
(D) 58.2 g/mol

65. According to ideal gas law,:

(A) molecules have neither attraction between them nor have any finite size, being treated as a point mass.
(B) molecules do have attraction between them but do not have any finite size, being treated as a point mass.
(C) molecules have no attraction between them but do have a finite size.
(D) molecules have both attraction between them and have a finite size.

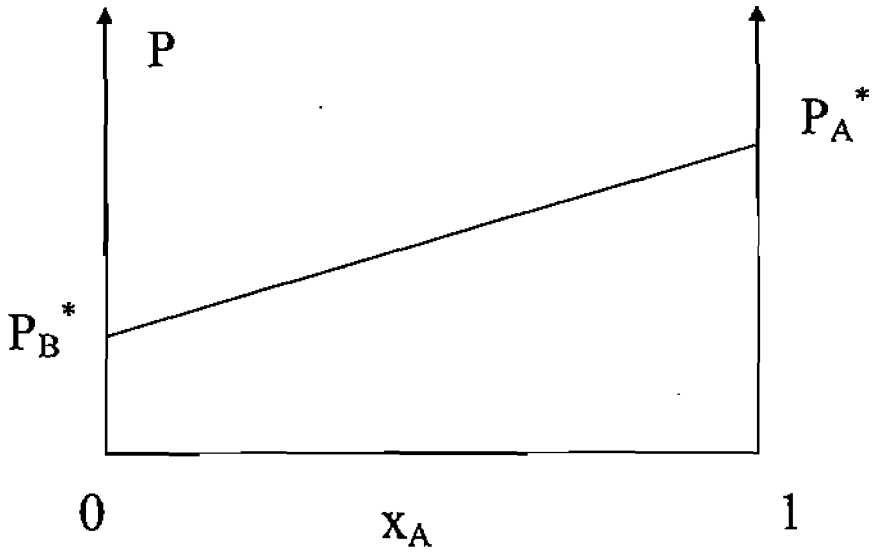
66. For the gas phase reaction: $CO + NO_2 \rightarrow CO_2 + NO$, the activation energy is found to be 116 kJ $mol^{-1}$. The enthalpy of formation for CO, $NO_2$, $CO_2$ and NO are – 110, 33, -394 and 90 kJ $mol^{-1}$, respectively. The activation energy (in kJ $mol^{-1}$) for the reverse reaction is:

(A) 343
(B) –227
(C) 227
(D) 116

67. Factors affeciing the average kinetic energy of gas rnolecules are:

(A) pressure only
(B) temperature only
(C) both temperature and pressure
(D) neither temperature nor pressure

68. The figure below shows the dependence at some fixed temperature T of the total vapour pressure P of a mixture of two volatile liquids A and B on the mole fraction $x_A$ of component A, with $P_A^*$ the vapour pressure of pure A and $P_B^*$ the vapour pressure of pure B.




Among the following statement about this figure, the one that is NOT TRUE is:

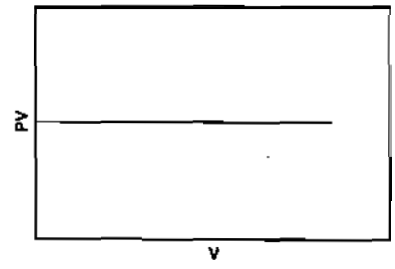
(A) The mixture is ideal.
(B) In the region above the line $P_B^*P_A^*$, the liquid phase of the mixture is the stable phase.
(C) Along the line $P_B^*P_A^*$, the liquid and vapour phases of the mixture are in equilibrium.
(D) The vapour pressure of component B, $P_B$, is given by the relation $P_B = P_A^*(1-x_A)$.

