CHEMISTRY

1 Phenol associates in benzene to form dimers. The Van't Hoff's factor is 0.54. What is the degree of association of phenol?

a. 0.46
b. 0.54
c. 0.98
d. 0.92

2. Which one of the following solutions produces maximum elevation in boiling point?

a. 0.1 M glucose
b. 0.2 M sucrose
c. 0.1 M $BaCl_2$
d. 0.1 M $MgSO_4$

3 12 g of acetic acid when dissolved in 100 g of benzene raised the boiling point of benzene by 0.26°. What is the value of van't Hoff's factor of acetic acid in benzene? (Molal elevation constant of benzene is 2.58°)

a. 2
b. 1
c. 5
d. 0.5

4 What are the number of components and the number of degrees of freedom in $Fe_{(s)} + H_2O \rightleftharpoons FeO_{(s)} + H_{2(g)}$ respectively?

a. 3, 2
b. 4, 3
c. 3, 1
d. 4, 2

5 Consider the following statements:

1. For a one component system, the maximum number of phases that can exist in equilibrium is three.
2. A system can have negative degrees of freedom.
3. The number of phases in a system does not depend on the amounts of the various substances present in equilibrium.

Which of the statements given above is/are correct?

a. 1 and 3
b. 1 only
c. 3 only
d. 2 and 3

6 Solid carbon reacts with oxygen in the presence of a catalyst to form the gaseous oxides CO and CO_2. What is the number of degrees of freedom (variance) for the system once equilibrium has been attained?

a. 0
b. 1
c. 2
d. 3

7 For which of the following processes ΔS will be positive?

1. $2NO_2(g) + O_3(g) \rightarrow N_2O_5(g)$
2. $NH_4NO_3(s) \rightarrow NH_4NO_3(aq)$
3. O_2 (g, 1 atm) → O_2 (g, 10 atm)
4. $C(s) + H_2O(g) \rightarrow CO(g) + H_2(g)$

Select the correct answer using the codes given below:

a. 1 and 2
b. 2 and 3
c. 2 and 4
d. 1 and 4

8 Which one of the following is the correct statement? A chemical reaction will be spontaneous if it is accompanied by a decrease of

a. enthalpy of the system
b. entropy of the system
c. internal energy of the system
d. free energy of the system

9 For an adiabatic process, what is the relation between temperature and pressure?

a. $\frac{T_2}{T_1} = \left(\frac{p_2}{p_1}\right)^{\cdot}$

b

c. $\frac{T_2}{T_1} = \left(\frac{p_2}{p_1}\right)^{\frac{\cdot}{\gamma}}$

d. $\frac{t_2}{t_1} = \left(\frac{p_2}{p_1}\right)^{\frac{1}{n}}$

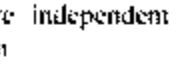
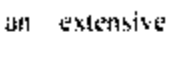
10. Which one of the following statements is correct ?
    a. Extensive properties are independent of the mass of the system
    b. Potential energy is an extensive property
    c. Intensive properties depend on the mass of the system
    d. Density is an extensive property

11. At what temperature will the helium atoms have the same root mean square speed as that of oxygen molecules at 256 K?
    a. 32 K
    b. 64 K
    c. 128 K
    d. 256 K

12. If the intermolecular forces vanish away, what is the volume occupied by molecules contained in 4·5 kg of water at N.T.P.?
    a. 5.6 m^3
    b. 4.5 m^3
    c. 11.2 m^3
    d. 11.2 litre

13. Which one of the following is the correct order of δ values for the protons attached to an alkane, alkene and alkyne carbon atom ?
    a. Alkane - H > alkene - H > alkyne - H
    b. Alkene - H > alkyne - H > alkane - H
    c. Alkyne - H > alkene - H > alkane -H
    d. Alkyne – H > alkane – H > alkene - H

14. Match List I with List II and select the correct answer using the codes given below the lists:
    List I
    A. Aldol condensation
    B. Cannizzaro reaction
    C. Reformatsky reaction
    D. Benzoin condensation
    List II
    1. Hydride ion transfer
    2. Organozinc compound
    3. $CN^{\ominus}$ as catalyst
    4. Enolate ion
    a. A4, B1, C2, D3
    b. A2, B3, C4, D1
    c. A4, B3, C2, D1
    d. A2, B1, C4, D3

15. Consider the following four carbonyl compounds:
    1. C_6H_5 —CHO
    2. 
    3. 
    4. NO_2-CH-CHO

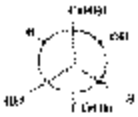
    Which one of the following is the correct sequence of decreasing order of reactivity towards nucleophilic addition reactions of the above compounds ?
    a. 3-1-2-4
    b. 4-2-1-3
    c. 2-4-1-3
    d. 4-3-2-1

