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JEE (MAIN) 2024

QUESTIONS & SOLUTIONS

SHIFT-1

DATE & DAY: 01st February 2024 & Thursday

PAPER-1

Duration: 3 Hrs.
Time: 09:00 - 12:00 IST

SUBJECT: CHEMISTRY

REGISTERED & CORPORATE OFFICE (CIN: U80302RJ2007PLC024029):
CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Rajasthan) - 324005
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PART : CHEMISTRY

61. If one strand of a DNA has the sequence ATGCTTCA, sequence of the base in complementary strand is :

(1) CATTAGCT (2) TACGAAGT (3) GTACTTAC (4) ATGCGACT

Ans. **(2)**

Sol. Theory based.

62. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : Haloalkanes react with KCN to form alkyl cyanides as a main product while with AgCN form isocyanide as the main product.

Reason (R) : KCN and AgCN both are highly ionic compounds.

In the light of the above statements, choose the most appropriate answer from the options given below :

(1) (A) is correct but (R) is not correct

(2) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

(3) (A) is not correct but (R) is correct

(4) Both (A) and (R) are correct and (R) is the correct explanation of (A)

Ans. **(1)**

Sol. AgCN is more covalent and replace Halogen by isocyanide group whereas KCN is ionic and replace halogen by cyanide group.

63. In acidic medium, $K_2Cr_2O_7$ shows oxidising action as represented in the half reaction :

$$Cr_2O_7^{2-} + XH^+ + Ye^{\ominus} \longrightarrow 2A + ZH_2O$$

X, Y, Z and A are respectively are :

(1) 8, 6, 4 and Cr_2O_3 (2) 14, 7, 6 and Cr^{3+}

(3) 8, 4, 6 and Cr_2O_3 (4) 14, 6, 7 and Cr^{3+}

Ans. **(4)**

Sol. $Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$

64. Which of the following reactions are disproportionation reactions ?

(A) $Cu^+ \rightarrow Cu^{2+} + Cu$

(B) $3MnO_4^{2-} + 4H^+ \longrightarrow 2MnO_4^- + 2H_2O$

(C) $2KMnO_4 \longrightarrow K_2MnO_4 + MnO_2 + O_2$

(D) $2MnO_4^- + 3Mn^{2+} + 2H_2O \longrightarrow 5MnO_2 + 4H^+$

(1) (A), (B) (2) (B), (C), (D) (3) (A), (B), (C) (4) (A), (D)

Ans. **(1)**

Sol. In redox disproportionation reaction same element of same substance get oxidised as well as reduced

65. In case of isoelectronic species the size of F^-, Ne and Na^+ is affected by :

(1) Principal quantum number (n)

(2) None of the factors because their size is the same

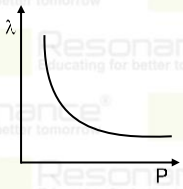
(3) Electron-electron interaction in the outer orbitals

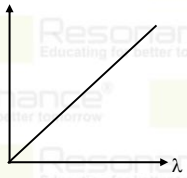
(4) Nuclear charge (z)

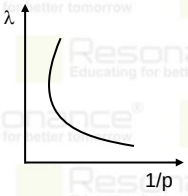
Ans. **(4)**

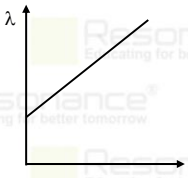
Sol. For isoelectronic species (10 e^-) $Z \uparrow r \downarrow$

66. According to the wave-particle duality of matter by de-Broglie, which of the following graph plot presents most appropriate relationship between wavelength of electron(λ) and momentum of electron (p) ?

(1) 

(2) 

(3) 

(4) 

Ans. **(1)**

Sol. $\lambda = \frac{h}{P}$ $\lambda \propto \frac{1}{P}$

67. Given below are two statements :

Statement-I : A solution of $[Ni(H_2O)_6]^{2+}$ is green in colour.

Statement-II : A solution of $[Ni(CN)_4]^{2-}$ is colourless.

In the light of the above statements, choose the, most appropriate answer from the options given below:

(1) Both statements I and statement II are incorrect.

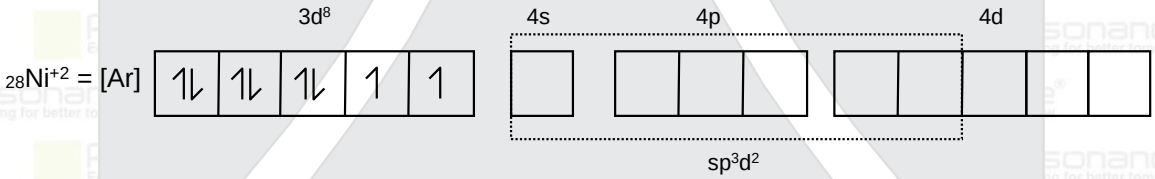
(2) Both statements I and statement II are correct.

