DU M.SC. ENTRANCE CHEMISTRY 2014

1. The ground state term symbol for Eu^{3+} is

(a) $^7F_0$ (b) $^7F_6$ (c) $^3F_0$ (d) $^3F_6$

2. Which of the following compound would be drawn most strongly into a magnetic field?

(a) $TiCl_4$ (b) VCl_3 (c) $FeCl_2$ (d) $CuCl_2$

3. Which of the following correctly represents the balanced chemical reaction between aluminum and sulfur?

(a) $16Al + 3S_8 \rightarrow 8Al_2S_3$ (b) $12Al + S_8 \rightarrow 4Al_3S_2$

(c) $8Al + S_8 \rightarrow 8AlS$ (d) $4Al + S_8 \rightarrow 8AlS_2$

4. When two ionic compounds are dissolved in water, a double replacement reaction can

(a) Never occur since all ions in water are "spectator ions"

(b) Occur if two of the ions form an insoluble ionic compound, which precipitates out of solution

(c) Occur if the ions react to form a gas, which bubbles out of the solution

(d) Occur only if the ions form covalent bonds with each other

5. Which Bronsted acid $\left(H_2O \text{ or } H_2S_{(aq)}\right)$ is the stronger acid and why is the stronger acid?

(a) H_2O is the stronger acid because oxygen has a greater electronegativity than sulfur, which gives the attached hydrogen atom more proton character

(b) H_2O is the stronger acid because H_2S is a gas and gases are not acids.

(c) H_2S is the stronger acid because the hydrogen-sulfur bond is much weaker than the hydrogen-oxygen bond due to a greater difference in atomic orbital energy levels.

(d) H_2S is the stronger acid because it is a heavier molecule and therefore has more energetic collisions.

6. The common features among the species CN, CO, and NO are

(a) Bond order three and iso-electronic

(b) Bond order three and weak-field ligands

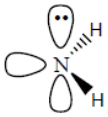
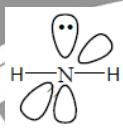
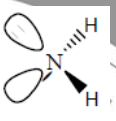
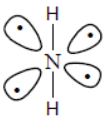
(c) Bond order two and stronger-field ligands

(d) Iso-electronic and weak-field ligands

7. The central atom is BrF_5 has _?_ bonding pairs of electrons and _?_ non-bonding pairs of electrons

(a) 1 and 5 (b) 0 and 5 (c) 5 and 1 (d) 5 and 0

8. Which of the following best represents the three-dimensional view of H_2 ion?

(a)  (b)  (c)  (d) 

9. What you call an element if it has 18 electrons in penultimate shell and 3 electrons in outer most shell?

(a) s block element (b) p block element (c) d block element (d) f block element

10. What is the geometry of $\left[AuCl_4\right]^-$ complex ion?

(a) Square-planar (b) Tetrahedral

(c) Trigonal monopyramidal (d) See-saw

11. The complex ions $\left[Cr(en)_2ClBr\right]Br$ and $\left[Cr(en)_2Br_2\right]Cl$ are called (where "en" stands for ethylene diamine):

(a) Optical isomers (b) Linkage isomers

(c) Geometrical isomers (d) Ionisation isomers

12. The correct formula of the compound whose name is hexaamminechromium (III) nitrate is

(a) $\left[Cr(NH_2)_6\right](NO_3)_3$ (b) $\left[Cr(NH_3)_6\right](NO_2)_3$

(c) $\left[Cr(NH_3)_6\right](NO_3)_3$ (d) $\left[Cr(NO_3)_3\right](NH_3)_6$

13. The expected spin-only magnetic moments for $\left[Fe(CN)_6\right]^4$ and $\left[FeF_6\right]^3$ are

(a) 1.73 and 1.73 B.M. (b) 1.73 and 5.92 B.M.

(c) 0.0 and 1.73 B.M. (d) 0.0 and 5.92 B.M.

14. The molecule $\left[Pt(NH_3)(OH_2)BrCl\right]$ is square planar. How many geometrical isomers of this molecule can exist?