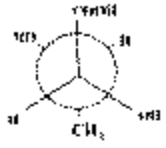
16. Consider the following alcohols:
    1. n-butyl alcohol
    2. Secondary butyl alcohol
    3. Tertiary butyl alcohol

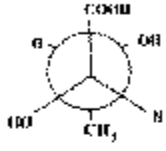
    Which one of the following is the correct sequence of the above alcohols in terms of increasing order of their solubility in water?
    a. 1 > 2 > 3
    b. 2 > 3 > 1
    c. 2 > 1 > 3
    d. 3 > 2 > 1

17. The reaction of methyl bromide with other halide ions was studied separately in gas phase and in methanol solution. Which one of the following gives the correct order of reactivity of halide ions?
    a. $F^- > Cl^- > I^-$ in gas phase while $I^- > Cl^- > F^-$ in methanol solution
    b. $I^- > Cl^- > F^-$ in gas phase while $F^- > Cl^- > I^-$ in methanol solution
    c. $F^- > Cl^- > I^-$ in both gas phase and methanol solution
    d. $I^- > Cl^- > F^-$ in both gas phase and methanol solution

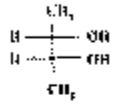
18. Which one of the following is the correct Newman projection formula of a molecule having 2s, 3 s-configuration?
    a. 

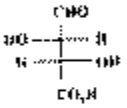
b. 

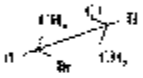
c. 

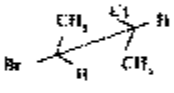
d. 

19. Consider the following compounds:

1. 

2. 

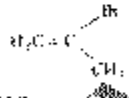
3. 

4. 

Which one of the following is the correct classification of above compounds as threo and erythro compounds ?

a. 1, 3 = Erythro ; 2, 4 Threo
b. 1, 4 = Erythro ; 2, 3 = Threo
c. 2, 3, 4 = Erythro ; 1 = Threo
d. 2, 3 Erythro ; 1, 4 = Threo

20. Consider the following compound:



What are the two methylene protons in the above compound called?

a. Homotopic protons
b. Enantiomeric protons
c. Diastereotopic protons
d. Enantiotopic protons

21. What does the reaction of acetamid with methyl magnesium bromide followed by acid hydrolysis yield ?

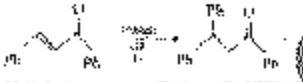
a. Acetone
b. t- butyl alcohol
c. t-butyl amine
d. N-methyl acetamide

22. Which one of the following is the correct statement ?

1-phenyl ethanol arid 2-phenyl ethanol may be prepared by the reaction of phenyl magnesium bromide with

a. HCHO and CH_3CHO, respectively
b. FICHO and , respectively
c. CH3CHO and , respectively
d. and CH_3COCH_3, respectively

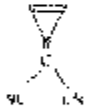
23. Consider the following reaction:



Which one of the following is the correct statement?

a. The ketone is obtained with PhMgBr while the alcohol is obtained with PhLi as the major product
b. The ketone is obtained with PhLi while the alcohol is obtained with PhMgBr as the major product
c. PhMgBr produces both ketone and alcohol in 1: 1 ratio, while PhLi gives the alcohol as the major product
d. PhLi produces both ketone arid alcohol in 1:1 ratio, while PhMgBr gives the ketone as the major product

24. Consider the following compounds

1. 

2. 

3. 

Which of the above compounds exhibit aromaticity?

a. 1 and 2 only
b. 2 and 3 only
c. 1 and 3 only
d. 1, 2 and 3

25. **Assertion (A):** The phosphorescence spectrum is observed at shorter wavelengths than the fluorescence spectrum.

Reason (R): T_1 state has a lower energy than S_1 state.

a Both A and R are individually true and R is the correct explanation of A
b Both A and R are individually true but R is not the correct explanation of A
c A is true but R is false
d A is false but R is true

26 **Assertion (A):** Pressure of a gas is due to the impact of collision of gas molecules against the walls of the container

Reason (R): The collisions between molecules depend on the temperature and are independent of nature of the gas

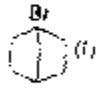
a Both A and R are individually true and R is the correct explanation of A
b Both A and R are individually true but R is not the correct explanation of A
c A is true but R is false
d A is false but R is true

27 **Assertion (A):** Ethylacetoacetate gives reddish violet colour with ferric chloride

