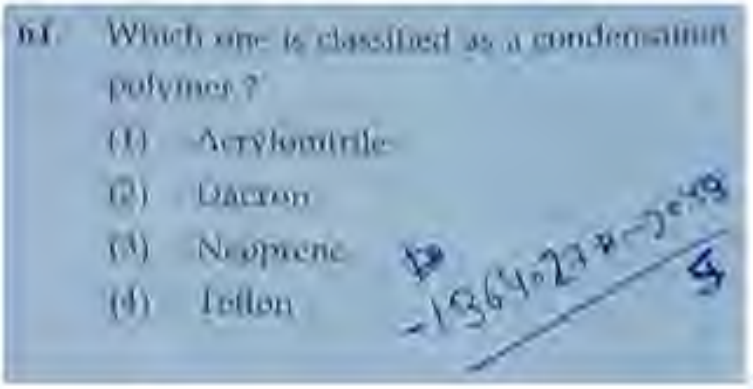
JEE MAIN 2014
Solution Chemistry

Strategy:

a) With majority of questions being from Organic Chemistry and Physical Chemistry, the thrust of the students should be on these two segments of Chemistry.
b) The questions were a mix of application type questions and questions testing the detailed knowledge of the objects/compounds/elements/processes. The students should thoroughly understand the things before they attempt the questions.


61. Which one is classified as a condensation polymer?
(1) Acrylonitrile
(2) Dacron
(3) Neoprene
(4) Teflon

Solution: (2)

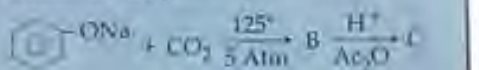
The polyester Dacron is an example of synthetic condensation polymers, also known as step-growth polymers. In contrast to chain-growth polymers, most of which grow by carbon-carbon bond formation, step-growth polymers generally grow by carbon-heteroatom bond formation (C-O & C-N in Dacron). Although polymers of this kind might be considered to be alternating copolymers, the repeating monomeric unit is usually defined as a combined moiety.


62. Which one of the following properties is not shown by NO?
(1) It's bond order is 2.5
(2) It is diamagnetic in gaseous state
(3) It is a neutral oxide
(4) It combines with oxygen to form nitrogen dioxide

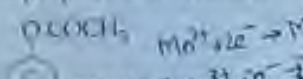
Solution: (2)

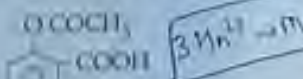
Nitrogen oxide has an unpaired electron thereby making it Paramagnetic in nature.

63. Sodium phenoxide when heated with CO_2 under pressure at 125°C yields a product which on acetylation produces C.



The major product C would be

(1) 

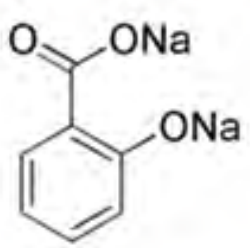
(2) 

(3) 

(4) 

Solution: (2)

Sodium phenoxide on heating with Carbon di oxide gives:



This on acetylation gives the required compound.

64. Given below are the half - cell reactions :

$Mn^{2+} + 2e^- \rightarrow Mn$; $E^0 = -1.18$ V

$2(Mn^{3+} + e^- \rightarrow Mn^{2+})$; $E^0 = +1.51$ V

The E^0 for $3Mn^{2+} \rightarrow Mn + 2Mn^{3+}$ will be :

