CHEMISTRY - 2010

1. Identify the correct statement :
   (a) The second ionization energy (I_2) is the ionization energy of the least, tightly bound electron of the neutral atom
   (b) The second ionization energy (I_2) is the ionization energy of the least tightly bound electron of the monovalent cation of the element
   (c) The first ionization energy (I_1) is the ionization energy of the least tightly bound electron of the neutral atom
   (d) The first ionization energy (I_1) is the ionization energy of the least tightly bound electron of the monovalent cation of the element

2. Which of the following statements is incorrect :
   (a) Ionic radii increases down a group
   (b) Ionic radii decreases across a period
   (c) Ionic radii decrease with increase in coordination number
   (d) Ionic radii increase with decreasing charge number

3. Which of the following statements is correct :
   (a) The higher radius ratio gives an indication of a higher coordination number of a compound
   (b) The higher radius ratio gives an indication of a lower coordination number of a compound
   (c) The lower radius ratio gives an indication of a higher oxidation state of a metal ion in a compound
   (d) None of the above

4. According to Fajan's rule, the covalent bond is favoured by :
   (a) Large cation and small anion   (b) Large cation and large anion
   (c) Small cation and small anion   (d) Small cation and large anion

5. The structures of $AlCl_3$ and PCl_3 can be described by :
   (a) Planar geometry
   (b) Pyramidal geometry
   (c) Planar and Pyramidal geometry, respectively
   (d) Pyramidal and planar geometry, respectively

6. Identify the incorrect statement :
   (a) The existence of electron deficient species is explained by the delocalization of the bonding influence of electrons over several atoms
   (b) Molecular orbitals are formed from linear combination of atomic orbitals of different symmetry
   (c) The bond order in N_2 is 3
   (d) As per M.O. theory, the oxygen molecule is paramagnetic

7. Which of the following statements is incorrect ?
   (a) In heteronuclear diatomic molecules, the more electronegative element makes the larger contributions to bonding orbitals and less electronegative element makes the greater contribution to the antibonding orbitals
   (b) In HF, the bonding orbital is more concentrated on the H atom and the antibonding orbital is more concentrated on F atom
   (c) A bonding orbital arises from the constructive interference of neighbouring atomic orbitals; an antibonding orbital arises from their destructive interferences
   (d) The bond order assesses the net number of bonds between two atoms in the molecular orbital formalism

8. Metallic hydrides are :
   (a) Non-volatile, electrically non-conducting, crystalline solids
   (b) Non-stoichiometric, electrically conducting solids
   (c) Binary compounds of an element and hydrogen in the form of individual, discrete molecules
   (d) All of the above

9. The compound which is not formed by xenon is :
   (a) $Xe\, O_3$
   (b) $Xe\, F_4$
   (c) $Xe\, Cl_4$
   (d) $Xe\, OF_4$

10. Which of the following is incorrect :
   (a) NO_3^- and NO_2^- ions are both strong oxidizing agents
   (b) Hydrazine and hydroxylamine are both good reducing agents
   (c) Hydrazine is a good oxidizing agent but hydroxylamine is a reducing agent
   (d) NO_2 is stable with respect to oxidation in air

11. Saline carbides :
   (a) are ionic solids, formed by the high electropositive elements of group 1 and 2
   (b) are formed by d-block elements and possess metallic conductivity and lustre
   (c) are hard covalent solids, formed by boron and silicon
   (d) are not formed by direct reaction of a metal oxide and carbon at a high temperature

12. Which of the following is not a gas filled radiation detector ?
   (a) Ionization chamber   (b) Proportional counter
   (c) G-M counter   (d) ZnS Scintillater

13. The radio isotope used in the treatment of hyperthyroidism is :
   (a) Co-60   (b) Na-24
   (c) I-131   (d) I-123

14. Sodium hydroxide can not be used as a primary standard for acid base titration, because :
   (a) It is corrosive and reacts with glass
   (b) The dissolution of sodium hydroxide in water is highly exothermic and, thus, changes its concentration
   (c) It is hygroscopic and also reacts with atmospheric CO_2
   (d) Hydroxides can not be used as primary standards

15. $KMnO_4$ reacts with oxalic acid according to the equation :
   $2KMnO_4 + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$. Here 20ml of 0.1 M $KMnO_4$ will react with
   (a) 20ml of 0.5M $H_2C_2O_4$ (b) 50ml of 0.1M $H_2C_2O_4$
   (c) 50ml of 0.5M $H_2C_2O_4$ (d) 20ml of 0.1M $H_2C_2O_4$

