18204
120 MINUTES

1. The ground state energy of a particle in a 1 D box of length $1 \AA$ is $0.6032 \times 10^{-17} \mathrm{~J}$. The energy gap between first and the second energy level is
A) $\quad 6.032 \times 10^{-17} \mathrm{~J}$
B) $\quad 1.8095 \times 10^{-17} \mathrm{~J}$
C) $\quad 0.2528 \times 10^{-17} \mathrm{~J}$
D) $\quad 0.6032 \times 10^{-17} \mathrm{~J}$
2. The commutator $\left[\hat{L}_{x}, \hat{L}_{y}\right]$ is equal to
A) $\quad i h \hat{L}_{z}$
B) $i \hbar \hat{L}_{z}$
C) $-i \hbar \hat{L}_{z}$
D) $-i h \hat{L}_{z}$
3. The value of the spherical harmonics $Y_{1,0}(\theta, \phi)$ is
A) $\sqrt{\frac{3}{4 \pi}} \sin \theta$
B) $\sqrt{\frac{3}{4 \pi}} \cos \theta$
C) $\sqrt{\frac{3}{4 \pi}} \sin \theta \cos \phi$
D) $\sqrt{\frac{3}{4 \pi}} \sin \theta \sin \phi$
4. The Huckel theory secular determinant equation for cyclobutadiene is
A) $\quad\left|\begin{array}{llll}x & 1 & 0 & 1 \\ 1 & x & 1 & 0 \\ 0 & 1 & x & 1 \\ 1 & 0 & 1 & x\end{array}\right|=0$
В) $\quad\left|\begin{array}{llll}x & 0 & 1 & 1 \\ 1 & x & 0 & 1 \\ 1 & 0 & x & 1 \\ 1 & 1 & 0 & x\end{array}\right|=0$
C) $\left|\begin{array}{llll}x & 1 & 0 & 0 \\ 1 & x & 1 & 0 \\ 0 & 1 & x & 1 \\ 0 & 0 & 1 & x\end{array}\right|=0$
D) $\quad\left|\begin{array}{llll}x & 0 & 0 & 1 \\ 1 & x & 1 & 0 \\ 0 & 1 & x & 1 \\ 1 & 0 & 0 & x\end{array}\right|=0$
5. The delocalisation energy of benzene according to Huckel M O method is
A) $\quad 0.48 \beta$
B) $\quad 2.0 \beta$
C) $\quad 4.0 \beta$
D) $\quad 4.472 \beta$
6. The number of fundamental vibrational modes of $\mathrm{CO}_{2}$ appearing common both in its IR and Raman spectra are:
A) four
B) three
C) two
D) zero
7. The resistance of Hg drops to zero when cooled to:
A) $\quad$ at 4.2 K
B) at $4.2^{\circ} \mathrm{C}$
C) below 180 K
D) zero Kelvin
8. The number of 1H-NMR signals that would appear in the spectrum of
$\mathrm{CH}_{3}-\mathrm{CH}=\mathrm{CH}_{2}$ is:
A)
1
B) 2
C) 3
D) 4
9. Which of the following molecular orbitals of homo diatomic molecules have gerade parity?
A) $\quad \sigma_{s} \sigma_{p} \pi_{p}^{*}$
B) $\quad \sigma_{s}^{*} \sigma_{p}^{*} \pi_{p}^{*}$
C) $\quad \sigma_{s} \sigma_{p} \pi_{p}$
D) $\quad \sigma_{s} \sigma_{p}^{*} \pi_{p}$
10. Certain volume of He takes 20s to effuse through a porous barrier. The time taken by same volume of methane gas to effuse under same condition is
A) $\quad 10 \mathrm{~s}$
B) $\quad 20 \mathrm{~s}$
C) 40 s
D) 80 s
11. The physical processes undergone by a photochemically excited molecule responsible for phosphorescence is
A) $\mathrm{T}_{1} \sim \sim \sim>\mathrm{S}_{0}$ + heat
B) $\quad \mathrm{S}_{1} \sim \sim \sim \mathrm{~S}_{0}+$ heat
C) $\mathrm{T}_{1} \longrightarrow \mathrm{~S}_{0}+\mathrm{h} v$
D) $\quad \mathrm{S}_{1} \longrightarrow \mathrm{~S}_{0}+\mathrm{h} \nu$
12. Which of the following mixture of $\mathrm{H}_{2}$ and He will show maximum entropy of mixing?
A) 0.5 moles of $\mathrm{H}_{2}$ and 0.5 moles of He
B) 0.25 moles of $\mathrm{H}_{2}$ and 0.75 moles of He
C) 0.75 moles of $\mathrm{H}_{2}$ and 0.25 moles of He
D) 0.6 moles of $\mathrm{H}_{2}$ and 0.4 moles of He
13. The inter-planar distance between (100) set of planes in a face cantered cubic unit cell is 170 pm . The distance between two (200) set of planes is
A) 170 pm
B) 340 pm
C) 85 pm
D) $\quad 100 \mathrm{pm}$
14. Which of the following statements are true for Schottky defect?
1) Cations occupies the interstitial positions.
2) Density of the crystal decreases.
3) It arises due to the loss of equal number of anions and cations.
4) It appears in crystals in which the anion and cations are of same size.
A) $1,2 \& 3$ only
B) $2 \& 3$ only
C) $2,3 \& 4$ only
D) $1 \& 4$ only
15. Match list I to list II and select the correct answer from the options given below.

