FINAL JEE–MAIN EXAMINATION – APRIL, 2024

(Held On Friday 05th April, 2024) **TIME : 9 : 00 AM to 12 : 00 NOON**

CHEMISTRY

TEST PAPER WITH SOLUTION

SECTION-A

61. The **incorrect** postulates of the Dalton's atomic theory are :

(A) Atoms of different elements differ in mass.

(B) Matter consists of divisible atoms.

(C) Compounds are formed when atoms of different element combine in a fixed ratio.

(D) All the atoms of given element have different properties including mass.

(E) Chemical reactions involve reorganisation of atoms.

Choose the **correct** answer from the options given below :

(1) (B), (D), (E) only

(2) (A), (B), (D) only

(3) (C), (D), (E) only

(4) (B), (D) only

Ans. **(4)**

Sol. B, D

62. The following reaction occurs in the Blast furnance where iron ore is reduced to iron metal

$$Fe_2O_{3(s)} + 3CO_{(g)} \rightleftharpoons Fe_{(l)} + 3CO_{2(g)}$$

Using the Le-chatelier's principle, predict which one of the following will not disturb the equilibrium.

(1) Addition of Fe_2O_3

(2) Addition of CO_2

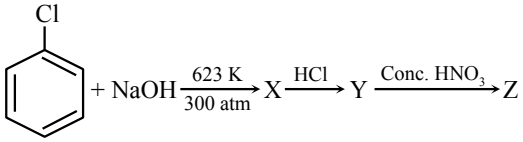
(3) Removal of CO

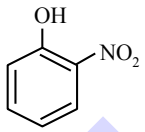
(4) Removal of CO_2

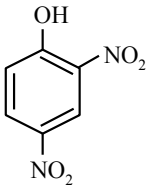
Ans. **(1)**

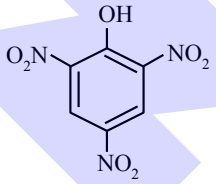
Sol. When solid added no effect on equilibrium.

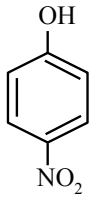
63. Identify compound (Z) in the following reaction sequence.



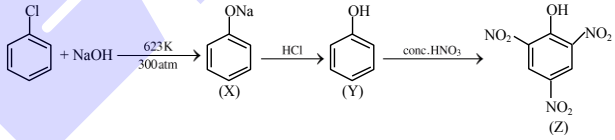
(1) 

(2) 

(3) 

(4) 

Ans. **(3)**

Sol. 

64. Given below are two statements : One is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**

Assertion (A): Enthalpy of neutralisation of strong monobasic acid with strong monoacidic base is always –57 kJ mol^{-1}

Reason (R): Enthalpy of neutralisation is the amount of heat liberated when one mole of H^+ ions furnished by acid combine with one mole of ^-OH ions furnished by base to form one mole of water.

In the light of the above statements, choose the **correct** answer from the options given below.

(1) **(A)** is true but **(R)** is false

(2) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**

(3) **(A)** is false but **(R)** is true

(4) Both **(A)** and **(R)** are true but **(R)** is **not** the correct explanation of **(A)**

Ans. **(2)**

Sol. Enthalpy of neutralization of SA & SB is always –57 kJ / mol because strong monoacid gives one mole of H^+ and strong mono base gives one mole of OH^- which form one mole of water.

65. The statement(s) that are **correct** about the species O^{2-}, F^-, Na^+ and Mg^{2+}.

(A) All are isoelectronic

(B) All have the same nuclear charge

(C) O^{2-} has the largest ionic radii

(D) Mg^{2+} has the smallest ionic radii

Choose the **most appropriate** answer from the options given below :

(1) (B), (C) and (D) only

(2) (A), (B), (C) and (D)

(3) (C) and (D) only

(4) (A), (C) and (D) only

Ans. **(4)**

Sol.