69. The enthalpy of fusion of $H_2O$ at 0 °C is 1.436 kcal $mol^{-1}$. The AS for the process $H_2O(l) \Leftrightarrow H_2O(s)$ at 0 °C is:

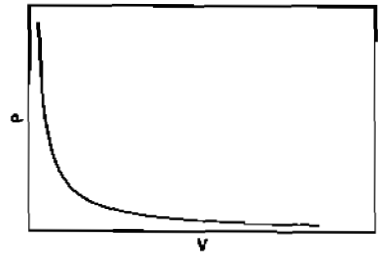
(A) 52.6 cal $mol^{-1}$ $K^{-1}$
(B) -5.26 cal $mol^{-1}$ $K^{-1}$
(C) 5.26 cal $mol^{-1}$ $K^{-1}$
(D) -52.6 cal $mol^{-1}$ $K^{-1}$

70. Among the following graphs, the one that *does* not correspond to ideal gas behaviour is: (P = pressure, V = volume, T = temperature in K):

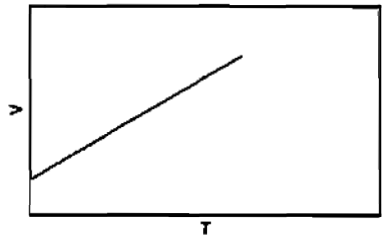
(A) At constant T



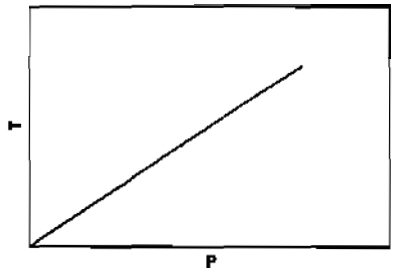

(B) At constant T




(C) At constant P




(D) At constant V



71. A particle is confined to a one dimensional box of length $2a$ extending from $x=-a$ to $x=a$ along the x-axis. The average value of position and momentum, for the particle, if it is sitting in the lowest possible state *is:*

(A) $\langle x\rangle = 0$ and $\langle p_x\rangle = 0$
**(B)** $(x) = a/2$ and $\langle p_x\rangle = 0$
(C) $\langle x\rangle = 0$ and $\langle p_x\rangle = -i\eta$
(D) $\langle x\rangle = 0$ and $\langle p_x\rangle = \eta$

72. In the following $N$ denotes a suitable constant that one may choose as desired. Of the following the functions, the only function that is NOT an acceptable wave function for an electron in the Hydrogen atom is:

(A) $N\exp(-r)$
(B) $N\exp(r)$
*(C)* $Nr\exp(-r)\exp(i\phi)$
(D) $Nr\exp(-r^2)\exp(i\phi)$

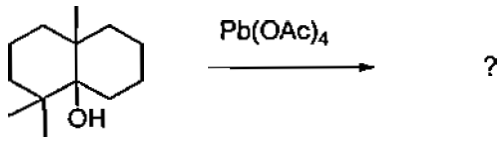
73. In the electromagnetic spectrum, the wavenumber decreases in the order:

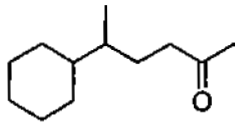
**(A)** X-ray > rnicrowave > infra-red > ultra-violet
(B) X-ray > rnicrowave > ultra-violet > infra-red
**(C)** X-ray > ultra-violet > infra-red > microwave
(D) rnicrowave > infra-red > ultra-violet > X-ray

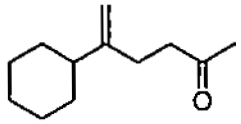
74. The number of electrons (per second) that pass ihrough a cross section of copper wire carrying a current of $10^{-9}$ A *is:*

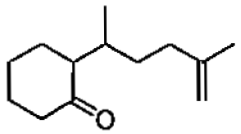
(A) $62.5 \times 10^{10}$ e/s
(B) 120 e/s
(C) 12000 e/s
(D) $0.625 \times 10^{10}$ e/s

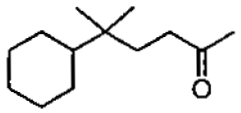
**75.** The major product in the following reaction is:



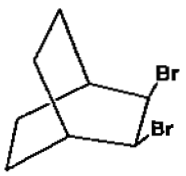

(A) 

(B) 

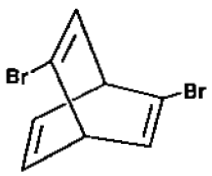
((C) 

(D) 