## $\underline{\text { List I }}$

a) $\left(\frac{\partial E}{\partial T}\right)_{V}$

List II
b) $\left(\frac{\partial T}{\partial P}\right)_{H}$
2. $C_{\mathrm{v}}$
c) $\left(\frac{\partial G}{\partial P}\right)_{T}$
3. $\mu_{\mathrm{JT}}$
d) $\left(\frac{\partial G}{\partial T}\right)_{p}$
4. -S
A) $\quad \mathrm{a}-4, \mathrm{~b}-1, \mathrm{c}-3, \mathrm{~d}-2$
B) $\quad \mathrm{a}-2, \mathrm{~b}-3, \mathrm{c}-1, \mathrm{~d}-4$
C) $\quad \mathrm{a}-4, \mathrm{~b}-2, \mathrm{c}-3, \mathrm{~d}-1$
D) $\quad \mathrm{a}-3, \mathrm{~b}-2, \mathrm{c}-1, \mathrm{~d}-4$
16. The residual entropy of solid CO at absolute zero of temperature is
A) $\quad 2.50 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
B) $\quad 5.76 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
C) $\quad 5.76 \mathrm{~K}^{-1} \mathrm{~mol}^{-1}$
D) $\quad 3.76 \mathrm{JK}^{-1} \mathrm{~mol}^{-1}$
17. For an ideal binary mixture
A) $\Delta V_{m i x}=0, \Delta H_{\text {mix }}=0, \Delta S_{m i x}=0, \Delta G_{m i x}=0$
B) $\Delta V_{m i x}=0, \Delta H_{m i x}=0, \Delta S_{\text {mix }}=+v e, \Delta G_{m i x}=+v e$
C) $\Delta V_{\text {mix }}=0, \Delta H_{\text {mix }}=0, \Delta S_{\text {mix }}=+v e, \Delta G_{m i x}=-v e$
D) $\Delta V_{m i x}=-v e, \Delta H_{m i x}=0, \Delta S_{m i x}=0, \Delta G_{m i x}=-v e$
18. For an adiabatic reversible expansion
A) $\quad\left(T_{1} / T_{2}\right)=\left(V_{2} / V_{1}\right)^{\gamma-1}$
B) $\quad\left(T_{1} / T_{2}\right)=\left(V_{2} / V_{1}\right)^{1-\gamma}$
C) $\quad\left(T_{2} / T_{1}\right)^{\gamma-1}=\left(P_{2} / P_{1}\right)$
D) $\quad\left(T_{1} / T_{2}\right)=\left(P_{2} / P_{1}\right)^{\gamma}$
19. The ionic strength of a solution which is 0.2 molal in $\mathrm{CaCl}_{2}$ and 0.1 molal NaCl is
A) 0.6
B) $\quad 1.2$
C) $\quad 1.4$
D) 0.7
20. Potassium chloride is commonly used for preparing salt bridge. This is because
A) Both the cation and anion have same activity.
B) The cation and anion are isoelectronic.
C) It is a 1:1 electrolyte.
D) The transference numbers of cation and anion are nearly same.
21. All spontaneous adsorption processes are
A) highly exothermic and there is a decrease in entropy
B) highly endothermic and there is a decrease in entropy
C) highly exothermic and there is an increase in entropy
D) highly endothermic and there is an increase in entropy
22. Which one pair belongs to abelian group?
A) $\quad C_{2 v}$ and $C_{3 v}$
B) $\quad \mathrm{C}_{2 \mathrm{v}}$ and $\mathrm{C}_{4}$
C) $\quad \mathrm{C}_{3 \mathrm{v}}$ and $\mathrm{C}_{2 \mathrm{~h}}$
D) $\quad \mathrm{D}_{6 \mathrm{~h}}$ and $\mathrm{C}_{3 \mathrm{v}}$
23. Mulliken notation for the irreducible representation $\Gamma$ is

| $\mathrm{C}_{4 \mathrm{v}}$ | E | $2 \mathrm{C}_{4}$ | $\mathrm{C}_{2}$ | $2 \sigma_{\mathrm{v}}$ | $2 \sigma_{\mathrm{d}}$ |
| :--- | :--- | :--- | :--- | :--- | :--- |
| $\Gamma$ | 1 | 1 | 1 | -1 | -1 |

A) $\mathrm{A}_{1}$
B) $\quad \mathrm{A}_{2}$
C) $\quad B_{1}$
D) $\quad B_{2}$
24. Symmetry planes present in benzene molecule are
A) One horizontal plane and six vertical planes
B) One horizontal and six dihedral planes
C) Three horizontal planes and three vertical planes
D) One horizontal plane, three vertical planes and three dihedral planes.
25. Ruthenocene belongs to the point group
A) $\quad \mathrm{D}_{5 \mathrm{~h}}$
B) $\quad \mathrm{C}_{5 \mathrm{~h}}$
C) $\quad \mathrm{C}_{5 \mathrm{v}}$
D) $\quad D_{5 d}$
26. The reducible representation $\Gamma$ given below can be reduced into

| $\mathrm{C}_{2 \mathrm{v}}$ | E | $\mathrm{C}_{2}$ | $\sigma_{\mathrm{yz}}$ | $\sigma_{\mathrm{xz}}$ |
| :--- | ---: | ---: | ---: | ---: |
| $\mathrm{A}_{1}$ | 1 | 1 | 1 | 1 |
| $\mathrm{~A}_{2}$ | 1 | 1 | -1 | -1 |
| $\mathrm{~B}_{1}$ | 1 | -1 | -1 | 1 |
| $\mathrm{~B}_{2}$ | 1 | -1 | 1 | -1 |
| $\Gamma$ | 5 | -1 | 5 | -1 |