(a) 2 (b) 3 (c) 4 (d) 6

15. Which statement about octahedral complex ions is correct?

(a) $A\,C_3$ axis makes the d_{xy}, d_{xz} and d_{yz} orbitals indistinguishable, or degenerate (b) $A\,C_3$ axis destabilizes the d_{xy}, d_{xz} and d_{yz} orbitals relative to the $d_{x^2-y^2}$ and d_x^2 orbitals

(c) The donor atoms of the ligands point directly toward the d_{xy}, d_{xz} and d_{yz} orbitals.

(d) The t_{2g} orbitals are destabilized by $+3/5A_0$

16. Which equation best represents the first ionization energy of magnesium?

(a) $Mg(s) \rightarrow Mg^{+}(s) + e^{-}$ (b) $Mg(g) \rightarrow Mg^{3+}(g) + 2e^{-}$

(c) $Mg(s) \rightarrow Mg^{2+}(g) + e^{-}$ (d) $Mg(s) \rightarrow Mg^{+}(g) + e^{-}$

17. Which pair of species describes the correct increasing order to the property given?

(a) Covalent character : HI, HBr (b) Ionic radius : Mg, Mg^{2+}

(c) Melting point : I_2, Br_2 (d) First ionization potential : O, S

18. Consider the following nuclear reaction

$^{60}Ni_{2s} + \alpha \rightarrow X \rightarrow ^{63}Zn_{30} + Y$

The X and Y are

(a) $^{63}Zn_{30}$ and neutron (b) $^{63}Zn_{30}$ and β particle

(c) $^{64}Zn_{31}$ and proton (d) $^{64}Zn_{32}$ and neutron

19. The reaction between hexacyanoferrate (III) and iodide ion in strongly acidic solution produces:

(a) $\left[Fe(CN)_6\right]^{3-}$ and iodine (b) $\left[Fe(CN)_6\right]^{2-}$ and iodide ion

(c) $\left[Fe(CN)_6\right]^{4-}$ and iodine (d) $\left[Fe(CN)_6\right]^{3-}$ and iodide ion

20. The perchloric acid molecule contains

(a) 13 lone pairs, 1 π bond, and 4 σ bonds

(b) 9 lone pairs, no π bond, and 6 σ bonds

(c) 8 lone pairs, 2 π bonds, and 7 σ bonds

(d) 11 lone pairs, no π bonds, and 5 σ bonds

21. Toluene on oxidation with a alkaline $KMnO_4$ forms benzoic acid. What is the product formed when n-propyl benzene is oxidized with $KMnO_4$?

(a) $C_6H_5CH_2COOH$ (b) $C_6H_5CH_2CH_2COOH$

(c) C_6H_5COOH (d) C_6H_5CHO

22. What is the relative area of each peak in a quarter spin-spin splitting pattern?

(a) $1:4:4:1$ (b) $1:2:2:1$ (c) $1:2:1$ (d) $1:3:3:1$

23. Which of the following reacts with fastest with $NaOH, H_2O$?

(a) ethylene oxide (oxirane) (b) cis-2, 3-dimethyloxirane

(c) trans-2, 3-dimethyloxirane (d) 2, 2, 3, 3-tetramethyloxirane

24. What is the relationship between keto and enol tautomers?

(a) Resonance forms

(b) Stereoisomers

(c) Constitutional isomers

(d) Different conformations of the same compound

25. Lucas reagent is

(a) Anhydrous $CuCl_2/HCl$ (b) Anhydrous $CuCl_2/H_2SO_4$

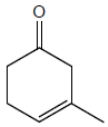
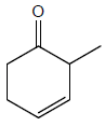
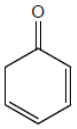
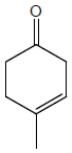
(c) Anhydrous $ZnCl_2/HCl$ (d) Anhydrous $ZnCl_2/H_2SO_4$

26. Correct order of basicity of the following anion is

(a) $CH_3COO < OH < CH_3O$ (b) $CH_3COO > OH > CH_3O$

(c) $CH_3COO < CH_3O < OH$ (d) $CH_3COO > CH_3O > OH$

27. Which of the following compounds will have largest λ_{max} ?

(a)  (b)  (c)  (d) 