	O^{-2}	F^-	Na^+	Mg^{+2}
(No. of e^-)	10	10	10	10

(Ionic radius) $O^{-2} > F^- > Na^+ > Mg^{+2}$

Zeff $O^{-2} < F^- < Na^+ < Mg^{+2}$

66. For the compounds:

(A) $H_3C–CH_2–O–CH_2–CH_2–CH_3$

(B) $H_3C–CH_2–CH_2–CH_2–CH_3$

(C) $CH_3–CH_2–\underset{\underset{O}{\|}}{C}–CH_2–CH_3$

(D) $H_3C–\underset{\underset{OH}{|}}{CH}–CH_2–CH_2–CH_3$

The increasing order of boiling point is :

Choose the **correct** answer from the options given below :

(1) (A) < (B) < (C) < (D)

(2) (B) < (A) < (C) < (D)

(3) (D) < (C) < (A) < (B)

(4) (B) < (A) < (D) < (C)

Ans. **(2)**

Sol. Compounds having same number of carbon atoms follow the boiling point order as:

$(\text{Boiling point})_{\text{Hydrogen bonding}} > (\text{Boiling point})_{\text{high polarity}} > (\text{Boiling point})_{\text{low polarity}} > (\text{Boiling point})_{\text{non polar}}$

67. Given below are two statements :

Statement I: In group 13, the stability of +1 oxidation state increases down the group.

Statement II: The atomic size of gallium is greater than that of aluminium.

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

(1) **Statement I** is incorrect but **Statement II** is correct

(2) Both **Statement I** and **Statement II** are correct

(3) Both **Statement I** and **Statement II** are incorrect

(4) **Statement I** is correct but **Statement II** is incorrect

Ans. **(4)**

Sol. **Statement I :** Number of d & f electrons, increases down the group and due to poor shielding of d & f e^-, stability of lower oxidation states increases down the group

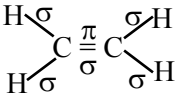
Statement II : The atomic size of aluminium is greater than that of gallium.

68. Number of σ and π bonds present in ethylene molecule is respectively :

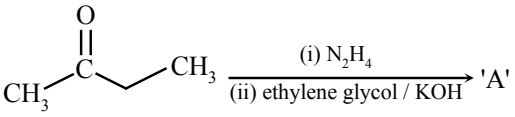
(1) 3 and 1 (2) 5 and 2

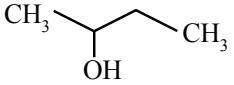
(3) 4 and 1 (4) 5 and 1

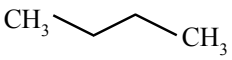
Ans. **(4)**

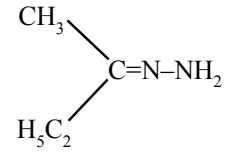
Sol. ethylene is  , it has 5σ bonds and 1π bond.

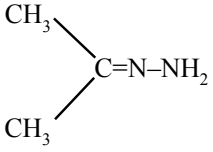
69. Identify 'A' in the following reaction :



(1) 

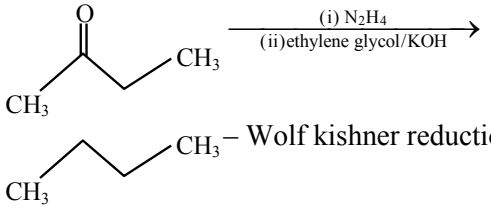
(2) 

(3) 

(4) 

Ans. **(2)**

Sol.



– Wolf kishner reduction.

70. The reaction at cathode in the cells commonly used in clocks involves.

(1) reduction of Mn from +4 to +3

(2) oxidation of Mn from +3 to +4

(3) reduction of Mn from + 7 to +2

(4) oxidation of Mn from + 2 to +7

Ans. (1)

Sol. In the cathode reaction manganese (Mn) is reduced from the +4 oxidation state to the +3 state.

71. Which one of the following complexes will exhibit the least paramagnetic behaviour ?

[Atomic number, Cr = 24, Mn = 25, Fe = 26, Co = 27]

(1) $[Co(H_2O)_6]^{2+}$ (2) $[Fe(H_2O)_6]^{2+}$

(3) $[Mn(H_2O)_6]^{2+}$ (4) $[Cr(H_2O)_6]^{2+}$

Ans. (1)

Sol.