A) $3 \mathrm{~A}_{1}+2 \mathrm{~B}_{1}$
B) $\quad 2 \mathrm{~A}_{1}+\mathrm{B}_{1}+2 \mathrm{~B}_{2}$
C) $\quad 2 \mathrm{~A}_{1}+3 \mathrm{~B}_{2}$
D) $A_{1}+2 B_{1}+2 B_{2}$
27. Which of the following are symmetric top?
A) $\quad \mathrm{CH}_{3} \mathrm{Cl} \& \mathrm{BF}_{3}$
B) $\mathrm{H}_{2} \mathrm{O} \& \mathrm{CH}_{2} \mathrm{Cl}_{2}$
C) $\quad \mathrm{HCl} \& \mathrm{CO}_{2}$
D) $\quad \mathrm{CH}_{4} \& \mathrm{SF}_{6}$
28. The cryoscopic constant for water is $1.86 \mathrm{~K} \mathrm{~kg} \mathrm{~mol}^{-1}$. At what temperature a 0.1 m KCl will freeze?
A) $\quad-0.186^{\circ} \mathrm{C}$
B) $\quad+0.186^{\circ} \mathrm{C}$
C) $\quad-0.372^{\circ} \mathrm{C}$
D) $\quad+0.372^{\circ} \mathrm{C}$
29. Which of the following equilibrium reactions have same values of Kp and Kc ?
A) $\quad \mathrm{N}_{2}(\mathrm{~g})+3 \mathrm{H}_{2}(\mathrm{~g}) \rightleftharpoons 2 \mathrm{NH}_{3}(\mathrm{~g})$
B) $2 \mathrm{SO}_{2}(\mathrm{~g})+\mathrm{O}_{2}(\mathrm{~g}) \rightleftharpoons 2 \mathrm{SO}_{3}(\mathrm{~g})$
C) $\mathrm{N}_{2}(\mathrm{~g})+\mathrm{O}_{2}(\mathrm{~g}) \rightleftharpoons 2 \mathrm{NO}(\mathrm{g})$
D) $\quad \mathrm{PCl}_{5}(\mathrm{~g}) \rightleftharpoons \mathrm{PCl}_{3}(\mathrm{~g})+\mathrm{Cl}_{2}(\mathrm{~g})$
30. The emf of Daniel cell can be increased by increasing
A) The surface area of Cu electrode
B) The surface area of Zn electrode
C) The concentration of $\mathrm{Cu}^{2+}$ solution
D) The concentration of $\mathrm{Zn}^{2+}$ solution
31. Which is the incorrect statement?
A) For solutions show +ve deviation from Raoult's law, $\mathrm{P}_{\mathrm{B}}>\mathrm{x}_{\mathrm{B}} \mathrm{P}_{\mathrm{B}}{ }^{0}$
B) For solutions show -ve deviation from Raoult's law, $\mathrm{P}_{\mathrm{B}}<\mathrm{x}_{\mathrm{B}} \mathrm{P}_{\mathrm{B}}{ }^{0}$
C) For solutions show +ve deviation from Raoult's law, $\mathrm{P}_{\mathrm{B}}<\mathrm{x}_{\mathrm{B}} \mathrm{P}_{\mathrm{B}}{ }^{0}$
D) For solutions obey Raoult's law, $\mathrm{P}_{\mathrm{B}}=\mathrm{x}_{\mathrm{B}} \mathrm{P}_{\mathrm{B}}{ }^{0}$
32. The emf of the cell $\mathrm{Ag}(\mathrm{s}) / \mathrm{Ag}+(\mathrm{aq}, 0.1 \mathrm{M}) / / \mathrm{Ag}+(\mathrm{aq} ., 0.01 \mathrm{M}) / \mathrm{Ag}(\mathrm{s})$ at $25^{\circ} \mathrm{C}$ is
A) $\quad+0.591 \mathrm{~V}$
B) $\quad+0.0591 \mathrm{~V}$
C) $\quad-0.0591 \mathrm{~V}$
D) $\quad-0.591 \mathrm{~V}$
33. The rate expression for the reaction $2 \mathrm{NO}(\mathrm{g})+2 \mathrm{H}_{2}(\mathrm{~g}) \rightarrow \mathrm{N}_{2}(\mathrm{~g})+2 \mathrm{H}_{2} \mathrm{O}(\mathrm{g})$ is given by $\mathrm{r}=\mathrm{k}[\mathrm{NO}]^{2}\left[\mathrm{H}_{2}\right]$. When [NO] is doubled and $\left[\mathrm{H}_{2}\right]$ is halved, the rate of the reaction is:
A) doubled
B) remain unchanged
C) increased by four times
D) increased by three times.
34. For a first order reaction a plot of lnk versus $1 / \mathrm{T}$ has slope -4157 . Energy of activation will be
A) $\quad-79.6 \mathrm{~kJ} \mathrm{~mol}^{-1}$
B) $\quad-34.5 \mathrm{~kJ} \mathrm{~mol}^{-1}$
C) $\quad+34.5 \mathrm{~kJ} \mathrm{~mol}^{-1}$
D) $\quad+79.6 \mathrm{~kJ} \mathrm{~mol}^{-1}$
35. Maxwell Boltzmann statistics is applicable for
A) ideal gas
B) protons
C) photons
D) electrons
36. Microcanonical ensembles are characterised by same
A) $\mathrm{N}, \mathrm{V}, \mathrm{E}$