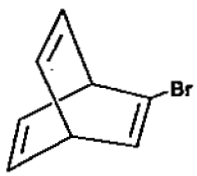
76. **Among the following molecules, the one that is chiral is:**



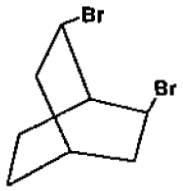

a)




b)



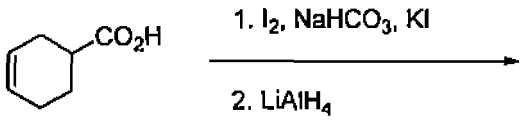

c)

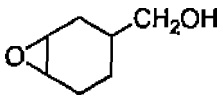


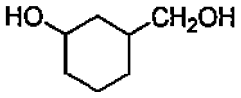

d)

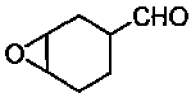
(A) a
(B) b
(C) c
(D) d

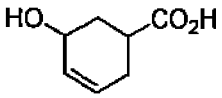
77. The major product in the following reaction is:




(A) 


(B) 

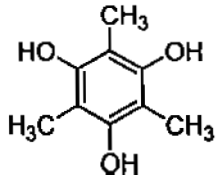

(C) 

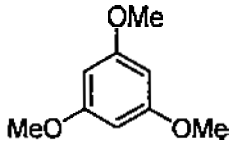

(D) 

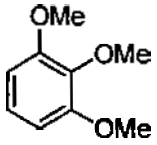

78. Arrange the following in the increasing order of acidity:
(i) Benzoic acid (ii) *p*-Methoxy benzoic acid (iii) *p*-Methyl benzoic acid

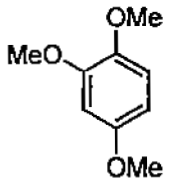
(A) (i) < (ii) < (iii)
(B) (iii) < (ii) < (i)
(C) (ii) < (iii) < (i)
(D) (ii) < (i) < (iii)

79. A compound with molecular formula $C_9H_{12}O_3$ exhibited two singlets at δ 6.7 and δ 3.8 in $^1H$ NMR spectrum in 1:3 ratios. The structure of the compound *is:*

(A) 


(B) 

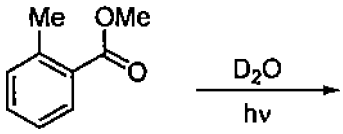

(C) 

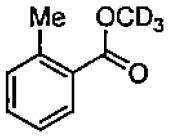

(D) 

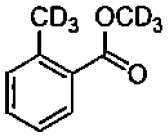

80. The number of diastereomers possible for the following compound is:

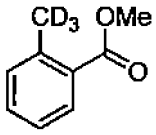

(A) 4
(B) 3
(C) 2
(D) 1

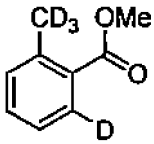
81. The product formed in the following reaction is:




(A) 


(B) 

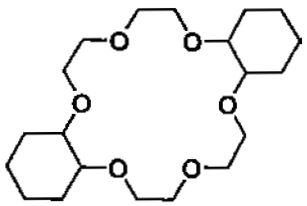

(C) 

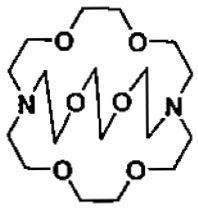

(D) 

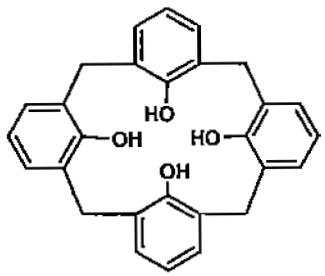

82. Among the following molecules, the one that will **NOT** undergo a Diels-Alder reaction is:

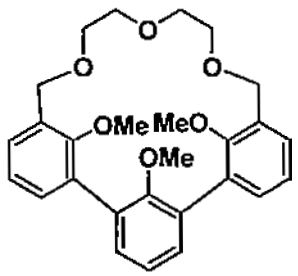
(A) ethylene
(B) 2-butene
(C) maleic anhydride
(D) succinic anhydride

83. The generic names for the following molecules are, respectively:

(A) 