	Number of unpaired e^-	$\mu = \sqrt{n(n+2)}$ B.M.
$[Co(H_2O)_6]^{2+}$	3	3.87
$[Fe(H_2O)_6]^{2+}$	4	4.89
$[Mn(H_2O)_6]^{2+}$	5	5.92
$[Cr(H_2O)_6]^{2+}$	4	4.89

Least paramagnetic behaviour = $[Co(H_2O)_6]^{2+}$

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

Assertion (A): Cis form of alkene is found to be more polar than the trans form

Reason (R): Dipole moment of trans isomer of 2-butene is zero.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) Both **(A)** and **(R)** are true but **(R)** is **NOT** the correct explanation of **(A)**

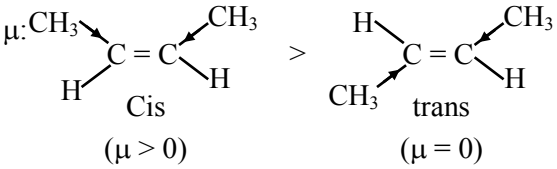
(2) **(A)** is true but **(R)** is false

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

(4) **(A)** is false but **(R)** is true

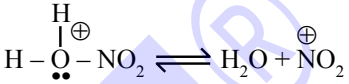
Ans. (3)

Sol. Dipole moment is a vector quantity and for compound net dipole moment is the vector sum of all dipoles hence dipole moment of cis form is greater than trans form.



73. Given below are two statements :

Statement I: Nitration of benzene involves the following step –



Statement II: Use of Lewis base promotes the electrophilic substitution of benzene.

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

(1) Both **Statement I** and **Statement II** are incorrect

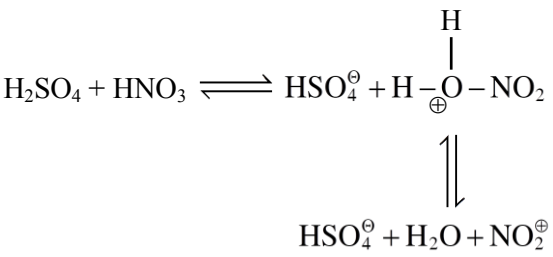
(2) **Statement I** is correct but **Statement II** is incorrect

(3) Both **Statement I** and **Statement II** are correct

(4) **Statement I** is incorrect but **Statement II** is correct

Ans. (2)

Sol. In nitration of benzene concentrated H_2SO_4 and HNO_3 is used as reagent which generates electrophile $N\overset{\oplus}{O}_2$ in following steps:



Lewis acids can promote the formation of electrophiles not Lewis base

74. The correct order of ligands arranged in increasing field strength.

(1) $Cl^- < {}^-OH < Br^- < CN^-$

(2) $F^- < Br^- < I^- < NH_3$

(3) $Br^- < F^- < H_2O < NH_3$

(4) $H_2O < {}^-OH < CN^- < NH_3$

Ans. (3)

Sol. Experimental order $Br^- < F^- < H_2O < NH_3$

75. Which of the following gives a positive test with ninhydrin ?

(1) Cellulose (2) Starch

(3) Polyvinyl chloride (4) Egg albumin

Ans. (4)

Sol. Ninhydrin test is a test of amino acids. Egg albumin contains protein which is a natural polymer of amino acids which will show positive ninhydrin test

76. The metal that shows highest and maximum number of oxidation state is:

(1) Fe (2) Mn

(3) Ti (4) Co

Ans. (2)

Sol. Mn shows highest oxidation state (Mn^{+7}) in 3d series metals.

77. Ail organic compound has 42.1% carbon, 6.4% hydrogen and remainder is oxygen. If its molecular weight is 342, then its molecular formula is :

(1) $C_{11}H_{18}O_{12}$ (2) $C_{12}H_{20}O_{12}$

(3) $C_{14}H_{20}O_{10}$ (4) $C_{12}H_{22}O_{11}$

Ans. (4)

Sol. only $C_{12}H_{22}O_{11}$ has 42.1% carbon, 6.4% hydrogen & 51.5 percent oxygen.

78. Given below are two statement :

Statement I : Bromination of phenol in solvent with low polarity such as $CHCl_3$ or CS_2 requires Lewis acid catalyst.

Statement II : The lewis acid catalyst polarises the bromine to generate Br^+.

In the light of the above statements, choose the **correct** answer from the options given below :

(1) Statement I is true but Statement II is false.

(2) Both Statement I and Statement II are true

(3) Both Statement I and Statement II are false.

(4) Statement I is false but Statement II is true.

Ans. (4)

Sol. Phenol is a highly activated compound which can undergo bromination directly with Bromine without any lewis acid.