B) $\quad \mathrm{N}, \mathrm{V}, \mathrm{T}$
C) $\quad \mathrm{N}, \mathrm{T}, \mu$,
D) $\quad \mathrm{N}, \mathrm{V}, \mu$
37. Maximum number of phases that can be coexist in a one component system is
A) 1
B) 2
C) 3
D) 4
38. Total number of Bravais lattices, point groups and space groups in crystals are:
A) 14, 32 and 230
B) 14,32 and 232
C) 14, 30 and 232
D) 7,32 and 232
39. The molar mass of macromolecule determined by osmometry is
A) $\quad \bar{M}_{V}$
B) $\quad \bar{M}_{n}$
C) $\bar{M}_{W}$
D) $\quad \bar{M}_{V}$ and $\bar{M}_{n}$
40. The protons in acetone molecule appeared in an NMR spectrum recorded on a 60 MHz instrument at 120 Hz . At what frequency would it appear if it were recorded on 400 MHz instrument?
A) $\quad 120 \mathrm{~Hz}$
B) $\quad 400 \mathrm{~Hz}$
C) 800 Hz
D) 600 Hz
41. The electron gain enthalpy of halogens are in the order
A) $\mathrm{F}>\mathrm{Cl}>\mathrm{Br}>$ I
B) $\mathrm{F}>\mathrm{Br}>\mathrm{Cl}>$ I
C) $\quad \mathrm{Cl}>\mathrm{F}>\mathrm{Br}>$ I
D) $\mathrm{Cl}>\mathrm{Br}>\mathrm{F}>$ I
42. Which is the smallest cation among the following?
A) $\quad \mathrm{Fe}^{2+}$
B) $\quad \mathrm{Fe}^{3+}$
C) $\mathrm{Na}^{+}$
D) $\mathrm{Li}^{+}$
43. The faint pink colour of aqueous solution of $\mathrm{Mn}^{2+}$ ion is due to
A) spin allowed d-d transition
B) Laporte allowed d-d transition
C) Ligand to metal charge transfer
D) Laporte and spin forbidden d-d transition
44. Choose the correct statement given below
A) $\quad \mathrm{Mn}_{3} \mathrm{O}_{4}$ is inverse spinel
B) $\quad \mathrm{Co}_{3} \mathrm{O}_{4}$ is normal spinel
C) $\quad \mathrm{Fe}_{3} \mathrm{O}_{4}$ is normal spinel
D) None of these
45. Among the hydrogen halides, which is the most powerful reducing agent?
A) HCl
B) HBr
C) HF
D) HI
46. The shapes of $\mathrm{I}_{3}^{-}, \mathrm{XeF}_{4}, \mathrm{ClF}_{3}$ and $\mathrm{SF}_{4}$ are respectively
A) Linear, square planar, T-shaped and see-saw
B) V-shaped, square pyramid, T-shaped and see-saw
C) Linear, pentagonal, T-shaped and see-saw
D) Linear, square pyramid, T-shaped and tetrahedral
47. The unfavorable factor for the use of hydrogen as a fuel at room temperature and pressure is its
A) Low enthalpy of combustion
B) Low specific enthalpy
C) Low enthalpy density
D) High production cost
48. STYX number for $\mathrm{B}_{2} \mathrm{H}_{6}$ is
A) 2002
B) 4112
C) 4002
D) 4102
49. The structure of polyhedron of the carborane cluster $\mathrm{C}_{2} \mathrm{~B}_{4} \mathrm{H}_{6}$ based on Wades rule is
A) Arachno
B) Nido
C) Closo
D) Нуро
50. Which of the following statements is not true for Zeise's salt?
A) Pt is four coordinated.
B) Ethylene molecule retains its original planarity in the complex.
C) The hybridisation of Pt is $\mathrm{dsp}^{2}$.
D) The hapticity of ethylene is two.
51. Metal ions capable of forming double bonds with oxygen are
A) $\quad \mathrm{Cr}$ (III), $\mathrm{Os}(\mathrm{VIII}), \mathrm{Mn}$ (III)
B) $\quad \mathrm{Cr}(\mathrm{III}), \mathrm{Os}(\mathrm{VI}), \mathrm{Mn}(\mathrm{II})$
C) $\quad \mathrm{Cr}(\mathrm{III}), \mathrm{Os}(\mathrm{VIII}), \mathrm{Mn}(\mathrm{II})$
D) $\quad \mathrm{Cr}(\mathrm{VI}), \mathrm{Os}(\mathrm{VIII}), \mathrm{Mn}(\mathrm{VII})$
52. The d-orbitals on the Re atoms suitable for making delta bond in $\left[\mathrm{Re}_{2} \mathrm{Cl}_{8}\right]^{2-}$ is
A) $d_{x y}$
B) $d_{y z}$