Reason (R) : It exists predominantly in the keto form

a Both A and R are individually true and R is the correct explanation of A
b Both A and R are individually true but R is not the correct explanation of A
c A is true but R is false
d A is false but R is true

28 **Assertion (A):** A bridgehead halide like norbornyl bromide (I) is inert to S_N2 displacement



Reason (R): Carbonium ions at bridgehead positions cannot be formed because planarity is prohibited

a Both A and R are individually true and R is the correct explanation of A
b Both A and R are individually true but R is not the correct explanation of A
c A is true but R is false
d A is false but R is true

29 **Assertion (A):** The greater the number of alkyl groups attached to the doubly bonded carbon atoms, the more stable is the alkene

Reason (R): Delocalisation of electrons through overlap involving it and a bond orbitals known as hyper-conjugation, occurs to a greater extent as the number of alkyl groups is increased

a. Both A and R are individually true and R is the correct explanation of A
b Both A and R are individually true but R is not the correct explanation of A
c A is true but R is false
d A is false but R is true

30 **Assertion (A):** Cr(VI) is much more toxic than Cr(III)

Reason (R): The toxicity of Cr(VI) is due to its powerful oxidising property

a. Both A and R are individually true and R is the correct explanation of A
b Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d A is false but R is true

31 **Assertion (A):** On cooling the brown colour of NO_2 disappears

Reason (R): On cooling, NO_2 dimerizes resulting in the pairing of odd electron of

a Both A and R are individually true and R is the correct explanation of A.
b Both A and R are individually true but R is not the correct explanation of A.
c. A is true but R is false
d A is false but R is true

32. **Assertion (A):** PCl_5 exists but NCl_5 does not exist

Reason (R): Phosphorus is more electro-positive than nitrogen

a. Both A and R are individually true and R is the correct explanation of A
b Both A and R are individually true but R is not the correct explanation of A
c A is true but R is false
d A is false but R is true

33 **Assertion (A):** Maltose is a reducing sugar while sucrose is not

Reason (R): Sucrose has ketal linkage whereas maltose has hemiacetal linkage

a Both A and R are individually true and R is the correct explanation of A.
b Both A and R are individually true but R is not the correct explanation of A
c. A is true but R is false
d. A is false but R is true

34 Which one of the following is the correct statement?

Micelles form only above the Critical Micelle concentration and above the

a absolute temperature
b Kraft temperature
c Curie temperature
d Neel temperature

35 Which one of the following statements is not correct?
a Lyophobic colloids are thermodynamically unstable
b Lyophobic colloids are stabilized kinetically by adsorbed ions
c Emulsions are lyophobic colloids, stabilized kinetically by the presence of an emulsifying agent
d Lyophobic colloids are destabilized kinetically by the presence of a polymer in the solution

36 Which one of the reactions represented by the following equations is an example of homogeneous catalysis?
a. $C_2H_4(g) + H_2(g) \xrightarrow{Ni} C_2H_6(g)$
b $2SO_2 + O_2(g) \xrightarrow{V_2O_5} 2SO_3(g)$
c $2CH_3OH(g) + O_2(g) \xrightarrow{Ag} 2HCHO(g) + 2H_2O(g)$
d $CH_3COOH(l) + C_2H_5OH(l) \rightarrow CH_3COOC_2H_5(l) + H_2O(l)$

37 Which one of the following is the correct statement? The enzyme-catalyzed reaction is faster than a metal catalyzed reaction because
a its activation energy is greater
b Its activation energy is lower
c enzymes are present in large amount
d it increases the heat of reaction

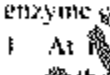
38 Which of the following statements holds(s) for the Michaelis-Menten mechanism of an enzyme catalyzed reaction?
1 At low concentration of the substrate the reaction rate is first order in [S]
2 At very high concentration of the substrate S, the reaction rate is independent of [S]
3 A plot of the reciprocal of the reaction rate against the reciprocal of the substrate concentration is linear
Select the correct answer using the codes given below
a 1 only
b 2 only
c 3 only
d 1, 2 and 3

39 What is the radiative transition that occurs from the lowest triplet state T_1 to the ground state singlet S_0 known as?
a Fluorescence
b Phosphorescence
c Internal conversion
d Inter system crossing

40 Which one of the following statements is correct?
a Absorption of photon by a molecule always leads to chemical reaction
b The molar extinction coefficient is limitless
c The quantum yield of any reaction is always nearly unity
d In a reacting system only the absorbed radiation is effective

41 Why is ferric chloride used to stop bleeding in a
a Fe^{3+} coagulates blood which is positively charged sol
b Fe^{3+} coagulates blood which is negatively charged sol
c Cl^- coagulates blood which is positively charged sol
d Cl^- coagulates blood which is negatively charged sol