79. Molar ionic conductivities of divalent cation and anion are 57 S cm^2 mol^{-1} and 73 S cm^2 mol^{-1} respectively. The molar conductivity of solution of an electrolyte with the above cation and anion will be :

(1) 65 S cm^2 mol^{-1} (2) 130 S cm^2 mol^{-1}

(3) 187 S cm^2 mol^{-1} (4) 260 S cm^2 mol^{-1}

Ans. (2)

Sol. $\Lambda_C^{+2} = 57 S cm^2 mol^{-1}$

$\Lambda_A^{+2} = 73 S cm^2 mol^{-1}$

$\Lambda_{Solution} = \lambda_C^{+2} + \Lambda_A^{-2}$

$= 57 + 73 = 130$

80. The number of neutrons present in the more abundant isotope of boron is 'x'. Amorphous boron upon heating with air forms a product, in which the oxidation state of boron is 'y'. The value of x + y is …

(1) 4 (2) 6

(3) 3 (4) 9

Ans. (4)

Sol. More abundant isotope = B^{11}

[Number of neutrons = 6]

x = 6

$B + O_2 \rightarrow B_2O_3$

Oxidation state of B in B_2O_3 = +3

So, y = 3

Hence x + y = 9

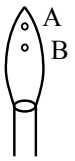
SECTION-B

81. The value of Rydberg constant (R_H) is 2.18×10^{-18} J. The velocity of electron having mass 9.1×10^{-31} kg in Bohr's first orbit of hydrogen atom = …… $\times10^5$ ms^{-1} (nearest integer)

Ans. (22)

Sol. $V = 2.18 \times 10^6 \times \frac{Z}{n}$

$= 21.8 \times 10^5 \times \frac{1}{1} \approx 22 \times 10^5$ (nearest)

82. 

In a borax bead test under hot condition, a metal salt (one from the given) is heated at point B of the flame, resulted in green colour salt bead. The spin-only magnetic moment value of the salt is ……. BM (Nearest integer)

[Given atomic number of Cu = 29, Ni = 28, Mn = 25, Fe = 26]

Ans. **(6)**

Sol. Fe^{+3} will give green coloured bead when heated at point B.

Number of unpaired e^- in Fe^{+3} = 5

$\mu = 5.92$

Nearest integer = 6

83. The heat of combustion of solid benzoic acid at constant volume is –321.30 kJ at 27°C. The heat of combustion at constant pressure is (–321.30 – xR) kJ, the value of x is …….

Ans. **(150)**

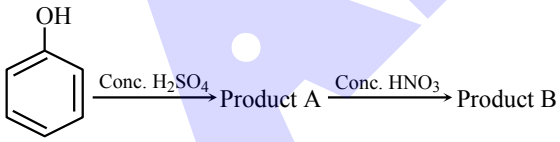
Sol. $C_6H_5COOH(S) + \frac{15}{2}O_2(g) \rightarrow 7CO_2(g) + 3H_2O(\ell)$

$\Delta H = \Delta U + \Delta n_g RT$

$= -321.30 - \frac{1}{2}\frac{R}{100} \times 300$

= (–321.30 – 150R) kJ

84. Consider the given chemical reaction sequence :



Total sum of oxygen atoms in Product A and Product B are ……

Ans. **(14)**

Sol. Picric acid is prepared by treating phenol first with concentrated sulphuric acid which converts it to phenol-2,4-disulphonic acid and then with concentrated nitric acid to get 2, 4, 6 trinitrophenol.

85. The spin only magnetic moment value of the ion among Ti^{2+}, V^{2+}, Co^{3+} and Cr^{2+}, that acts as strong oxidising agent in aqueous solution is …….. BM (Near integer).

(Given atomic numbers : Ti : 22, V : 23, Cr : 24, Co : 27)

Ans. **(5)**

Sol. Strong oxidising agent = Co^{+3}

No. of unpaired e^- in $Co^{+3}[3d^6]$ = 4

Hence $\mu = \sqrt{n(n+2)} = \sqrt{24}$ BM

Nearest integer = 5

86. During Kinetic study of reaction $2A + B \rightarrow C + D$, the following results were obtained :

	A[M]	B[M]	initial rate of formation of D
I	0.1	0.1	6.0×10^{-3}
II	0.3	0.2	7.2×10^{-2}
III	0.3	0.4	2.88×10^{-1}
IV	0.4	0.1	2.40×10^{-2}

Based on above data, overall order of the reaction is …….