C) $d_{x z}$
D) $d_{(x 2-y 2)}$
53. Number of $\mathrm{Cu}-\mathrm{O}$ bonds present in $\mathrm{Cu}\left(\mathrm{CH}_{3} \mathrm{COO}\right)_{2} \cdot 2 \mathrm{H}_{2} \mathrm{O}$ is
A) 6
B) 8
C) 10
D) 4
54. The hapticities shown by $\mathrm{C}_{5} \mathrm{H}_{5}$ rings in the molecule $\mathrm{Ti}\left(\mathrm{C}_{5} \mathrm{H}_{5}\right)_{4}$ is/are:
A) 1 only
B) $1 \& 5$
C) $2 \& 5$
D) 5 only
55. The catalyst used for the conversion of ethylene to acetaldehyde is
A) Wilkinson catalyst
B) $\quad \mathrm{PdCl}_{2} / \mathrm{CuCl}_{2}$
C) $\mathrm{Al}(\mathrm{Et})_{3} / \mathrm{TiCl}_{4}$
D) $\quad \mathrm{Co}_{2}(\mathrm{CO})_{8}$
56. The terms derived from $\mathrm{d}^{2}$ configuration are:
A) ${ }^{3} \mathrm{D},{ }^{3} \mathrm{P},{ }^{1} \mathrm{D},{ }^{1} \mathrm{P},{ }^{1} \mathrm{~S}$
B) ${ }^{3} \mathrm{~F},{ }^{3} \mathrm{P},{ }^{1} \mathrm{G},{ }^{1} \mathrm{D},{ }^{1} \mathrm{~S}$
C) ${ }^{3} \mathrm{P},{ }^{3} \mathrm{~F},{ }^{1} \mathrm{G},{ }^{1} \mathrm{D},{ }^{3} \mathrm{~S}$
D) ${ }^{3} \mathrm{~F},{ }^{3} \mathrm{P},{ }^{3} \mathrm{G},{ }^{1} \mathrm{D},{ }^{1} \mathrm{~S}$
57. The metals present in nitrogenise:
A) Cu and Zn
B) $\quad \mathrm{Cu}$ and Ni
C) $\quad \mathrm{Ni}$ and Co
D) Fe and Mo
58. Which one is Vaska's complex?
A) $\left[\mathrm{Co}\left(\mathrm{PPh}_{3}\right)_{2} \mathrm{COCl}\right]$
B) $\quad \operatorname{trans}-\left[\mathrm{Ir}\left(\mathrm{PPh}_{3}\right)_{2}(\mathrm{CO}) \mathrm{Cl}\right]$
C) $\quad$ cis- $\left[\mathrm{Ir}\left(\mathrm{PPh}_{3}\right)_{2}(\mathrm{CO}) \mathrm{Cl}\right]$
D) $\quad\left[\operatorname{Ir}\left(\mathrm{C}_{2} \mathrm{H}_{4}\right)_{2} \mathrm{COCl}\right]$
59. Which ligand would create the largest d-orbital splitting to a given 3d metal ion in an octahedral field?
A) $\quad \mathrm{N}$-nitrito
B) Ethylenediamine
C) Acetylacetonato
D) Carbonyl
60. The correct order of d-orbital splitting in a square planar field is
A) $\quad(d x z=d y z)<d z^{2}<d x y<d x^{2}-y^{2}$
B) $\mathrm{dz}^{2}<(\mathrm{dxz}=\mathrm{dyz})<\mathrm{dx}^{2}-\mathrm{y}^{2}<\mathrm{dxy}$
C) $\mathrm{dz}^{2}<\mathrm{dx}^{2}-\mathrm{y}^{2}<(\mathrm{dxz}=\mathrm{dyz})<\mathrm{dxy}$
D) $\mathrm{dz}^{2}<\mathrm{dx}^{2}-\mathrm{y}^{2}<\mathrm{dxy}<(\mathrm{dxz}=\mathrm{dyz})$
61. The reaction, $\left[\mathrm{RhCl}\left(\mathrm{PPh}_{3}\right)_{3}\right]+\mathrm{H}_{2} \longrightarrow\left[\mathrm{RhCl}\left(\mathrm{PPh}_{3}\right)_{3}(\mathrm{H})_{2}\right]$ is
A) oxidative addition
B) reductive elimination
C) insertion
D) beta elimination
62. The process of precipitating of two slightly soluble compounds containing same cation or anion form the solution is known as:
A) fractional precipitation
B) post precipitation
C) co-precipitation
D) homogeneous precipitation
63. Elemental boron can be purified by
A) Zone refining
B) Van Arkel process
C) Electrolytic process
D) Thermite process
64. The strength of $\mathrm{H}_{2} \mathrm{SO}_{4}, \mathrm{HClO}_{4}$ and HCl in glacial acetic acid are in the order
A) $\quad \mathrm{H}_{2} \mathrm{SO}_{4}>\mathrm{HClO}_{4}>\mathrm{HCl}$
B) $\mathrm{HCl}>\mathrm{HClO}_{4}>\mathrm{H}_{2} \mathrm{SO}_{4}$
C) $\quad \mathrm{H}_{2} \mathrm{SO}_{4}>\mathrm{HCl}>\mathrm{HClO}_{4}$
D) $\quad \mathrm{HClO}_{4}>\mathrm{H}_{2} \mathrm{SO}_{4}>\mathrm{HCl}$
65. Zintl ions among the following are:

1) $\quad \mathrm{PF}_{6}{ }^{-}$
2) $\mathrm{Sn}_{9}{ }^{4-}$
3) $\mathrm{AsBi}^{5+}$
4) $\mathrm{Sb}_{7}{ }^{3-}$
A) $1,2,3$
B) $1,2,4$
C) $2,3,4$
D) $2 \& 4$
66. Which of the following compound is ESR active?
A) $\quad \mathrm{KMnO}_{4}$
B) $\quad \mathrm{K}_{2} \mathrm{Cr}_{2} \mathrm{O}_{7}$
C) $\quad \mathrm{Cu}_{2}(\mathrm{CN})_{2}$
D) $\quad \mathrm{FeSO}_{4} \cdot 7 \mathrm{H}_{2} \mathrm{O}$
67. The role of carbonic anhydrase enzyme is to
A) regulate pH and $\mathrm{CO}_{2}$ formation
B) oxidise ascorbic acid
C) help in digesting proteins
D) transport oxygen in higher animals.
68. The complex ion $\left[\mathrm{Co}(\mathrm{en})_{2} \mathrm{Cl}_{2}\right]^{+}$exhibit
A) optical isomerism only
B) optical isomerism and geometrical isomerism
C) geometrical isomerism only
D) neither optical nor geometrical isomerism.
69. Match the following from List I (fuels) with List II (composition)