16. IUPAC name for $K_3[Al(C_2H_4)_3]$ is :
   (a) Potassium trioxalato aluminate (III)
   (b) Potassium aluminium oxalate
   (c) Potassium trioxalato aluminium (III)
   (d) Potassium trisoxalato aluminate (III)

17. The CFSE of a Cr3+ ion in an octahedral complex will be equal to :
   (a) 0.4 Δ 0   (b) 0.8 Δ 0
   (c) 1.2 Δ 0   (d) 1.6 Δ 0

18. Chromium has the lowest oxidation state in :
    (a) Chromium sulphate
    (b) Chromium trioxide
    (c) Potassium chromate
    (d) Potassium dichromate

19. Lanthanide contraction occurs due to :
    (a) Poor shielding properties of F-orbitals
    (b) Increase in effective nuclear charge
    (c) Both of the above
    (d) Decrease in effective nuclear charge

20. Common salt is important for physiological activity of human body, because :
    (a) It contains ions, each having eight electrons in its outermost shell and, therefore, acts as an inert nutrient
    (b) It is involved in the carbohydrate metabolism
    (c) It has a high lattice energy and is one of the sources of energy in the body
    (d) It helps in maintaining the osmotic balance among the body fluids

21. The increasing order of strength of secondary forces is :
    (a) Vander Wall forces, H-bonding, London forces, Dipole-dipole interaction
    (b) H-bonding, Vander Wall forces, London forces, Dipole interaction
    (c) London forces, Dipole-Dipole interaction, H-bonding, covalent bonding
    (d) Vander Wall forces, London forces, Dipole-dipole interaction and H-bonding

22. Which of the following reaction involves retention of configuration ?

    (a) $N \equiv \overset{\ominus}{C} : + CH_3CH_2CH_2B_r \longrightarrow$

    (b) $C_2H_5ONa + C_6H_5 - \overset{\overset{\displaystyle CH3}{|}}{\underset{\underset{\displaystyle CH_2CH_3}{|}}{C}} - B_r \longrightarrow$

    (c) $CH_3 - \overset{\overset{\displaystyle CH=CH_2}{|}}{\underset{\underset{\displaystyle CH_2-CH_3}{|}}{C}} - OH + SoCl_2 \longrightarrow$

    (d) $D (+) Glucose \underset{H_2O}{\overset{\overset{\ominus}{OH}}{\rightleftharpoons}} D(+) Mannose$

23. Which of the following conformations of methyl cyclohexane will have maximum steric interaction :
    (a) 1,a-H: 2,a-CH₃
    (b) 1,e-H: 2,e-CH₃
    (c) 1,a-H: 3-a-CH₃
    (d) 1,e-CH₃: 3-a-H

24. Which amongst the following will not be a reactant in Diels Alder reaction ?
    (a) 1 : 3 butadiene & butane   (b) 2-butene and propylene
    (c) 1-butene and 2-Methyl propylene (d) 1 : 3 butadiene and propylene

25. Which amongst the following metal catalyst reduction process represent Birch reduction :
    (a) Toluene $\xrightarrow{\text{Ni/H}_2}$ Methyl Cyclohexane
    (b) Benzene $\xrightarrow[\text{NH}_3,\text{EtOH}]{\text{Na}}$ Cyclohexene
    (c) p – xylene $\xrightarrow{\text{Sn/HCl}}$ 1,4dimethy Cyclohexane
    (d) Isopropyl benzene $\xrightarrow[\text{liquid NH}_3/\text{C}_2\text{H}_5\text{OH}]{\text{Na}}$ 3 – isopropyl, 1,4 Cyclohaxadiene

26. Which amongst the following conversions represents claisen rearrangement ?
    (a) Intermolecular conversion of Allyl phenyl ethers to allyl phenols
    (b) Interamolecular conversions of Allyl phenyl ethers to allyl phenols
    (c) Intramolecular conversion between two molecules of ethyl acetate in presence of sodium ethoxide to ethyl acetoacetate
    (d) Reaction of ethyl benzoate with ethyl acetate in presence of sodium ethoxide to Ethyl benzoyl acetate

27. Which amongst the following will be a preferential product during conversion of 1,2 epoxy cyclohexane under acidic conditions ?
    (a) Trans 1,2, cyclohexane diol
    (b) Cis, 1,2, cyclohexanediol
    (c) 50% trans product and 50% Cis product
    (d) 1-Hydroxymethyl cyclochexanol