42 Which one of the following is the correct statement? Fog is an example of colloidal system of
a. liquid dispersed in gas
b gas dispersed in gas
c solid dispersed in gas
d solid dispersed in liquid

43 Which one of the following compounds has enantiotopic faces?
a 
b 
c 
d $C_6H_5 \cdot C \equiv N$

44 Consider the following statements about aromatic amines
1 Aromatic amines are weaker bases than ammonia
2 Electron-releasing substituents increase the basicity of aniline and electron-withdrawing substituents decrease the basicity

3. A given substituent affects the basicity of an amine and the acidity of a carboxylic acid in opposite ways.

Which of the statements given above are correct?

a. 1 and 2 only
b. 2 and 3 only
c. 1 and 3 only
d. 1, 2 and 3

45. *m*-bromoanisole and *o*-bromoanisole are treated with $NaNH_2$ in liquid NH_3 separately. Which one of the following is the result of this treatment?

a. Both yield *o*-anisidine
b. Both yield *m*-anisidine
c. *m*-bromoanisole yields *m*-anisidine while *o*-bromoanisole yields *o*-anisidine
d. *m*-bromoanisole yields *p*-anisidine while *o*-bromoanisole yields a mixture *o*- and *m*-anisidines

46. An aldose is oxidised separately by Br_2H_2O (Condition-A) and by HNO_3 (Condition-B). Which one of the following is the correct combination of the products formed?

a. Condition-A gives aldonic acid while Condition-B yields aldaric acid
b. Condition-A gives aldaric acid while Condition-B yields aldonic acid
c. Condition-A gives aldonic acid while Condition-B yields a mixture of aldonic and aldaric acids
d. Condition-A gives aldaric acid while Condition-B yields a mixture of aldonic and aldaric acids

47. Glucose on treatment with HCN, followed by hydrolysis and reduction with HI produces which one of the following acids?

a. Hexanoic acid
b. Heptanoic acid
c. Pentannic acid
d. Butanoic acid

48. Which one of the following is the carbene?

a. R_4C^{+}
b. R_3C^{+}
c. $R_2\ddot{C}$:
d. $\overline{R\ddot{N}}$

49. Which one of the following methods is not used for the conversion of an aldohexose to an aldopentose?

a. The Ruff Method
b. The Wohl Method
c. The Fenton's reagent Method
d. The Kiliani's Synthesis

50. Which one of the following species will be present when a solution of glycine is made acidic?

a. $H_3\overset{+}{N}CH_2\text{-}COOH$
b. $H_2N\text{-}CH_2\text{-}COOH$
c. $H_2N\text{-}CH_2\text{-}COO^{\ominus}$
d. $H_2\overset{\delta}{N}\text{-}CH_2\text{-}\overset{\delta}{C}OO$

51. Consider the following statements about amino acids:

1. At isoelectric point an amino acid does not migrate under the influence of an electric field.
2. The solubility of an amino acid is highest at isoelectric point.
3. Amino acids exist as dipolar ions.

Which of the statements given above are correct?

a. 1 and 2 only
b. 2 and 3 only
c. 1 and 3 only
d. 1, 2 and 3

52. An aldehyde reacts with a mixture of KCN and NH_4Cl to give a product ($C_4H_8N_2$), which upon hydrolysis yields alanine. Which is this aldehyde?

a. Formaldehyde
b. Acetaldehyde
c. Propionaldehyde
d. Benzaldehyde

53. Which one of the following is an example of phospho protein?

a. Casein
b. Glycogen
c. Oxytocin
d. Gamma globulin

54. Which of the following reactions is/are mainly involved in drying of oils?

1. Hydrogenation
2. Hydrolysis
3. Polymerisation
4. Oxidation

Select the correct answer using the codes given below:

a. 1 and 2
b. 2 only
c. 2 and 3
d. 3 and 4

55. How many equivalent protons are contained by TMS, a reference compounds for PMR?

a. 10
b. 11
c. 12
d. 13

56. Which one of the following correctly describes a fat?

a. Fats are carboxylic esters derived from a single fatty acid, oleic acid
b. Fats are carboxylic esters derived from a single alcohol, glycerol
c. Fats are sodium salts of alkyl-benzenesulfonic acids
d. Fats are mixtures of sodium salts of long chain unsaturated fatty acids