## List I

a) water gas
b) Producer gas
c) Coal gas
d) Marsh gas

## List II

1) $\mathrm{CO}+\mathrm{N}_{2}$
2) $\mathrm{CO}+\mathrm{H}_{2}$
3) $\mathrm{CH}_{4}$
4) $\mathrm{CO}+\mathrm{H}_{2}+\mathrm{CH}_{4}+\mathrm{CO}_{2}$
A) $\quad \mathrm{a}-1, \mathrm{~b}-2, \mathrm{c}-3, \mathrm{~d}-4$
B) $\quad \mathrm{a}-2, \mathrm{~b}-1, \mathrm{c}-3, \mathrm{~d}-4$
C) $\quad \mathrm{a}-1, \mathrm{~b}-2, \mathrm{c}-4, \mathrm{~d}-3$
D) $\quad \mathrm{a}-2, \mathrm{~b}-1, \mathrm{c}-4, \mathrm{~d}-3$
70. The metal ion and the macrocyclic ring present in met-haemoglobin is
A) $\quad \mathrm{Fe}$ (II) and corrin
B) $\quad \mathrm{Co}(\mathrm{II})$ and corrin
C) $\mathrm{Fe}(\mathrm{II})$ and porphyrin
D) $\quad \mathrm{Fe}(\mathrm{III})$ and porphyrin
71. Number of hyper fine ESR signals for $\left[\mathrm{Mn}\left(\mathrm{H}_{2} \mathrm{O}\right)_{2}\right]^{2+}\left(\mathrm{I}_{\mathrm{Mn}}=5 / 2\right)$.
A) 5
B) 36
C) 15
d) 30
72. The $\left[\mathrm{Ti}\left(\mathrm{H}_{2} \mathrm{O}\right)_{6}\right]^{3+}$ is purple coloured complex and its absorption maxima appeared at $20300 \mathrm{~cm}^{-1}$. This corresponds to $243 \mathrm{~kJ} / \mathrm{mol}$. The CFSE of the complex is
A) $243 \mathrm{~kJ} / \mathrm{mol}$
B) $\quad 145.8 \mathrm{~kJ} / \mathrm{mol}$
C) $\quad 97 \mathrm{~kJ} / \mathrm{mol}$
D) $\quad 194 \mathrm{~kJ} / \mathrm{mol}$
73. Unequal $\mathrm{M}-\mathrm{O}$ bond lengths is observed in
A) $\left[\mathrm{Zn}\left(\mathrm{OH}_{2}\right)_{6}\right]^{2+}$
B) $\left[\mathrm{Mn}\left(\mathrm{OH}_{2}\right)_{6}\right]^{2+}$
C) $\left[\mathrm{Fe}\left(\mathrm{OH}_{2}\right)_{6}\right]^{3+}$
D) $\left[\mathrm{Fe}\left(\mathrm{OH}_{2}\right)_{6}\right]^{2+}$
74. The volume of 0.025 molar $\mathrm{KMnO}_{4}$ solution required to oxidise 20 mL of 0.025 molar ferrous iron solution is
A) $\quad 20 \mathrm{~mL}$
B) 40 mL
C) $\quad 4 \mathrm{~mL}$
D) 5 mL
75. Which of the following characteristics of the target and product species are favourable for carrying out estimation by neutron activation method?
A) Target with high neutron cross-section area and product with short half life.
B) Target with low neutron cross-section area and product with long half life.
C) Target with low neutron cross-section area and product with short half life.
D) Target with high neutron cross-section area and product with long half life.
76. The number of $\alpha$ - and $\beta$ - particles emission involved in the transformation of ${ }_{92}^{238} \mathrm{U} \rightarrow{ }_{82}^{206} \mathrm{~Pb}$ is
A) $\quad 8 \alpha$ and $8 \beta$
B) $\quad 8 \alpha$ and $6 \beta$
C) $\quad 6 \alpha$ and $8 \beta$
D) $\quad 8 \alpha$ and $10 \beta$
77. BOD of a water sample is equal to the amount of oxygen consumed in mg per litre of it when kept at
A) $\quad 20^{\circ} \mathrm{C}$ for five days
B) $\quad 28^{\circ} \mathrm{C}$ for five days
C) $\quad 20^{\circ} \mathrm{C}$ for three days
D) $25^{\circ} \mathrm{C}$ for five days
78. Catalytic converter is a device fitted to the engine in vehicles to
A) filter out dust particle from air to reach engines
B) convert CO to $\mathrm{H}_{2} \mathrm{O}$ vapour
C) convert CO to $\mathrm{CO}_{2}$ in the exhaust.
D) convert oxides nitrogen to ammonia vapour
79. Which one of the following is an antimalarial?
A) Phenacetin
B) Erythromycin
C) Chloroquin
D) Digitoxin
80. Which of the following methods are used for synthesising nanoparticles?
1) Sol-gel method
2) Chemical vapour deposition
3) sputtering
4) laser beam lithography
A) 1, 2 and 4 only
B) 1, 2 and 3 only
C) 3 and 4 only
D) 1,2,3 and 4
81. Number of oxygen atoms shared in the structures of chain and cyclic silicates are
A) 1 and 2 respectively
B) $\quad 2$ and 1 respectively
C) 2 and 2 respectively
D) 2 and 3 respectively
82. An unknown alkyl halide reacts with alcoholic potash followed by ozonolysis yields propanal and methanal as products. The alkyl halide is
A) 1-bromobutane
B) 2-bromobutane
C) 1,2-dibromobutane
D) 1,4-dibromobutane
83. 18- annulene is aromatic. The number of protons in the shielded region is
A) 18
B) $\quad 12$
C) 6
D) 10
84. Which is not true for reversed phase HPLC?
A) The stationary phase is non-polar
B) Starting eluent is polar and the eluent polarity is gradually decreased.
C) The most polar component will come out first.
D) Only polar eluent is used always
85. The best method for the separation of o- and p-nitrophenols mixture is
A) Steam distillation
B) Simple distillation
C) Distillation under reduced pressure
D) Fractional distillation
86. The correct order of polarity of solvents is
A) $\mathrm{C}_{6} \mathrm{H}_{14}<\mathrm{C}_{6} \mathrm{H}_{6}<\mathrm{CH}_{2} \mathrm{Cl}_{2}<\mathrm{CH}_{3} \mathrm{Cl}<\mathrm{EtOAc}<\mathrm{EtOH}<\mathrm{AcOH}$
B) $\mathrm{C}_{6} \mathrm{H}_{14}<\mathrm{C}_{6} \mathrm{H}_{6}<\mathrm{CH}_{3} \mathrm{Cl}<\mathrm{CH}_{2} \mathrm{Cl}_{2}<\mathrm{EtOAc}<\mathrm{EtOH}<\mathrm{AcOH}$
C) $\mathrm{C}_{6} \mathrm{H}_{14}<\mathrm{C}_{6} \mathrm{H}_{6}<\mathrm{CH}_{2} \mathrm{Cl}_{2}<\mathrm{CH}_{3} \mathrm{Cl}<\mathrm{EtOH}<\mathrm{EtOAc}<\mathrm{AcOH}$
D) $\mathrm{C}_{6} \mathrm{H}_{14}<\mathrm{C}_{6} \mathrm{H}_{6}<\mathrm{CH}_{3} \mathrm{Cl}<\mathrm{CH}_{2} \mathrm{Cl}_{2}<\mathrm{EtOH}<\mathrm{EtOAc}<\mathrm{AcOH}$
87. What would be the product of the reaction?

a)

b)

c)

d)

88. In the following rearrangement reaction, the final product is

a)

b) H

c)

d)

89. 

The product of the reaction

a)

b)

c)

d)

90. The reaction involved in the transformation of cyclohexanoneoxime to caprolactum is
A) Beckmann rearrangement
B) Demjanov rearrangement
C) Wagner-Meerwein rearrangement
D) Favorski rearrangement
91.

In the reaction

a)

b)

c)

d)

92. The unsaturated hydrocarbon formed at the end of Hoffmann exhaustive methylation of

a)

b)

c)

d)

93. The product formed in the reduction of naphthalene in the presence of Ni is
A) cis-decalin
B) trans- decalin
C) 1, 4-dihydro naphthalene
D) 1,2,3,4- tetrahydronaphthalene
94. Suggest a suitable reagent for the transformation

A) $\quad \mathrm{MnO}_{2}$
B) $\quad \mathrm{OsO}_{4}$
C) $\quad \mathrm{H}_{2} \mathrm{O}_{2} / \mathrm{OH}^{-}$
D) $\quad \mathrm{SeO}_{2} / \mathrm{AcOH}$
95. The reactant R in the following reaction is

a)

b) $\mathrm{CH}_{3}-\mathrm{CH}_{2}-\mathrm{CH}_{2}-\mathrm{CH}_{2}-\mathrm{NH}_{2}$
c)

d) either (a) or (c)
96. The $\lambda_{\text {max }}$ calculated for the following molecule by applying Woodward-Fieser rule is