28. Which amongst the following name reactions does not involve Hydride shift ?
    (a) Cannizzaro's reaction
    (b) Meervin Pond Off Verly reduction
    (c) Mannich reaction
    (d) Oppenauer oxidation

29. Which amongst the following compounds would undero Hell-volhard zelinsky reaction ?
    (a) Propionic acid $\xrightarrow[\text{P}]{\text{Br}_2}$
    (b) 2, 2, dimethyl Propionic acid $\xrightarrow[\text{P}]{\text{Br2}}$
    (c) p – hydroxybenzoic acid $\xrightarrow{\text{Br}_2}$
    (d) Formic acid $\xrightarrow{\text{Br}_2}$

30. Propionic acid on treatment with carbon monoxide and steam under pressure at 300-400° C in presence of phosphoric acid yields :
    (a) Propiolic acid
    (b) 2-methyl propionic acid
    (c) Isobutyric acid .
    (d) n-butyric acid

31. The product of reaction between maleic acid and $KMnO_4$ is :
    (a) (+) Tartaric acid
    (b) (–) Tartaric acid
    (c) (±) Tartartic acid
    (d) Succinic acid

32. Pyrrole on chlorination with sulphuryl chloride in ether at 0°C yields :
    (a) 2,3,4,5, tetrachloropyrole
    (b) 2-Chloropyrole
    (c) 3-Chloropyrole
    (d) 2,3, dichloropyrole

33. The UV absorption maxima of 2,4, cholestadiene is :
    (a) 258 nm
    (b) 275 nm
    (c) 220 nm
    (d) 270 nm

34. The absorption due to carbonyl group in acetophenone will be displayed at :
    (a) 1705 cm^{-1}
    (b) 1735 cm^{-1}
    (c) 1690 cm^{-1}
    (d) 1650 cm^{-1}

35. The number and nature of signals in HNMR spectra of P-xylene will be :
    (a) 4-signals; as singlets
    (b) 3-signals; as 1-singlet & 2-doublets
    (c) 2-signals; as 1-singlet & pair of doublets
    (d) 1-signal ; as double doublet only

36. Which amongst the following compound will display most deshielded signal ?
    (a) Ethanol
    (b) Acetaldelyde
    (c) Acetophenone
    (d) Acetone

37. The geometry of substitutents at the anomeric carbon w.r.t. CH_2OH in case of -D- Glucopyranose is :-
    (a) Trans
    (b) Cis
    (c) Both Cis & trans
    (d) Neither Cis nor trans

38. Amino acids are synthesized by :
    (a) HVZ reaction
    (b) Gabrial Pthalimide synthesis
    (c) Strecker synthesis
    (d) All the above

39. The sex hormone which does not display enone system in its structure is :
    (a) Androsterone
    (b) Estrone
    (c) Testosterone
    (d) Progesterone

40. The nature of the bond in an organo-metallic compound is :-
    (a) Covalent
    (b) Ionic
    (c) Partially covalent
    (d) Partially ionic

41. The derivative of $e^{6x} - 3x^{-2}$ is :
    (a) $6e^{6x} - 6x^{-3}$
    (b) $e^{6x} + 6x^{-3}$
    (c) $6e^{6x} + 6x^{-3}$
    (d) $6e^{6x} - 6/x$

42. The van der Waals constant b, the actual volume V and the critical volume V_c of molecules in a gas are related as :
    (a) $V_c = 3b = 2V$
    (b) $V_c = 3b, V = b$
    (c) $V_c/3 = 4V = b$
    (d) $V_c = 4b, V = b/3$

43. The dipole moment of CO_3 ion is zero. The structure of the ion should be :
    (a) tetrahedral
    (b) trigonal planar
    (c) pyramidal
    (d) linear

44. A plane that diagonally bisects a cubic unit cell into two prisms has the miller index :
    (a) 100
    (b) 101
    (c) 200
    (d) 111

45. The rate of O_2 production in the reaction $2O_3 \rightarrow 3O_2$ is 1.32×10^{-3} Ms^{-1} at 373 K when the concentration of ozone is 0.10 M and the rate law is $v = k[O_3]^n$. What is the order of the reaction if the rate constant is 4.4×10^{-2} M^{-1} s^{-1}
    (a) 1
    (b) 0
    (c) 2
    (d) 2.5