57. Which one of the following shows the approximate chemical shifts and splitting patterns of $CH_3COCH_2COCH_3$?

a. Singlet (2 δ), singlet (3.6 δ), singlet (2.5 δ)
b. Singlet (2 δ), singlet (2.2 δ), singlet (3.6 δ)
c. Singlet (2 δ), singlet (2.5 δ)
d. Singlet (3.5 δ), multiplet (2.5 δ)

58. What is the characteristic IR absorption of ether linkage in epoxide?

a. 925-1050 cm^{-1}
b. 3050-3080 cm^{-1}
c. 1450-1500 cm^{-1}
d. 2850-2900 cm^{-1}

59. Which one among the following is the most soluble in water?

a. LiI
b. LiBr
c. LiCl
d. LiF

60. Which one of the following is the correct statement? The blue solutions of alkali metals in liquid ammonia decompose very slowly with liberation of

a. gaseous ammonia
b. hydrogen azide
c. nitrogen gas
d. hydrogen gas

61. What is the role of phosphates in detergents?

a. To control pH level of the detergent containing water
b. To remove Ca^{2+} and Mg^{2+} ions from water that cause the hardness to water
c. To provide whiteness to the fabrics
d. To solidify detergent as without phosphate, detergents are liquid in nature

62. Which among the following are most stable and least stable oxoanions, respectively?

1. OCl^-
2. ClO_2^-
3. ClO_3^-
4. ClO_4^-

Select the correct answer using the codes given below:

a. 1 and 3
b. 2 and 3
c. 4 and 1
d. 2 and 4

63. Which one of the following represents the yellow solid formed on mixing deepred PtF_6 vapour with an equal amount of Xe?

a. $[XeF]$
b. $[XeF]^+[PtF_6]^-$
c. $[Xe]^+[PtF_6]^-$
d. $[XeF]^+[Pt_2F_{11}]^-$

64. How are noble gas hydrates of Argon, Krypton and Xenon formed?

a. Covalent bonds formation
b. Electrostatic interaction
c. Charge transfer
d. Trapping of noble gas atoms in the cavities of frozen water

65. Why are magnetic moments of trivalent lanthanide ions not affected by ligands in comparison to those of 3d-transition metals?

a. Lanthanides are heavier than 3d-transition metals
b. Properties of lanthanide ions are similar
c. *f*-electrons are more deep seated than d-electrons

d. Lanthanides show high coordination number

66. Aqueous iron (III) solution develops intense orange-red colour on adding thiocyanate solution. What is the colour due to?
a. Charge transfer transition
b. d-d transition
c. σ-π^* transition in the ligand
d. π-π^* transition in the ligand

67. Why is $[Ni(en)_3]^{2+}$ nearly 10^{10} times more stable than $[Ni(NH_3)_6]^{2+}$?
a. NH_3 evaporates easily and causes instability to the $[Ni(NH_3)_6]^{2+}$ complex
b. Six NH_3 ligands cause steric hindrance around the Ni^{2+} centre
c. 'en' is a chelating ligand and forms thermodynamically more stable complexes
d. NH_3 is the weakest ligand known

68. When concentrated HCl is added to a solution of $[Co(H_2O)_6]^{2+}$ ion, an intense blue colour develops due to the formation of which one of the following?
a. $[CoCl_6]^{4-}$
b. $[CoCl_4]^{2-}$
c. $[CoCl_2(H_2O)_4]$
d. $[CoCl(H_2O)_5]^{+}$

69. For $[Ti(H_2O)_6]^{3+}$, the absorption maximum due to d-d transition is found at 20,000 cm^{-1}. What is the crystal field stabilization energy?
a. 20,000 cm^{-1}
b. 8000 cm^{-1}
c. (4/9) x (20,000) cm^{-1}
d. (4/9) x (8000) cm^{-1}

70. The oxidation potentials for copper ions in acidic solutions are Cu^{2+} $\underline{-0.15\ V}$ Cu^{+} $\underline{+0.50\ V}$ Cu
Thus Cu^{+} state in acidic solution
Which one of the following is the correct statement?
a. is very stable
b. disproportionate into Cu^{2+} and Cu
c. is oxidized to Cu^{2+}
d. is reduced to Cu

71. Which of the following types of bonds are present in $CuSO_4.5H_2O$?
1. Electrovalent
2. Covalent
3. Coordinate
Select the correct answer using the codes given below:
a. 1 and 2 only
b. 2 and 3
c. 1 and 3 only
d. 1, 2 and 3

72. When 1.0 g of an organic solid is added to 90 g of pure water, its vapour pressure is lowered by 1%. What is the molecular weight of the solid?
a. 40
b. 30
c. 20
d. 10