(1) −0.33 V ; the reaction will occur

(2) −2.69 V ; the reaction will not occur

(3) −2.69 V ; the reaction will occur

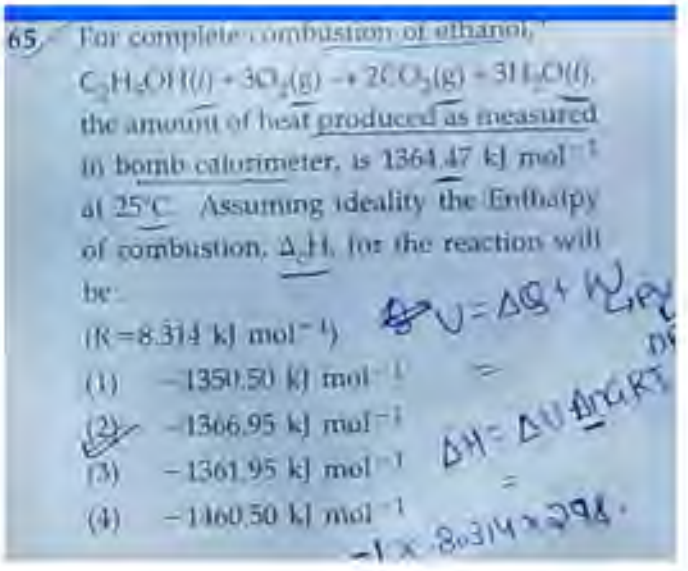
(4) −0.33 V ; the reaction will not occur

Solution: (2)

The required reaction can be obtained by multiplying the second equation by (-1) and adding the result with the first equation, i.e.:

$$Mn^{2+} + 2e^- \rightarrow Mn$$
$$2Mn^{2+} \rightarrow 2Mn^{3+} + 2e^-$$

The net E^0 value thus becomes: -1.18 - (1.51) = -2.69 eV



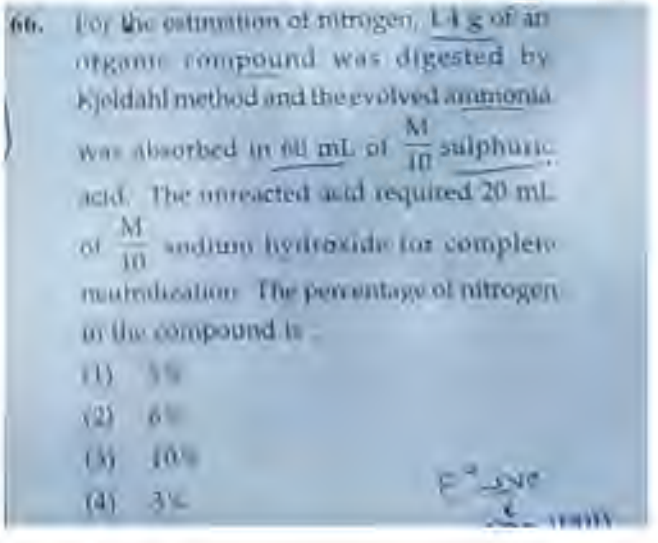
65. For complete combustion of ethanol, $C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$, the amount of heat produced as measured in bomb calorimeter, is 1364.47 kJ mol^{-1} at 25°C. Assuming ideality the Enthalpy of combustion, Δ_cH, for the reaction will be:
($R = 8.314$ kJ mol^{-1})
(1) -1350.50 kJ mol^{-1}
(2) -1366.95 kJ mol^{-1}
(3) -1361.95 kJ mol^{-1}
(4) -1460.50 kJ mol^{-1}

Solution: (2)

The net number of moles is equal to: (2+3) - (1+3) = 1 mole.

Hence, the Enthalpy of Combustion would be given by:

$$\Delta_cH = -1364.47 - 1 \times (273 + 25) \times 8.314 \times 10^{-3} = -1366.95\ kJ/mol$$



66. For the estimation of nitrogen, 1.4 g of an organic compound was digested by Kjeldahl method and the evolved ammonia was absorbed in 60 mL of $\frac{M}{10}$ sulphuric acid. The unreacted acid required 20 mL of $\frac{M}{10}$ sodium hydroxide for complete neutralization. The percentage of nitrogen in the compound is
(1) 3%
(2) 6%
(3) 10%
(4) 5%

Solution: (2)