28. The correct order of reactivity towards electrophilic aromatic substitution is:

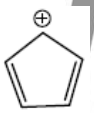
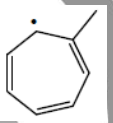
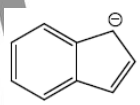
(a) Furan > Thiophene > Pyrrole > Benzene

(b) Thiophene > Furan > Pyrrole > Benzene

(c) Benzene > Thiophene > Furan > Pyrrole

(d) Pyrrole > Furan > Thiophene > Benzene

29. Which of the following compound is aromatic?

(a)  (b)  (c)  (d) 

30. Ethylene molecules may be joined together in large numbers form polymer which of the following best describes this process?

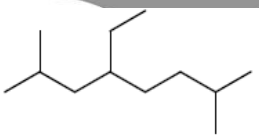
(a) Electrophilic addition catalyzed by an acid

(b) Nucleophilic addition catalyzed by an acid

(c) Addition reaction involves free radicals

(d) Substitution reaction catalyzed by oxygen

31. IUPAC name of the following compound is



(a) 2-Methyl-5-isobutylheptane (b) 2, 7-Dimethyl-4-ethyloctane

(c) 2, 7-Dimethyl-5-ethyloctane (d) 2, 7, 7-trimethyl-4-ethylheptane

32. Amino acids with OH group are

(a) Serine and alanine (b) Alanine and valine

(c) Serine and threonine (d) Valine and isoleucine

33. In accordance with the sequence rule, correct order of priority of the following group is

(a) $COOH > CH = CH_2 > CH_2CH = CH_2 > CH_2CH_2CH_3$

(b) $COOH < CH = CH_2 < CH_2CH = CH_2 < CH_2CH_2CH_3$

(c) $COOH < CH_2CH_2CH_3 > CH = CH_2 > CH_2CH = CH_2$

(d) $COOH > CH_2CH = CH_2 > CH = CH_2 > CH_2CH_2CH_3$

34. The fingerprint region of the infrared spectrum, which is characteristic for each individual compound, is between

(a) $400 - 1400\ cm^{-1}$ (b) $1400 - 900\ cm^{-1}$ (c) $900 - 600\ cm^{-1}$ (d) $600 - 250\ cm^{-1}$

35. Which of the following techniques would be most useful to identify and quantify the pressure of a known impurity in a drug substance?

(a) HPLC (b) NMR (c) IR (d) UV

36. Which of the following compounds does not absorb light in the UV/visible spectrum?

(a) Aspirin (b) Paracetamol (c) Chloral hydrate (d) Phenobarbitone

37. Victor Meyer test is used for the confirmation of

(a) $1°, 2°, 3°$ Amines (b) $1°, 2°, 3°$ Alcohols

(c) Carbonyl group (d) Nitro group

38. Correct statement about carbonyl stretching frequency in the IR of cyclopentanone and cyclohexaone is?

(a) Both have same frequency stretching

(b) Cyclopentanone : $1745\ cm^{-1}$; Cyclohexanone : $1715\ cm^{-1}$

(c) Cyclopentanone : $1715\ cm^{-1}$; Cyclohexanone : $1745\ cm^{-1}$

(d) Cyclopentanone : $1690\ cm^{-1}$; Cyclohexanone : $16475\ cm^{-1}$

39. An acid (HA) has $K_a = 10^{-7}$, what will be its pK_a ?

(a) 7 (b) -7 (c) -0.7 (d) 1/7

40. Major product that would be formed when 2-bromo-hexane undergoes 1 : 1 elimination reaction

(a) Z-2-Hexane (b) 1-Hexene

(c) E-2-Hexene (d) Mixture of E/Z-2-hexene

41. Vander Waal's equation for n moles of a gas is

(a) $\left(P+a/V^2\right)\left(V-b\right)=RT$ (b) $\left(P+na/V^2\right)\left(V-nb\right)=nRT$

(c) $\left(P+na/V^2\right)\left(V-b\right)=nRT$ (d) $\left(P+n^2a/V^2\right)\left(V-nb\right)=nRT$