73. Which one of the following is the correct statement? If an azeotropic solution of two liquids has a boiling point lower than either of them, then it
a. shows a negative deviation from Raoult's law
b. shows no deviation from Raoult's law
c. shows a positive deviation from Raoult's law
d. is saturated

74. An acid H_2A has dissociation constants K_1 = 0.10 and K_2 = 1 x 10^{-7}. What is the concentration of H_3O^+ in a solution prepared by dissolving 0.2 moles of the acid in water to give 1 litre of solution?
a. 0.20 M
b. 0.10 M
c. 0.15 M
d. 0.17 M

75. What is the approximate pH value of 10^{-10} M HCl solution?
a. 1
b. 2
c. 7
d. 10

76. Which one of the following is the correct sequence followed by molar ionic conductances of the ions?
a. $Li^+ > Na^+ > K^+ > Rb^+$
b. $Rb^+ > K^+ > Na^+ > Li^+$
c. $Na^+ > K^+ > Rb^+ > Li^+$
d. $Na^+ > K^+ > Li^+ > Rb^+$

77. At a given temperature and pressure, which of the following quantities must be the

same for aqueous HCl and for aqueous KCl?

1. Transport number at infinite dilution, of Cl^-, $t^\infty(Cl^-)$.
2. Molar conductivity at infinite dilution, of Cl^-, $\lambda^\infty(Cl^-)$.
3. Ionic mobility at infinite dilution, of Cl^-, $u^\infty(Cl^-)$.

Select the correct answer using the codes given below:

a. 1 and 2 only
b. 1 and 3 only
c. 2 and 3 only
d. 1, 2 and 3

78. An electrochemical cell is made from aluminium and silver electrodes. The standard electrode potentials of aluminium and silver are –1.66 V and + 0.80 V respectively. Which one of the following reactions takes place at the anode?

a. $Ag(s) \rightarrow Ag^+(aq) + e^-$
b. $Ag^+(aq) + e^- \rightarrow Ag(s)$
c. $Al(s) \rightarrow Al^{3+}(aq) + 3e^-$
d. $Al^{3+}(aq) + 3e^- \rightarrow Al(s)$

79. For the reaction $A + B \rightarrow C$, in which of the following cases, the maximum amount of product will be formed in a given time?

a. 1 mol of A and 1 mol of B in a one litre flask
b. 2 mol of A and 2 mol of B in a two litre flask
c. 0.5 mol of A and 0.5 mol of B in a 0.5 litre flask
d. 0.2 mol of A and 0.2 mol of B in a 0.1 litre flask

80. When a second order reaction behaves like a first order reaction due to the presence of large excess of one of the reactants, what is the reaction called?

a. First order reaction
b. Zero order reaction
c. Second order reaction
d. Pseudo first order reaction

81. In the Michaelis-Menten mechanism for an enzyme catalysed reaction,

$$E + S \underset{k_2}{\overset{k_1}{\rightleftharpoons}} ES \xrightarrow{k_3} P + E$$

What is the value of the Michaelis constant?

a. $\frac{k_1 + k_3}{k_2}$
b. $\frac{k_3}{k_1 + k_2}$
c. $\frac{k_2 + k_3}{k_1}$
d. $\frac{k_1 + k_2}{k_3}$

82. For a chemical reaction, $A \rightarrow B$, it is found that the rate of reaction doubles when the concentration of A is increased four times. What is the order of this reaction?

a. 2
b. 1
c. 0
d. 1/2

83. The rate constant for a second order reaction is 2.5×10^{-2} dm^3 $mol^{-1}s^{-1}$. If the initial concentration of the reactant is 0.05 mol dm^{-3}, what is the value of $t_{1/2}$ for the reaction?

a. 800 s
b. 1000 s
c. 144 s
d. 100 s

84. Consider the following statements:

1. Energy of activation is never negative.
2. The negative energy of activation means rate of reaction increases with temperature.
3. Zero activation energy means the rate of reaction is independent of temperature.