67. The major organic compound formed by the reaction of 1, 1, 1 – trichloromethane with silver powder is :

(1) 2 - Butene

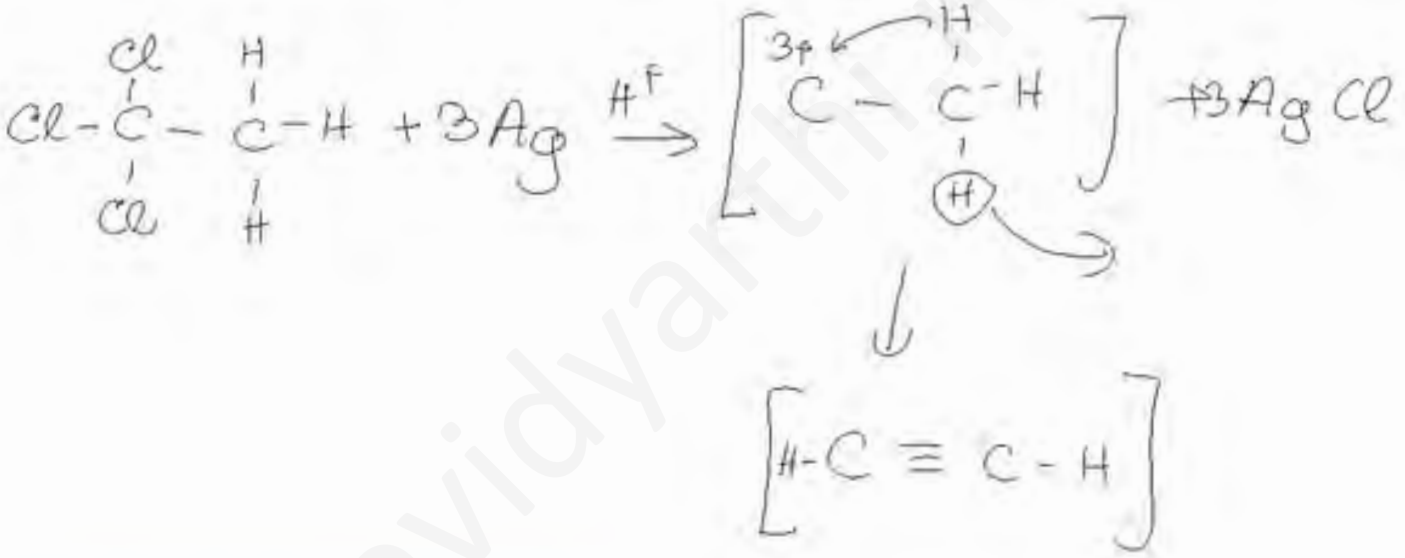
(2) Acetylene

(3) Ethene

(4) 2 - Butyne

Solution: (2)

The reaction proceeds as follows:



69. The metal that cannot be obtained by electrolysis of an aqueous solution of its salts is :

(1) Cr

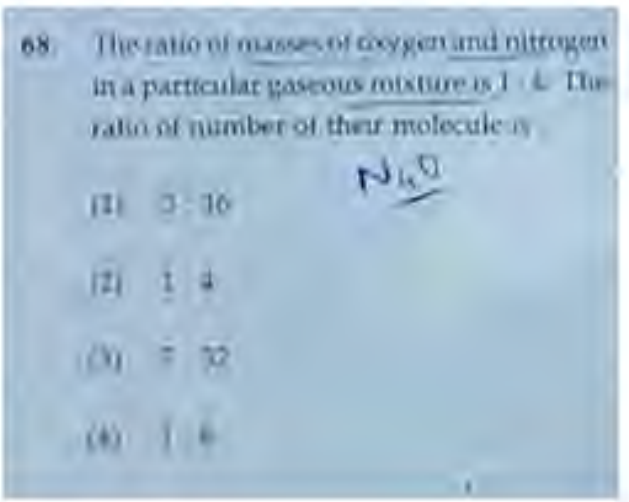
(2) Ag

(3) Ca

(4) Cu

Solution: (3)

Calcium fluoride is electrolyzed to get the calcium metal.