46. For the reaction $N_2O_5 \rightarrow 2NO_2 + \frac{1}{2}O_2$ what is the correct expression for representing the reaction rate ?
    (a) $d[N_2O_5]/dt$
    (b) $d[NO_2]/dt$
    (c) $\frac{1}{2} d[NO_2]/dt$
    (d) $\frac{1}{2} d[O_2]/dt$

47. In an isolated system :
    (a) ΔG is always negative
    (b) ΔS is always positive
    (c) both (a) & (b) are correct
    (d) All (a), (b) & (c) are incorrect

48. The statement of third law of thermodynamics that entropy of a substance is zero at zero Kelvin :
    (a) is always true
    (b) is true for all crystalline substances
    (c) is true only for substances with only one arrangement of atoms in the crystalline state
    (d) none of the above is true

49. The depression in freezing point method was used to determine the molar mass of benzoic acid in water. The result was found to be :
    (a) Correct
    (b) Lower than the correct value
    (c) Higher than the correct value
    (d) Molar mass of benzoic acid cannot be found by this method

50. The degree of dissociation of a very weak acid in water is α. Its dissociation constant in water is related to its concentration by the relation :
    (a) $K = c\,\alpha$
    (b) $K = c\sqrt{\alpha}$
    (c) $K = \alpha\,\sqrt{c}$
    (d) $\alpha = \sqrt{(K/c)}$

51. The solubility S of $Ag_2 S$ in water is related to its solubility product K_{sp} as :
    (a) $K_{sp} = 3S^2$
    (b) $K_{sp} = 4S^3$
    (c) $K_{sp} = S^2$
    (d) $K_{sp} = S^3$

52. The half cell $Hg\,(1)\,|\,Hg_2\,Cl_2\,(s)$, KCl (aq, 1.0 M) represents which electrode ?
    (a) redox electrode
    (b) metal/metal ion electrode
    (c) saturated calomel electrode
    (d) normal calomel electrode

53. The energy of a beam of light depends on its intensity. Higher intensity of the light beam means :
    (a) higher photon density
    (b) larger wavelength of the light rays
    (c) larger frequency of the light rays
    (d) smaller wavelength of the light rays

54. The statement that each observable property of a system is represented in quantum mechanics by an operator is :
    (a) the first postulate of quantum mechanics
    (b) the second postulate of quantum mechanics
    (c) the third postulate of quantum mechanics
    (d) is not a postulate of quantum mechanics

55. In which of the energy levels in the particle in a one-dimensional box has the particle wave wavelength equal to half the box length ?

    (a) 1st level   (b) 2nd level

    (c) 3rd level   (d) 4th level

56. The correct wave function for a system should be normalized. Which one of the following expressions represents the normalization condition ?

    (a) $\int \psi_1^* \psi_2 d\tau = n$ (b) $\int \psi_1^* \psi_2 d\tau = 1$

    (c) $\int \psi_1^* \psi_2 d\tau = 0$ (d) $\int \psi_1^* \psi_1 d\tau = 1$

57 The angular part of the hydrogen like wave function is the product of a theta part and a phi part. The phi part is $\Phi_m(\Phi) = \frac{1}{\sqrt{2\pi}} e^{im\Phi}$ where $i = \sqrt{-1}$, m is the magnetic quantum number and ϕ is the azimuthal angle. What is the correct function for the 2s electron ?

    (a) $\Phi_m(\varphi) = \frac{1}{\sqrt{2\pi}} e^{-i\phi}$ (b) $\Phi_m(\phi) = \frac{1}{\sqrt{2\pi}} e^{i\phi}$

    (c) $\Phi_m(\phi) = \frac{1}{\sqrt{2\pi}}$ (d) $\Phi_m(\phi) = \frac{1}{\sqrt{2\pi}} e^{2i\phi}$

58. Which one of the following molecules will not give rotational spectrum ?

    (a) HCl   (b) O_2

    (c) H_2O (d) NH_3

59 The selection rules for spectral transitions in atomic spectra are i) $\Delta n = 1,2,3 \ldots\ldots$ and ii) $\Delta l = \pm 1$. Which of the following transitions are allowed ?

    (a) $1s \rightarrow 3p$ (b) $3p \rightarrow 3d$

    (c) $2p \rightarrow 3p$ (d) none of these

60. Using the equipartition principle what is the average energy of CH_4 at a temperature T ?

    (a) 5 kT   (b) 6 kT

    (c) 9 kT   (d) 12 kT