Ans. **(3)**

Sol. $r = K[A]^x[B]^y$

(I) $6 \times 10^{-3} = K[0.1]^x[0.1]^y$

(IV) $2.4 \times 10^{-2} = K[0.4]^x[0.1]^y$

(IV)/(I)

$4 = (4)^x$

$x = 1$

$r = K[A]^x[B]^y$

(III) $2.88 \times 10^{-1} = K[0.3]^x[0.4]^y$

(II) $7.2 \times 10^{-2} = K[0.3]^x[0.2]^y$

(III)/(II)

$4 = 2^y$

$y = 2$

Overall order = x + y = 1 + 2 = 3

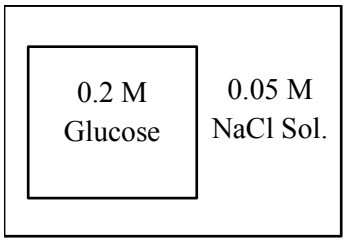
87. An artificial cell is made by encapsulating 0.2 M glucose solution within a semipermeable membrane. The osmotic pressure developed when the artificial cell is placed within a 0.05 M solution of NaCl at 300 K is _____ $\times 10^{-1}$ bar. (Nearest Integer)

[Given : R = 0.083 L bar mol^{-1} K^{-1}]

Assume complete dissociation of NaCl

Ans. **(25)**

Sol.



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

0.05M 0.05M 0.05M

Total $C_1 = 0.05 + 0.05 = 0.1$ M (NaCl)

$C_2 = 0.2$ M (glucose)

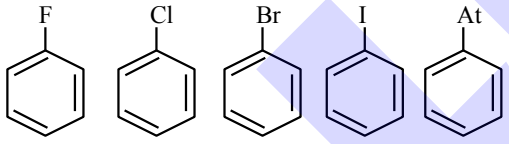
$\pi = (C_2 - C_1)RT$

$= (0.2 - 0.1) \times 0.083 \times 300$

$= 2.49$ bar

$= 24.9 \times 10^{-1}$ bar

88. The number of halobenzenes from the following that can be prepared by Sandmeyer's reaction is .....



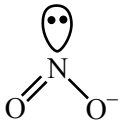
Ans. **(2)**

Sol. In Sandmayer reaction only bromobenzene & chlorobenzene are prepared

89. In the lewis dot structure for NO_2^-, total number of valence electrons around nitrogen is …….

Ans. **(8)**

Sol.

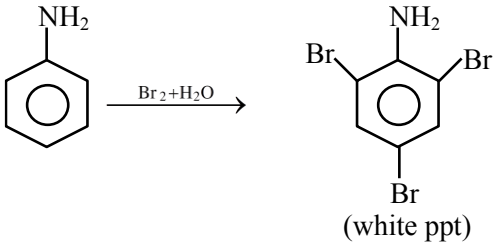


Number of valence e^- around N-atom = 8

90. 9.3 g of pure aniline is treated with bromine water at room temperature to give a white precipitate of the product 'P'. The mass of product 'P' obtained is 26.4 g. The percentage yield is …… %.

Ans. **(80)**

Sol.



(white ppt)

93 g of aniline produces 330 g of 2, 4, 6-tribromoaniline. Hence 9.3 g of aniline should produce 33g of 2, 4, 6-tribromoaniline. Hence percentage yield $\frac{26.4 \times 100}{33} = 80\%$

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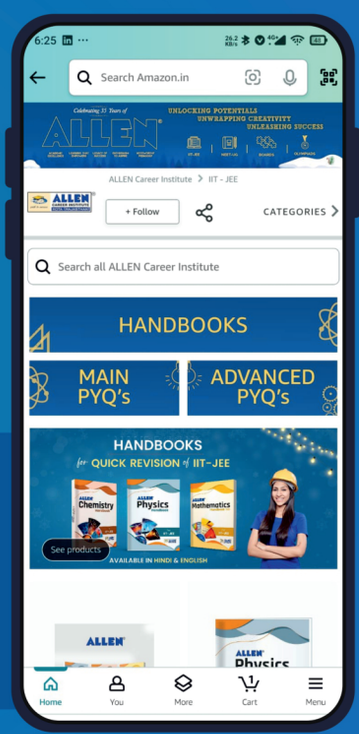

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