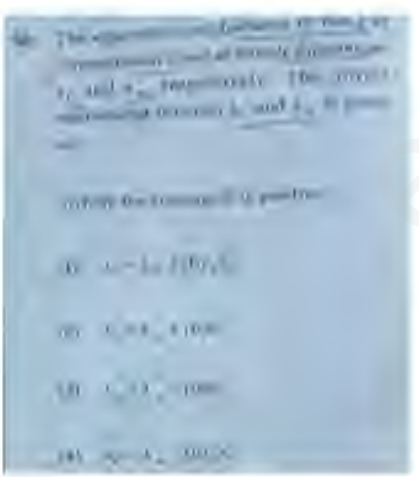
Solution: (3)

Let us assume x atoms of oxygen and y atoms of nitrogen, then:

$$\frac{x \times 16}{y \times 14} = \frac{1}{4}$$

On Cross multiplication, we get:

$$\frac{x}{y} = \frac{7}{32}$$



Solution: (4)

The variation for strong electrolytes is given by the required relation. Here the constant B is related to the viscosity.

71. The correct set of four quantum numbers for the valence electrons of rubidium atom ($Z = 37$) is

(1) $5, 0, 1, +\frac{1}{2}$

(2) $5, 0, 0, +\frac{1}{2}$

(3) $5, 1, 0, +\frac{1}{2}$

(4) $5, 1, 1, +\frac{1}{2}$

Solution: (2)

The electronic configuration is given by:

$$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1$$

Thus, the valence electron is in the 5th energy level. It thus n = 5.

It is in s shell, so l = 0.

Since, l = 0, so m_l=0

Also, since there is a single electron, so the spin is +1/2.

72. Consider separate solutions of 0.500 M $C_2H_5OH(aq)$, 0.100 M $Mg_3(PO_4)_2(aq)$, 0.250 M KBr(aq) and 0.125 M $Na_3PO_4(aq)$ at 25°C. Which statement is **true** about these solutions, assuming all salts to be strong electrolytes?

(1) 0.500 M $C_2H_5OH(aq)$ has the highest osmotic pressure.

(2) They all have the same osmotic pressure.

(3) 0.100 M $Mg_3(PO_4)_2(aq)$ has the highest osmotic pressure.

(4) 0.125 M $Na_3PO_4(aq)$ has the highest osmotic pressure.

Solution: (2) All of them have the same osmotic pressure values.

73. The most suitable reagent for the conversion of $R-CH_2-OH \rightarrow R-CHO$ is:

(1) PCC (Pyridinium Chlorochromate)

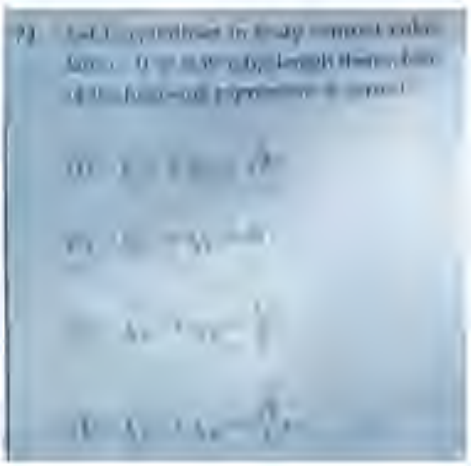
(2) $KMnO_4$

(3) $K_2Cr_2O_7$

(4) CrO_3

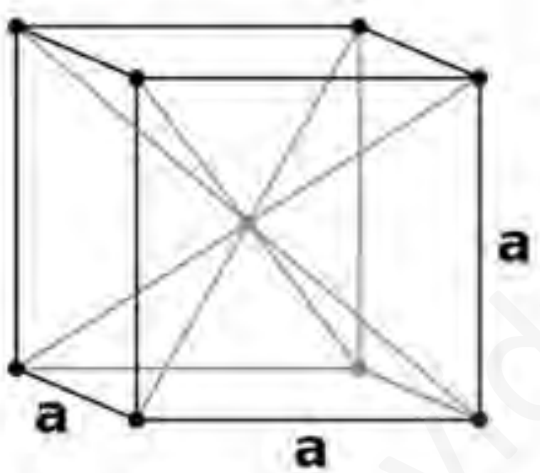
Solution: (1)

The reaction from alcohol to aldehyde needs a strong oxidising agent but not strong enough to oxidise it to an acid. Therefore, the most suitable choice is PCC.