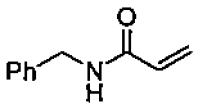
(B) 

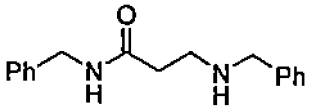
(C) 

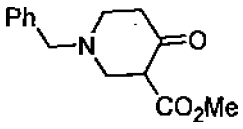

(D) 


(A) crown ether, cryptand, calixarene, and hemispherand.
(B) cryptand, calixarene, crown ether and hemispherand.
(C) crown ether, hemispherand, cryptand, and calixarene.
(D) crown ether, calixarene, cryptand, and hemispherand.

84. The major product in the reaction of rmethyl acrylate and benzylamine under ambient conditions is:

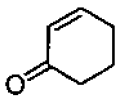
(A) 

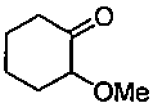
(B) 

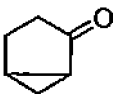
(C) 

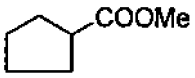
(D) Poly-(N-benzylacrylamide)

85. The major product of the reaction of 2-chlorocyclohexanone with NaOMe is:

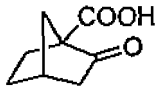
(A) 

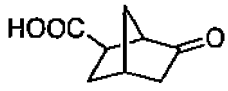
(B) 

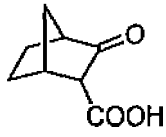
(C) 

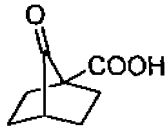
(D) 

86. **Among** the following compounds the one that readily **undergoes decarboxylation** upon heating **is:**

(A) 


(B) 


(C) 


(D) 


87. In the **mass spectrum** of $CH_2Cl_2$, **the ratio** of peaks at **mass values 84,** *86* **and 88 will respectively be:**

(A) 3:1:1
(B) 3:2:1
*(C)* 4:2:1
**(D)** 9:6:1

88. The **enthalpy change,** AH, for **the following process are given** in kJ/mol: **sublimation of** K(s) = +89, **ionization of** K(g) = +425; **dissociation of** $Cl_2(g)$ = +244, electron **gain by** Cl(g) = -355, **formation of** KCl(s) = 438. **Using a** Born-Haber cycle, **the** lattice **enthalpy of** KCl(s) **is calculated to be:**

(A) 719
(B) 0
*(C)* -719
(D) 1438

89. The absorption **maximum** of **a given sample of** cadmium sulfide **is 470 nm.** The **approximate band gap is:**

(A) 200 kJ $mol^{-1}$
(B) 250 kJ $mol^{-1}$
(C) 100 kJ $mol^{-1}$
(D) 150 kJ $mol^{-1}$

**90.** For a 6p sub-shell, the most positive value that $m_l$ can have is:

(A) +1
(B) +6
(C) +3
(D) +7

91. PhMgBr reacts with methanol to give:

(A) a mixture of anisole and Mg(OH)Br
(B) a mixture of toluene and Mg(OH)Br
(C) a mixture of phenol and MeMgBr
(D) a mixture of benzene and Mg(OMe)Br

92. $C_2B_{n-2}H_n$ is an isoelectronic analogue of:

(A) $B_nH_n$
(B) $B_nH_n^-$
(C) $B_nH_n^{3-}$
(D) $B_nH_n^{2-}$

93. The point group symmetry of cis-$[Co(NH_3)_4Cl_2]^+$ is:

(A) $C_{2v}$
(B) Oh
(C) $D_{2h}$
(D) $C_{4v}$

94. The electron transfer reaction between $[Co(NH_3)_5Cl]^{2+}$ and $[Cr(H_2O)_6]^{2+}$ in acidic medium leads to the formation of a chromium species of formulation:

(A) $[Cr(NH_3)_5(H_2O)]^{2+}$
(B) $[Cr(NH_3)_5Cl]^{2+}$
(C) $[Cr(H_2O)_5Cl]^{2+}$
(D) $[Cr(NH_3)_6]^{3+}$

**95.** Among the following molecules, the one that is polar is:

(A) $CH_4$
(B) $BF_3$
(C) $SF_6$
(D) $NH_3$

96. The VSEPR model is based on the:

(A) number of bonded pairs of electrons around the central atom.
(B) number of bonded and lone pairs of electrons around the central atom.
(C) number of lone pairs of electrons around the central atom.
(D) number of protons around the central atom.