A) 235 nm
B) 240 nm
C) 217 nm
D) 224 nm
97. Which is more stable?
A) $\left(\mathrm{CH}_{3}\right)_{3} \mathrm{C}^{+}$
B) tropylium cation
C) $\quad \mathrm{CH}_{2}=\mathrm{CH}-\mathrm{CH}_{2}{ }^{+}$
D) $\quad \mathrm{C}_{6} \mathrm{H}_{5} \mathrm{CH}_{2}{ }^{+}$
98. The major product of the reaction is

a)

b)

c)

d)

99. Match the IR frequencies from group II with the carbonyl compounds from group I .

## Group I

a) 2-cyclohexenone
b) Cyclohexanone
c) Cyclobutanone
d) Cyclopentanone
A) $\quad \mathrm{a}-3, \mathrm{~b}-4, \mathrm{c}-1, \mathrm{~d}-2$
B) $\quad \mathrm{a}-3, \mathrm{~b}-2, \mathrm{c}-1, \mathrm{~d}-4$
C) $\quad \mathrm{a}-4, \mathrm{~b}-1, \mathrm{c}-3, \mathrm{~d}-2$
D) $\quad \mathrm{a}-2, \mathrm{~b}-1, \mathrm{c}-3, \mathrm{~d}-4$
100. Which is more acidic?
a)

b)

c)

d)

101. Which one of the following shows highest dipole moment?
A) 1,3-dchlorobenzene
B) 1,3,5-trichlorobenzene
C) 1,4-dichlorobenzene
D) 1,2-dichlorobenzene
102. What would be the product of the following reaction?

a)

b)

c)

d)

103.


What is P ?
a)

b)

c)

d)

104. Which are the amino acids containing sulphur?
A) Proline and cysteine
B) Tryptophan and methionine
C) Serine and cysteine
D) Cysteine and methionine
105. The compound that can be synthesised by Kolbe Schmidt reaction is
A) 2-hydroxybenzene carboxylic acid
B) 2-acetyl benzenecarboxylic acid
C) Phenyl ethanoic acid
D) 2-aminobenzene carboxylic acid
106. The product of crossed Cannizaro reaction between $\mathrm{C}_{6} \mathrm{H}_{5} \mathrm{CHO}$ and HCHO
A) Formic acid and benzyl alcohol
B) Benzoic acid and methanol
C) Methyl benzoate
D) benzyl formate
107. Which of the following molecule consume two molecules of ethyl magnesium bromide?
A) $\mathrm{HC} \equiv \mathrm{C}-\mathrm{CH}_{3}$
B) $\quad \mathrm{HC} \equiv \mathrm{C}-\mathrm{CH}_{2}-\mathrm{OH}$
C) $\mathrm{HO}-\mathrm{H}_{2} \mathrm{C}-\mathrm{H}_{2} \mathrm{C}-\mathrm{OH}$
D) Both B and C
108. Solvent suitable for carrying out microwave assisted organic synthesis is
A) Benzene
B) $\quad$-xylene
C) cyclohexane
D) ethylene glycol
109. Find the reagent suitable for the conversion

A) $\mathrm{Br}_{2}$ in $\mathrm{CCl}_{4}$
B) $\quad \mathrm{Br}_{2} /$ red phosphorous
C) $\mathrm{HBr} / \mathrm{H}_{2} \mathrm{O}_{2}$
D) $\mathrm{NBS} / \mathrm{AIBN}$
110. Predict the product of the following reaction.

a)

b)

c)

d)

111. Give the IUPAC name of the following compound.

A) 1-bromospiro[5,4] decane
B) 1-bromospiro[4,5]decane
C) 2-bromospiro[4,5]decane
D) 2-bromospiro[5,4]decane
112. The more stable confirmation of cis-1, 2-dimethyl cyclohexane
A) Both group equatorial
B) Both axial
C) One axial and one equatorial
D) Twist boat conformation
113. Which is the weakest base among the following?


c)

d)

114. The reagent used for the separation of primary, secondary and tertiary amines from a mixture is
A) Bezenesulphonylchloride
B) o-toluene sulphonylchloride
C) Thionyl chloride
D) Tosyl chloride
115. D-Glucose and D-mannose are related as
A) Anomers
B) Epimers
C) Enantiomers
D) Homomers
116. Cis-trans isomerism is shown by
A) Cyclohexene
B) 1,2-dibromocyclohexane
C) 1-butene
D) 2,3-dimethyl butane
117. The intermediate formed in Reimer-Tiemann reaction is
A) Carbonium ion
B) Carbanion
C) Carbene
D) Dichlorocarbene
118. Absolute configuration of carbon atoms 2 and 3 are

A) $\quad 2 \mathrm{~S}, 3 \mathrm{~S}$
B) $\quad 2 \mathrm{~S}, 3 \mathrm{R}$
C) $\quad 2 \mathrm{R}, 3 \mathrm{~S}$
D) $2 R, 3 R$
119. The chief product in the Ziegler-Natta catalysed polymerisation of propylene is
A) isotactic polypropylene
B) syndiotactic polypropylene
C) atactic polypropylene
D) mixure of syndiotactic and actacic polypropylenes.
120. Dacron is a copolymer formed by the condensation of
A) phenol \& formaldehyde
B) adipic acid \& hexamethylenetetramine
C) ethyle glycol and terephthalic acid
D) urea \& formaldehyde