Solution: (4)

For a BCC structure,



The length of the body diagonal is equal to $\sqrt{3}a$.

Since, the positive and the negative charges lie half way across the diagonal so, the required answer is equal to $\frac{\sqrt{3}a}{2}$.

75. In which of the following reactions H_2O_2 acts as a reducing agent ?

(a) $H_2\overset{+2}{O_2} + 2H^+ + 2e^- \rightarrow 2\overset{+1}{H_2}O$

(b) $H_2\overset{-1}{O_2} - 2e^- \rightarrow \overset{0}{O_2} + 2H^+$

(c) $H_2\overset{-1}{O_2} + 2e^- \rightarrow 2\overset{-2}{O}H^-$

(d) $H_2O_2 + 2OH^- - 2e^- \rightarrow O_2 + 2H_2O$

(1) (b), (d)

(2) (a), (b)

(3) (c), (d)

(4) (a), (c)

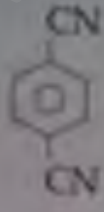
Solution: (1)

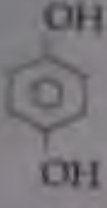
In both reactions (b) and (d), there is a loss in electrons on the reactant end and thereby there H_2O_2 acts as a reducing agent.

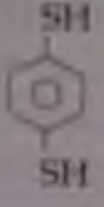
76.

For which of the following molecule significant $\mu \neq 0$?

(a) 

(b) 

(c) 

(d) 

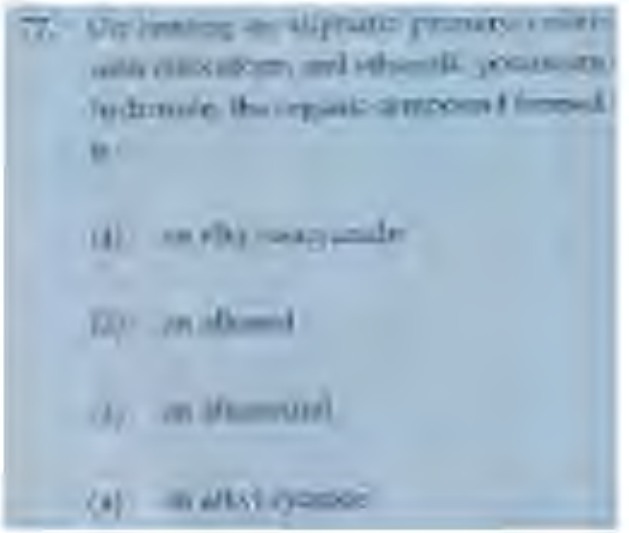
(1) (c) and (d)

(2) Only (a)

(3) (a) and (b)

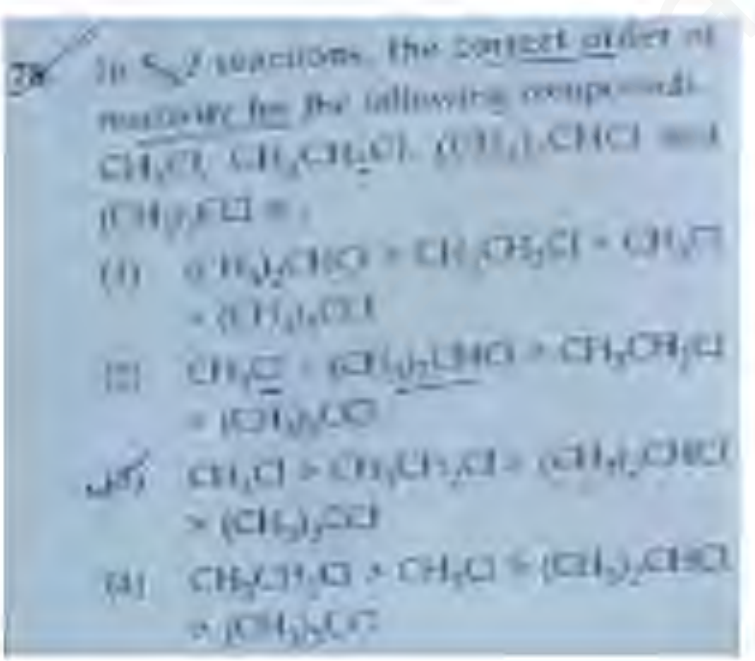
(4) Only (c)