Which of the statements given above is/are correct?

a. 2 only
b. 2 and 3
c. 1 and 3
d. 3 only

85. If the reaction $H(g) + F_2(g) \rightarrow HF(g) + F(g)$ were to proceed by the formation of a non-linear activated complex, what is the number of vibrational degrees of freedom for the activated complex?

a. 1
b. 2
c. 3
d. 4

86. H_2 dissociates in presence of light only when Hg vapours are present. This is an example of which one of the following?
   a. Chemiluminescence
   b. Fluorescence
   c. Photosensitization
   d. Autocatalysis

87. Which one of the following statements is correct in respect of a reversible reaction?
   a. The catalyst catalyses the forward reaction
   b. The catalyst catalyses the backward reaction
   c. The catalyst influences the direct and the reverse reactions to the same extent
   d. The catalyst increases the rate of forward reaction and decreases the rate of backward reaction

88. The atomic orbital with quantum numbers, $n = 4$, $l = 2$, and $m_l = 0$ corresponds to which one of the following orbitals?
   a. 4s
   b. $4p_z$
   c. $4d_{z^2}$
   d. $4d^{xy}$

89. Which one of the following orbitals has the angular part of wave function as $\sqrt{\frac{3}{4\pi}}\cos\theta$?
   a. s
   b. p_x
   c. p_z
   d. d_{z^2}

90. For a valence electron in a 3d state, what are possible l values?
   a. 5/2, 1/2
   b. 3/2, 1/2
   c. 3/2, 1/2
   d. 1, 0

91. If we have 32 elements in the 7th period of the periodic table, how many more artificial elements beyond Lawrencium (Z=103) should be synthesised?
   a. 18
   b. 18
   c. 10
   d. 21

92. What is the decreasing order of ionic radii of Tl^+, Ca^{2+}, La^{3+} and Th^{4+}?
   a. $Th^{4+} > Ca^{2+} > Tl^+ > La^{3+}$
   b. $Th^{4+} > Ca^{2+} > La^{3+} > Tl^+$
   c. $Tl^+ > La^{3+} > Th^{4+} > Ca^{2+}$
   d. $Th^{4+} > La^{3+} > Tl^+ > Ca^{2+}$

93. Which pair of molecules have identical shapes?
   a. CF_4, SF_4
   b. XeF_2, CO_2
   c. BF_3, PCl_3
   d. PF_5, IF_5

94. Which one of the following is the correct order of increasing C – O bond length among CO, CO_3^{2-} and CO_2?
   a. $CO_3^{2-} < CO_2 < CO$
   b. $CO_2 < CO < CO_3^{2-}$
   c. $CO < CO_3^{2-} < CO_2$
   d. $CO < CO_2 < CO_3^{2-}$

95. Which set describes shapes of XeF_2, XeF_4, XeF_6, respectively?
   a. V-shaped, tetrahedral, octahedral
   b. Linear, tetrahedral, distorted octahedral
   c. V-shaped, square planar, octahedral
   d. Linear, square planar, distorted octahedral

96. Match List I with List II and select the correct answer using the codes given below the lists

List I (Molecule)
A. SF_6
B. BeF_2
C. BF_3
D. PCl_5

List II (Hybridization)
1. d^2sp^3
2. sp
3. sp^2
4. sp^3d
5. sp^3d^2

   a. A5, B2, C3, D4
   b. A3, B4, C1, D2
   c. A5, B4, C3, D2
   d. A3, B2, C1, D4

97. Which one of the following is the correct statement according to Brönsted theory of acids and bases for reaction.
$HCl(aq) + H_2O(l) \rightarrow H_3O^+ Cl^-(aq)$?
   a. HCl and Cl are acids
   b. HCl and H_2O are acids
   c. HCl and H_3O^+ are acids
   d. H_3O^+ and Cl are bases

98. Which one of the following is the correct statement?
The conjugate acids of NH_3 and NH_2^- are
a. NH_2^- and NH_3, respectively
b. NH_4^+ and NH_3, respectively
c. NH_2^- and NH_4^+, respectively
d. NH_3 and N_2H_4, respectively

99. Consider the following statements.
Hydrogen is evolved by the action of cold dilute HNO_3 on
1. Fe
2. Mg
3. Mn
4. Al
Which of the statements given above are correct?
a. 1 and 4
b. 2 and 3 only
c. 1, 2 and 3
d. 2 and 4

100. Which one of the following statements is not correct for heavy water?
a. Density is greater than that of water
b. Dielectric constant is greater than that of water
c. Freezing point is higher than that of water
d. Surface tension is less than that of water

101. Which element among the following has f-electrons?
a. Arsenic
b. Germanium
c. Indium
d. Thallium

102. A metal M readily forms water soluble MSO_4. It also forms oxide MO which becomes inert on heating. Hydroxide M(OH)$_2$ is insoluble in water but soluble in NaOH solution. What is M?
a. Mg
b. Ba
c. Ca
d. Be

103. Which one of the following is the correct sequence of Ce^{+4}, La^{+3}, Pm^{+3}, and Yb^{+3} in increasing order of their ionic radii?
a. $Yb^{+3} < Pm^{+3} < Ce^{+3} < La^{+3}$
b. $Ce^{+4} < Yb^{+3} < Pm^{+3} < La^{+3}$
c. $Yb^{+3} < Pm^{+3} < La^{+3} < Ce^{+3}$
d. $Pm^{+3} < La^{+3} < Ce^{+3} < Yb^{+3}$