(3) Statement I is incorrect but statement II is correct.

(4) Statement I is correct but statement II is incorrect.

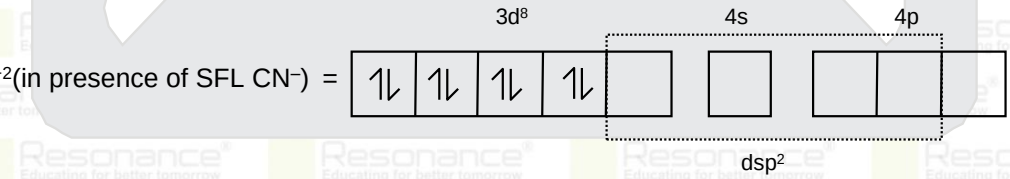
Ans. **(2)**

Sol. $[Ni(H_2O)_6]^{+2}$



n = 2 (unpaired e^-s), paramagnetic, green

$[Ni(CN)_4]^{-2}$



n = 0, diamagntic, colourless

68. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : PH_3 has lower boiling point than NH_3.

Reason (R) : In liquid sate NH3 molecules are associated through vander Waal's forces, but PH_3molecules are associated through hydrogen bonding.

In the light of the above statements, choose the most appropriate answer from the options given below :

(1) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

(2) (A) is not correct but (R) is correct

(3) Both (A) and (R) are correct and (R) is the correct explanation of (A)

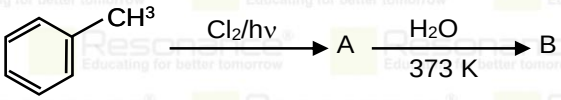
(4) (A) is correct but (R) is not correct

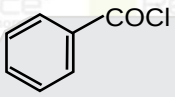
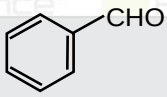
Ans. **(4)**

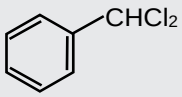
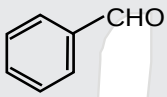
Sol. BP order $NH_3 > PH_3$

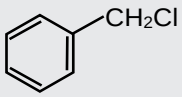
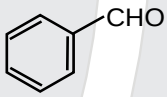
Reason $\longrightarrow$ In NH_3 H-bond is present

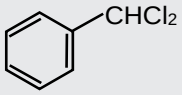
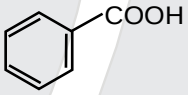
69. Identify A and B in the following sequence of reaction



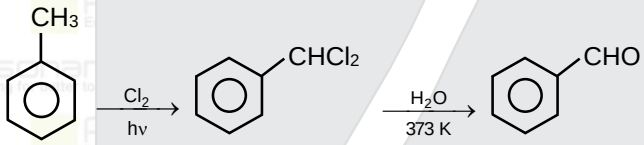
(1) A =  B = 

(2) A =  B = 

(3) A =  B = 

(4) A =  B = 

Ans. **(2)**

Sol. 

70. Given below are two statements :

Statement-I : Aminobenzene and aniline are same organic compounds.

Statement-II : Aminobenzene and aniline are different organic compounds.

In the light of the above statements, choose the, most appropriate answer from the options given below:

(1) Both statements I and statement II are correct.

(2) Statement I is correct but statement II is incorrect.

(3) Statement I is incorrect but statement II is correct.

(4) Both statements I and statement II are incorrect.

Ans. **(2)**

Sol. 

Aniline is systematic name, where as Aminobenzene is strict IUPAC name.

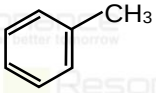
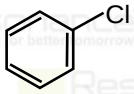
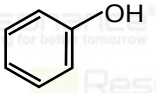
71. Which of the following complex is homoleptic ?

(1) $[Ni(CN)_4]^{2-}$ (2) $[Ni(NH_3)_2Cl_2]$ (3) $[Fe(NH_3)_4Cl_2]^+$ (4) $[Co(NH_3)_4Cl_2]^+$

Ans. **(1)**

Sol. In homoleptic complex only one type of ligand (same ligand) is present

72. Which of the following compound will most easily be attacked by an electrophile ?

(1)  (2)  (3)  (4) 

Ans. **(4)**

Sol. Greater the e^- density on benzene ring, faster the rate of EAS reaction.

73. Ionic reactions with organic compounds proceed through :

(A) homolytic bond cleavage

(B) heterolytic bond cleavage

(C) free radical formation

(D) primary free radical

(E) secondary; free radical

(1) (A) only

(2) (C) only

(3) (B) only

(4) (D) and (E) only

Ans. **(3)**

Sol. Ionic reaction proceed via heterolytic bond cleavage.