Solution: (1)



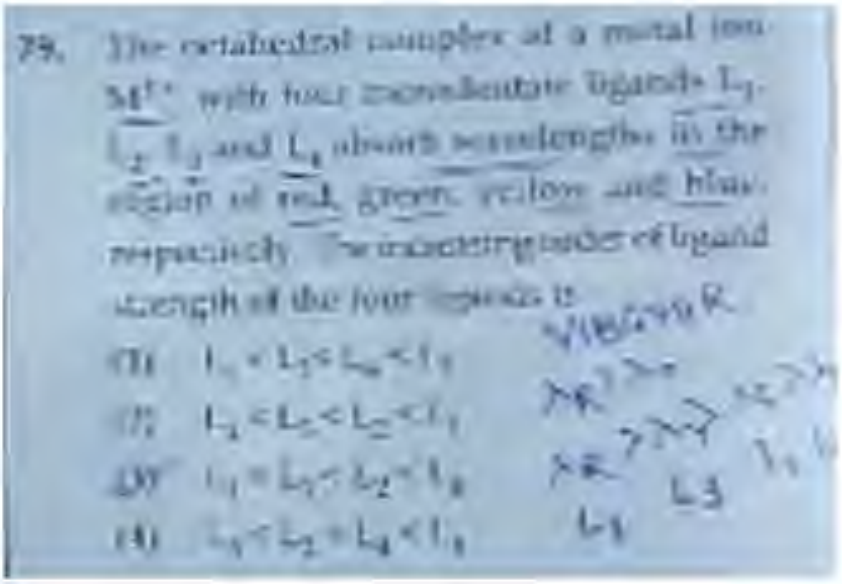
Solution: (1)

The reaction for ethylamine can be written as:



Solution: (3)

The alpha carbon is connected directly with the nucleophile in the case of CH_3Cl, thereby making it the most reactive. Also, as the number of carbons increase, the reactivity keeps on decreasing with the least reactivity being for the case when the alpha carbon is surrounded by three carbons.



79. The octahedral complex of a metal ion M^{3+} with four monodentate ligands L_1, L_2, L_3 and L_4 absorb wavelengths in the region of red, green, yellow and blue, respectively. The increasing order of ligand strength of the four ligands is