104. An aerated dilute solution of NaCN is used for the extraction of which one of the following metals?
a. Nickel
b. Iron
c. Copper
d. Gold

105. Th charge of the blast furnace for the extraction of iron is a mixture of oxide ore, coke and X. What is X?
a. Silica
b. Dolomite
c. Quicklime
d. Limestone

106. Which of the following are fissile elements?
1. ^{233}U
2. ^{235}U
3. ^{238}U
4. ^{239}Pu
Select the correct answer using the codes given below
a. 1 and 2
b. 1 and 3 only
c. 1, 3 and 4
d. 2, 3 and 4

107 What is the binding energy (kJ mol^{-1}) of ^{14}N, if the mass defect is 0.21 amu?
a. 1.89×10^{13}
b. 1.89×10^{12}
c. 1.89×10^{15}
d. 1.89×10^{10}

108. What does complex tris (ethylene diamine) cobalt (III) chloride exhibit?
a. ***fac-mer*** isomerism
b. Optical isomerism
c. cis-trans-isomerism
d. Linkage isomerism

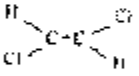
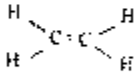
109 Gold (I) thiomaleate is used as a medicine for treatment of which one of the following?
a. Malaria
b. Arthritis
c. Diabetes
d. Ulcer

110. Which one of the following complex species does not obey the EAN rule?
a. $[Cu(CN)_4]^{-}$

b. $[Cr(NH_3)_6]^{+}$
c. $[Fe(CN)_6]^{4-}$
d. $[Ni(CO)_4]$

111. Consider the following statements:
1. PAN is a secondary air pollutant.
2. BOD and COD values are indicators of water pollution level.
Which of the statements given above is/are correct?
a. 1only
b. 2 only
c. Both 1 and 2
d. Neither 1 nor 2

112. Which one of the following shows hyper conjugation?
a. CH_3=CH_2
b. CH_3-CH_2-CH_3
c. CH_3-CH=CH_2
d. CH_2=C=CH_2

113. Which one of the following molecules has a net dipole moment?
a. 
b. 
c. 
d. 

114. Which on of the following is the strongest base?
a. $\overset{\oplus}{N}H_4$
b. $:NH_3$
c. $\overset{\ominus}{N}H_2$
d. $\overset{\ominus}{O}H$

115. Which one of the following is the correct statement ? The odd electron of methyl radical occupies
a. one of the sp^3-hybridised orbitals of C
b. one of the sp^3-hybridised orbitals of C
c. one of the sp-hybridised orbitals of C
d. the non-hybridized p-orbital of C

116. Carbenes do not undergo which one of the following reactions?
a. Addition
b. Insertion
c. Dimerisation
d. Rearrangement

117. Which one of the following reactive intermediates is involved in the base-catalysed racemisation of (+) - lactic acid?
a. Carbene
b. Carbanion
c. Carbon free radical
d. Carbocation

118. Which one of the following is the correct statement? The triphenyl methyl radical is a reactive species and undergoes irreversible dimerisation in the presence of a mineral acid, producing
a. hexaphenyl ethane
b. tetraphenyl ethane
c. ortho-Benzohydryltriphenyl methane
d. para-Benzohydryltetraphenyl methane

119. Consider the following carbocation:
$(C_6H_5)_3C^{+}$; CH_3CC^{+}; CF_3C^{+}, Cl_3CC^{+}
Which one of the following is the correct order of stability of the above carbocations?
a. $(C_6H_5)_3C^{+}$ > F_3CC^{+} > Cl_3CC^{+} > $(H_3C)_3C^{+}$
b. $(C_6H_5)_3C^{+}$ > Cl_3CC^{+}> F_3CC^{+} >$(H_3C)_3C^{+}$
c. F_3CC^{+} > Cl_3CC^{+} >$(H_3C)_3C^{+}$ > $(C_6H_5)_3C^{+}$
d. $(C_6H_5)_3C^{+}$ > $(H_3C)_3C^{+}$ > Cl_3CC^{+} > F_3CC^{+}

120. Reductive ozonolysis of an alkene $C_{10}H_{18}$ gave the following three products in 1:1:1 ration:
1. CH_3COCH_3
2. CH_3COCHO
3. $OHCCH_2CH_2COCHO$
Which is the most likely structure of the alkene?
a. 
b. 
c. 
d.