42. With increase in temperature, the viscosities of gases and liquids respectively :

(a) Increase, decrease (b) Decrease, increase

(c) Increase, increase (d) Decrease, decrease

43. The fraction of molecules of a gas possessing velocities in a given range depends on

(a) Total number of molecules (b) Temperature

(c) Volume of the gas (d) Pressure of the gas

44. The triple point of water is 273. 16K; what will be the temperature in degree Celsius:

(a) 0 (b) 0.01 (c) -0.01 (d) 100

45. System A is 1 mole of ice at $-10°C$ and system B is 1 mole of super-cooled water at $-10°C$. Choose the correct statement

(a) A has greater vapour pressure than B

(b) A has greater free energy than B

(c) A has lower free energy than B

(d) Both A and B have the same free energy

46. Reverse osmosis is an example of

(a) Reversible process (b) Irreversible process

(c) Equilibrium process (d) Non-spontaneous process

47. A gas (system) at 0.1 atm, pressure is enclosed in a cylinder fitted with a weightless, frictionless piston and the cylinder is placed in the surroundings, where the pressure is 1 atm. In the spontaneous process that occur isothermally.

(a) Entropy of the system increases, that of surroundings decreases

(b) Entropy of the system decreases, that of surroundings increases

(c) Entropy of the system and the surroundings increase

(d) Entropy of the system and the surroundings decrease

48. Mean velocity, most probable velocity and root mean square velocity are approximately in the ratio

(a) 1.13 : 1 : 1.23 (b) 1.23 : 1 : 1.13 (c) 1.23 : 1.13 : 1 (d) 1 : 1.13 : 1.23

49. Which one of the following is not a perfect differential?

(a) dG (b) dT (c) dQ (d) dH

50. A condition for equilibrium is

(a) $\delta G = 0$ (b) $\delta G_{T,V} = 0$ (c) $\delta G_{T,P} = 0$ (d) $\delta G_{P,V} = 0$

51. The E^0_{cell} of an Al-air battery is 2.73 V and it involves a 12 electron process. The ΔG^0 in kJ will be

(a) 3161.340 kJ (b) $-32.76\,kJ$ (c) $32.76\,kJ$ (d) $-3161.340\,kJ$

52. For the first order reaction, if the time taken for 50% of the reaction is t secs; the time required for completion of 99.99% reaction is

(a) 5 t (b) 10 t (c) 2 t (d) 100 t

53. If $e^{\alpha x}$ is an eigen function and d^n/dx^n is an operator then the eigen value will be

(a) α^n (b) α (c) n (d) n^α

54. A projectile of mass 1.0 g is known to be within $1\,\mu ms^{-1}$. Calculate the minimum uncertainty in its position.

(a) $5\times10^{26}\,m\,s^{-1}$ (b) $5\times10^{26}\,m$ (c) $5\times10^{-26}\,m\,s^{-1}$ (d) $5\times10^{-26}\,m$

55. In NMR spectroscopy, by what mechanism the saturation effect is removed, to maintain the population difference

(a) spin-spin relxation (b) spin-lattice relaxation

(c) Magic angle spinning (d) Nuclear Overhauser effect.

56. In the hydrogen molecule, when hydrogen is replaced by deuterium. What will happen to the rotational constant B?

(a) Increase (b) Becomes zero (c) Decreases (d) Remains same

57. Choose the correct statement

(a) For a real gas C_P change with temperature, but does not change with pressure

(b) For an ideal gas C_p changes neither with temperature nor with pressure

(c) For a real gas C_p changes with temperature, but does not with pressure

(d) For a real gas C_p changes with both temperature and pressure

58. Bragg's law can be stated as

(a) $n\lambda = 2d\sin\theta$ (b) $n\lambda = 2a\sin\theta$ (c) $n\lambda = \sqrt{2d}\sin\theta$ (d) $d = 2\lambda\sin\theta$

59. To be classified as "nanoscale" an object must have one dimension in the order of

(a) 10^{-10}m (b) 10^{-15}m (c) 10^{-8}m (d) 10^{-9}m

60. How many phase are present in the equilibria, $CaCO_3(s) \leftrightarrow CaO(s) + CO_2(g)$?

(a) 1 (b) 2 (c) 3 (d) 4