(1) $L_1 < L_3 < L_2 < L_4$

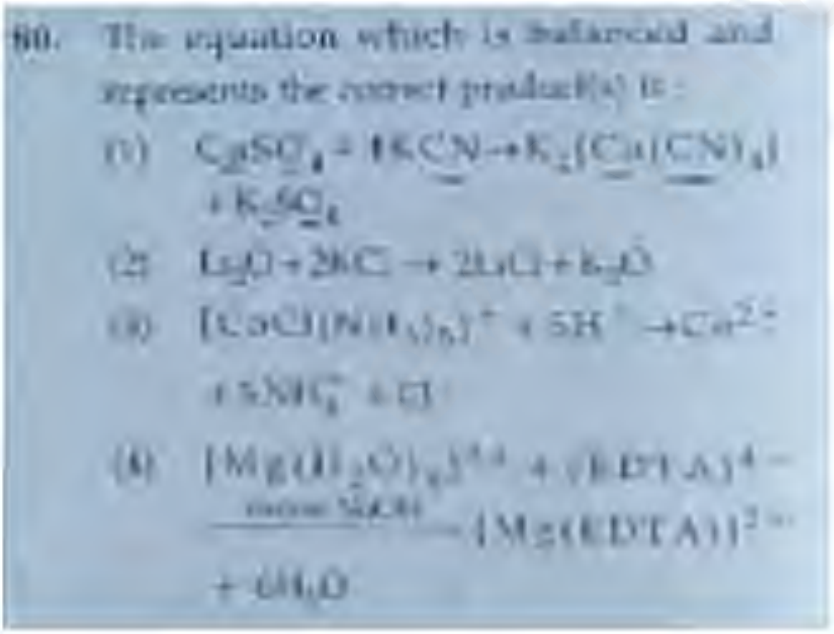
(2) $L_4 < L_2 < L_3 < L_1$

(3) $L_1 < L_3 < L_2 < L_4$

(4) $L_3 < L_2 < L_4 < L_1$

Solution: (3)

The Ligan strength varies inversely with wavelengths (or directly with frequency). Hence, for ligand absorbing red light, the ligand strength is going to be least and of blue its going to be maximum.



80. The equation which is balanced and represents the correct product(s) is :

(1) $CuSO_4 + 4KCN \rightarrow K_2[Cu(CN)_4] + K_2SO_4$

(2) $Li_2O + 2KCl \rightarrow 2LiCl + K_2O$

(3) $[CoCl(NH_3)_5]^+ + 5H^+ \rightarrow Co^{2+} + 5NH_4^+ + Cl^-$

(4) $[Mg(H_2O)_6]^{2+} + [EDTA]^{4-} \xrightarrow{\text{some NaOH}} [Mg(EDTA)]^{2-} + 6H_2O$

Solution: (2)

In Reaction (1), the valencies of copper are not satisfied.

In Reaction (3), the valencies of cobalt are not satisfied.

In Reaction (4), the number of EDTA is not satisfied.

81. In the reaction,

$CH_3COOH \xrightarrow{LiAlH_4} A \xrightarrow{PCl_5} B \xrightarrow{Alc.KOH} C$,

the product C is :

(1) Acetyl chloride

(2) Acetaldehyde

(3) Acetylene

(4) Ethylene

Solution: (4)

The reaction goes as follows:

$$CH_3COOH \xrightarrow{LiAlH_4} CH_3CH_2OH \xrightarrow{PCl_5} CH_3CH_2Cl \xrightarrow{Alc.KOH} CH_2 = CH_2$$

82. The correct statement for the molecule CsI_3 is

(1) it contains Cs^{+}, I^{-} and lattice I_2 molecule

(2) it is a covalent molecule

(3) it contains Cs^{+} and I_3^{-} ions

(4) it contains Cs^{3+} and I^{-} ions

Solution: (3)

The molecule CsI_3 can be broken as:

$$CsI_3 \rightleftharpoons Cs^{+} + I_3^{-}$$

83. For the reaction $SO_{2(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons SO_{3(g)}$, if $K_P = K_C(RT)^x$ where the symbols have usual meaning then the value of x is : (assuming ideality)

(1) 1

(2) -1

(3) $-\frac{1}{2}$

(4) $\frac{1}{2}$

Solution: (3)

The difference in number of moles is given by:

$$x = \Delta n = 1 - \left(1 + \frac{1}{2}\right) = -\frac{1}{2}$$

84. For the non - stoichiometre reaction $2A + B \rightarrow C + D$, the following kinetic data were obtained in three separate experiments, all at 298 K.