97. According to Irving-William series, Cu(II) is more stable than Ni(II) because of:

(A) Jahn-Teller distortion
(B) higher trans effect
(C) complexation with labile ligands
(D) induction effect

98. Among the hydrogen halides, the one having the highest bond energy is:

(A) HI
(B) HF
(C) HBr
(D) HCl

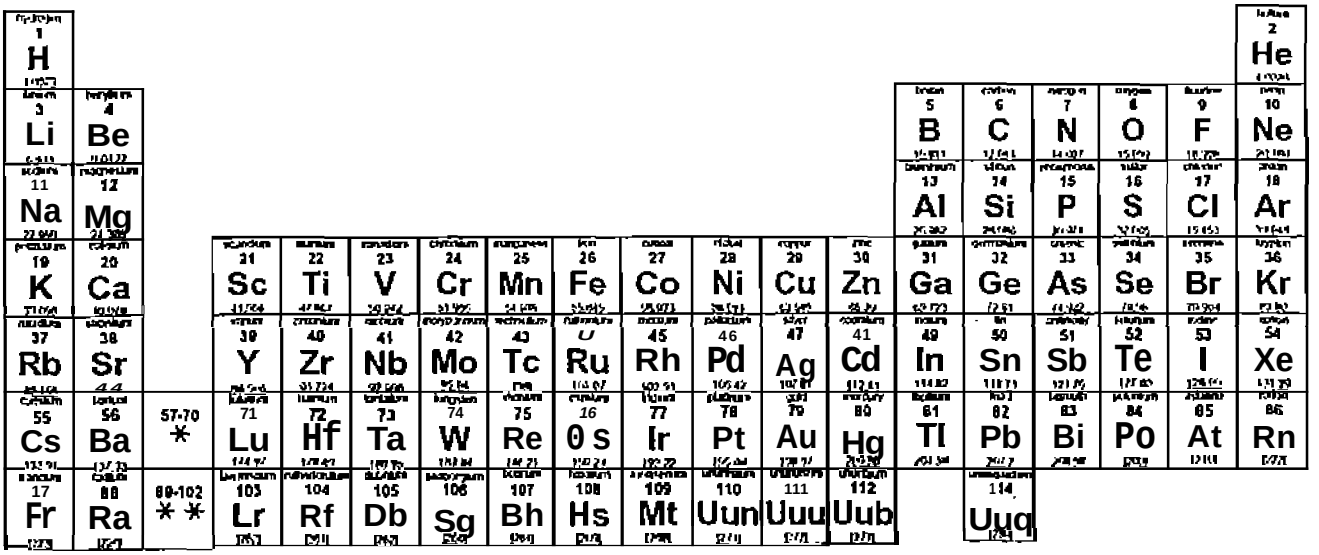
99. Among the following ligands, the strongest $\pi$ acceptor is:

(A) $CN^-$
(B) CO
(C) $N_2$
(D) $NO^+$

100. Among teflon, water, benzoic acid and protein, hydrogen bonding is not important only in:

(A) teflon
(B) water
(C) benzoic acid
(D) protein

## End of the Question Paper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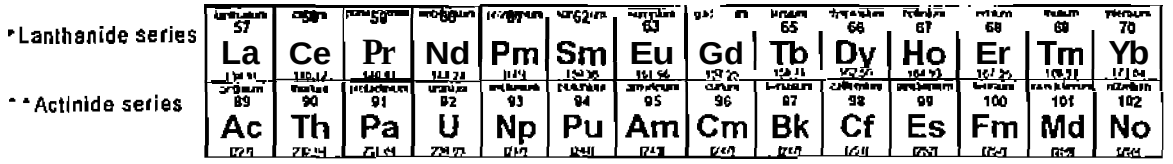
*Lanthanide series
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