74. Arrange the bonds in order of increasing ionic character in the molecules, Lif, K_2O, N_2, SO_2 and ClF_3:

(1) $ClF_3 < N_2 < SO_2 < K_2O < LiF$ (2) $LiF < K_2O < ClF_3 < SO_2 < N_2$

(3) $N_2 < SO_2 < ClF_3 < K_2O < LiF$ (4) $N_2 < ClF_3 < SO_2 < K_2O < LiF$

Ans. **(3)**

Sol. On the basis of electronegative difference.

75. We have three aqueous solutions of NaCl labelld as 'A', 'b' and 'C' with concentration 0.1 M, 0.01 M and 0.001 M, respectively. The value of van t hoff factor(i) for these solutions will be in the order :

(1) $i_A < i_B < i_C$ (2) $i_A < i_C < i_B$ (3) $i_A = i_B = i_C$ (4) $i_A > i_B > i_C$

Ans. **NTA (1), Reso (3)**

Sol. $NaCl \longrightarrow Na^+ + Cl^-$

$I = 1 + (n - 1)\alpha = 1 + (2 - 1) \times 1 = 2$

$i_1 = i_2 = i_3 = 2$

76. In Kjeldahl's method for estimation of nitrogen, $CuSO_4$ acts as :

(1) reducing agent (2) catalytic agent (3) hydrolysis agent (4) oxidising agent

Ans. **(2)**

Sol. It is fact.

77. Given below are two statements :

Statement-I : Potassium hydrogen phthalate is a primary standard for standardisation of sodium hydroxide solution.

Statement-II : In this titration phenolphthalein can be used as indicator.

In the light of the above statements, choose the, most appropriate answer from the options given below:

(1) Both statements I and statement II are correct.

(2) Statement I is correct but statement II is incorrect.

(3) Statement I is incorrect but statement II is correct.

(4) Both statements I and statement II are incorrect.

Ans. **(1)**

78. Match List –I with List –II.

List – I (Reactions) **List – II (Reagents)**

(A) $CH_3(CH_2)_5-\underset{\underset{O}{\|}}{C}-OC_2H_5 \longrightarrow CH_3(CH_2)_5CHO$ (I) CH_3MgBr, H_2O

(B) $C_6H_5COC_6H_5 \rightarrow C_6H_5CH_2C_6H_5$ (II) Zn(Hg) and conc. HCl

(C) $C_6H_5CHO \rightarrow C_6H_5CH(OH)CH_3$ (III) $NaBH_4$, H^+

(D) $CH_3COCH_2COOC_2H_5 \longrightarrow CH_3\underset{\underset{H}{|}}{C}(OH)CH_2COOC_2H_5$ (IV) DIBAL-H, H_2O

Choose the correct answer from the options given below :

(1) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

(2) (A)-(IV), (B)-(III), (C)-(I), (D)-(III)

(3) (A)-(IV), (B)-(II), (C)-(III), (D)-(I)

(4) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

Ans. **(2)**

79. Choose the correct option for free expansion of an ideal gas under adiabatic condition from the following:

(1) $q = 0, \Delta T \neq 0, w = 0$ (2) $q = 0, \Delta T < 0, w \neq 0$

(3) $q \neq 0, \Delta T = 0, w = 0$ (4) $q = 0, \Delta T = 0, w = 0$

Ans. **(4)**

Sol. Adiabatic free expansion against vacuum

$q = 0, P_{ext} = 0, w = 0$

$\therefore \Delta U = q + w = 0 + 0 = 0$

80. Given below are two statements :

Statement-I : The NH_2 group in Aniline is ortho and para directing and a powerful activating group.

Statement-II : Aniline does notundergo Friedel-Craft's reaction (alkylation and acylation).

In the light of the above statements, choose the, most appropriate answer from the options given below:

(1) Both statements I and statement II are correct.

(2) Both statements I and statement II are incorrect.

(3) Statement I is incorrect but statement II is correct.

(4) Statement I is correct but statement II is incorrect.

Ans. **(1)**

Sol. $-\ddot{N}H_2$ is strong activating group due to +M effect and aniline does not give Friedel craft acylation or alkylation as it consumes the catalyst $AlCl_3$.

81. Number of optical isomers possible for 2-chlorobutane _____ .

Ans. **(2)**

Sol. 

It has only one chiral carbon, hence only two optical isomer is possible.