Initial Concentration (A)	Initial Concentration (B)	Initial rate of formation of C ($mol\ L^{-}S^{-}$)
0.1 M	0.1 M	1.2×10^{-3}
0.1 M	0.2 M	1.2×10^{-3}
0.2 M	0.1 M	2.4×10^{-3}

The rate law for the formation of C is :

(1) $\frac{dc}{dt} = k[A]$

(2) $\frac{dc}{dt} = k[A]\,[B]$

(3) $\frac{dc}{dt} = k[A]^2\,[B]$

(4) $\frac{dc}{dt} = k[A]\,[B]^2$

Solution: (1)

We assume the rate law as given by:

$$\frac{dc}{dt} = k[A]^x[B]^y$$

From the given data:

(i) $1.2 \times 10^{-3} = k[0.1]^x[0.1]^y$

(ii) $1.2 \times 10^{-3} = k[0.1]^x[0.2]^y$

(iii) $2.4 \times 10^{-3} = k[0.2]^x[0.1]^y$

Thus, we see that x=1, y=0. So we get the required answer.

85. Resistance of 0.2 M solution of an electrolyte is 50 Ω. The specific conductance of the solution is 1.4 S m^{-1}. The resistance of 0.5 M solution of the same electrolyte is 280 Ω. The molar conductivity of 0.5 M solution of the electrolyte in S m^2 mol^{-1} is:

(1) 5×10^2

(2) 5×10^{-4}

(3) 5×10^{-3}

(4) 5×10^3

Solution: (2)

86. Among the following oxoacids, the correct decreasing order of acid strength is :

(1) $HClO_2 > HClO_4 > HClO_3 > HOCl$

(2) $HOCl > HClO_2 > HClO_3 > HClO_4$

(3) $HClO_4 > HOCl > HClO_2 > HClO_3$

(4) $HClO_4 > HClO_3 > HClO_2 > HOCl$

Solution: (4)

With the same central atom E, acid strength increases as the number of oxygen attached to central metal atom increases. With the same number of oxygens around central metal atom, acid strength increases with the electronegativity of central metal atom.

87. Which one of the following bases is not present in DNA ?

(1) Thymine

(2) Quinoline

(3) Adenine

(4) Cytosine

Solution: (2)

Quinoline is a drug and the rest are protein rings.

88. Considering the basic strength of amines in aqueous solution, which one has the smallest pK_b value ?

(1) $C_6H_5NH_2$

(2) $(CH_3)_2NH$

(3) CH_3NH_2

(4) $(CH_3)_3N$

Solution: (2)

The pKa value is maximum for $(CH_3)_2NH$ as the lone pairs of nitrogen atom are surrounded by the positive charge given by the methyl groups. This thereby makes thee pKb value the least among all.

89. If Z is a compressibility factor, van der Waals equation at low pressure can be written as -

(1) $Z = 1 + \frac{Pb}{RT}$

(2) $Z = 1 + \frac{RT}{Pb}$

(3) $Z = 1 - \frac{a}{VRT}$

(4) $Z = 1 - \frac{Pb}{RT}$

Solution:(3)

We have the Modified Van der Waals equation given by:

$$\left(P + a\left(\frac{n}{V}\right)^2\right)(V - nb) = nRT$$

Expressing as compressibility, we get:

$$P = \frac{nRT}{V - nb} - a\left(\frac{n}{V}\right)^2$$

Therefore, $Z = \frac{PV}{nRT} = \frac{V}{V-nb} - \frac{an}{RTV} \approx 1 - \frac{an}{RTV}$

90. Which series of reactions correctly represents chemical relations related to iron and its compound ?

(1) $Fe \xrightarrow{O_2,\ heat} Fe_3O_4 \xrightarrow{CO,\ 600°C}$

$FeO \xrightarrow{CO,\ 700°C} Fe$

(2) $Fe \xrightarrow{dil\ H_2SO_4} FeSO_4 \xrightarrow{H_2SO_4,\ O_2}$

$Fe_2(SO_4)_3 \xrightarrow{heat} Fe$

(3) $Fe \xrightarrow{O_2,\ heat} FeO \xrightarrow{dil\ H_2SO_4}$

$FeSO_4 \xrightarrow{heat} Fe$

(4) $Fe \xrightarrow{Cl_2,\ heat} FeCl_3 \xrightarrow{heat,\ air}$

$FeCl_2 \xrightarrow{Zn} Fe$

Solution: (1)