82. The potential for the given half cell at 298 K is (–) _____ $\times 10^{-2}$V.

$2H^+_{(aq)} + 2e^- \longrightarrow H_2(g)$

$[H^+] = 1M,\ P_{H_2} = 2$ atm

(Given : 2.303RT/F = 0.06 V, log2 = 0.3)

Ans. **(1)**

Sol. $E_{cell} = E^0_{cell} - \frac{0.0591}{2}\log\frac{P_{H_2}(g)}{[H^+]^2}$

$= -\frac{0.0591}{2}\log\frac{2\text{ bar}}{(1)^2}$

$\approx -\frac{0.06}{2}\times 0.3$

≈ -0.009

$\approx -9 \times 10^{-3}$

$\approx -0.9 \times 10^{-2}$

$\approx -1 \times 10^{-2}$

83. The number of white coloured salts, among the following is _____ .

(a) $SrSO_4$ (b) $Mg(NH_4)PO_4$ (c) $BaCrO_4$ (d) $Mn(OH)_2$
(e) $PbSO_4$ (f) $PbCrO_4$ (g) AgBr (h) PbI_2
(i) CaC_2O_4 (j) $[Fe(OH)_2(CH_3COO)]$

Ans. **(5)**

Sol. $Mg(NH_4)PO_4$, $PbSO_4$, CaC_2O_4, $SrSO_4$, $Mn(OH)_2$
These are white colour salts.

84. The ratio of $\frac{^{14}C}{^{12}C}$ in a piece of wood is $\frac{1}{8}$ part that of atmosphere, If half life of ^{14}C is 5730 years, the age of wood sample is _____ years.

Ans. **NTA (17328), Reso (17190)**

Sol. $A = A_0e^{-\lambda t}$

$A/A_0 = e^{-\lambda t}$

$\Rightarrow \frac{1}{8} = e^{-\lambda t}$

$\Rightarrow 8 = e^{\lambda t} \Rightarrow \lambda t = 3\ell n2 \Rightarrow t = \frac{3\ell n2}{\ell n2} \times t_{1/2} = 3 \times t_{1/2} = 3 \times 5730 = 17190$

85. The number of molecules/ion/s having trigonal bipyramidal shape is _____ .
PF_5, BrF_5, PCl_5, $[Pt\ Cl_4]^{2-}$, BF_3, $Fe(CO)_5$

Ans. **(3)**

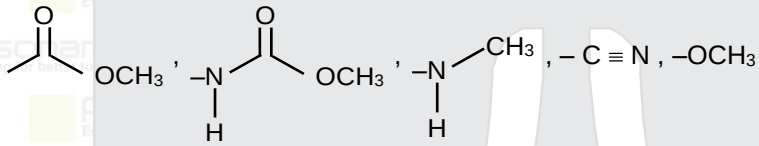
Sol. PCl_5, PF_5, sp^3d, 5BP + 0LP, trigonal bipyramidal

$[Fe(CO)_5]$ {dsp^3, trigonal bipyramidal}

BrF_5 {sp^3d^2, 5BP + 1LP square pyramidal}

AlF_4^- {sp^3, 4BP + 0LP tetrahedral}

86. Total number of deactivating groups in aromatic electrophilic substitution reaction among the following is _____ .



Ans. **(2)**

Sol. Only –CN, $–COCH_3$ are deactivating.

87. The lowest oxidation number of an atom in a compound A_2B is –2. The number of electrons in its valence shell is _____ .

Ans. **(6)**

Sol. $A_2^{+1}B^{-2}$

$\therefore$ O.N of B = –2

$\Rightarrow$ B can accept two electrons to complete their octet in A_2B

Therefore, no of Valence e^- in B = 6

88. Among the following oxides of p-block elements, number of oxides having amphoteric nature is _____ .
Cl_2O_7, CO, PbO_2, N_2O, NO, Al_2O_3, SiO_2, N_2O_5, SnO_2

Ans. **(3)**

Sol. Amphoteric Oxides: SnO_2, PbO_2, Al_2O_3

Acidic Oxides: SiO_2, N_2O_5, CO_2

Neutral Oxides: CO, NO, N_2O

89. Consider the following reaction :

$3PbCl_2 + 2(NH_4)_3PO_4 \rightarrow Pb_3(PO_4)_2 + 6NH_4Cl$

If 72 mmol of $PbCl_2$ is mixed with 50 mmol of $(NH_4)_3PO_4$, then the amount of $Pb_3(PO_4)_2$ formed is _____ mmol (nearest integer).

Ans. **(24)**

Sol. $3PbCl_2 + 2(NH_4)_3PO_4 \longrightarrow Pb_3(PO_4)_2 + 6NH_4Cl$

72 mmol **50 mmol**

$$\frac{n\,PbCl_2}{3} = \frac{n\,Pb_3(PO_4)_2}{1}$$

$$nPb_3(PO_4)_2 = \frac{72}{3} = 24 \text{ mmol}$$

90. K_a for CH_3COOH is 1.8×10^{-5} and K_b for NH_4OH is 1.8×10^{-5}. The pH of ammonium acetate solution will be _____ .

Ans. **(7)**

Sol. WABA salt : $pH = \frac{1}{2}(PK_w + PK_a - PK_b)$

$pH = \frac{1}{2}(14 + 4.74 - 4.74) = 7$

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