FINAL JEE–MAIN EXAMINATION – JANUARY, 2024

(Held On Thursday 01st February, 2024) TIME : 9 : 00 AM to 12 : 00 NOON

SECTION-A

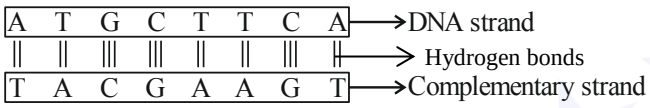
61. If one strand of a DNA has the sequence ATGCTTCA, sequence of the bases in complementary strand is:

(1) CATTAGCT (2) TACGAAGT

(3) GTACTTAC (4) ATGCGACT

Ans. **(2)**

Sol. Adenine base pairs with thymine with 2 hydrogen bonds and cytosine base pairs with guanine with 3 hydrogen bonds.



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 statement, choose the most appropriate answer from the options given below:

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

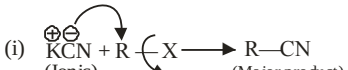
(2) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

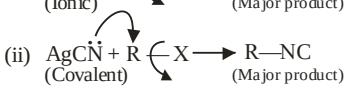
(3) (A) is not correct but (R) is correct

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

Ans. (1)

Sol.





AgCN is mainly covalent in nature and nitrogen is available for attack, so alkyl isocyanide is formed as main product.

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

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

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. The balanced reaction is,

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

X = 14

Y = 6

A = 7

64. Which of the following reactions are disproportionation reactions?

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

(B) $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$

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

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

Choose the correct answer from the options given below:

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

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

Ans. **(1)**

Sol. When a particular oxidation state becomes less stable relative to other oxidation state, one lower, one higher, it is said to undergo disproportionation.

$Cu^+ \rightarrow Cu^{2+} + Cu$

$3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$

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

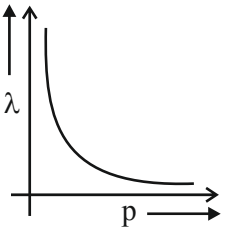
(3) Electron-electron interaction in the outer orbitals

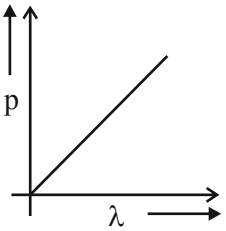
(4) Nuclear charge (z)

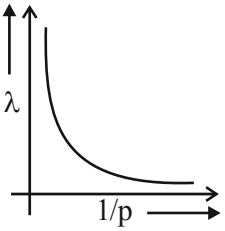
Ans. **(4)**

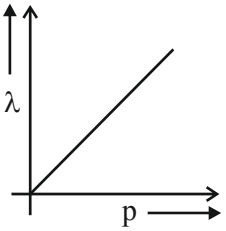
Sol. In F^-, Ne, Na^+ all have $1s^2$, $2s^2$, $2p^6$ configuration. They have different size due to the difference in nuclear charge.

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) 

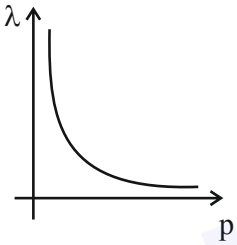
(4) 

Ans. (1)

Sol. $\lambda = \frac{h}{p}\left[\lambda \propto \frac{1}{p}\right]$

$\Rightarrow \lambda p = h$ (constant)

So, the plot is a rectangular hyperbola.



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 Statement I and Statement II are incorrect

(2) Both Statement 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. $[Ni(H_2O)_6]^{+2} \rightarrow$ Green colour solution due to d-d transition.

$[Ni(CN)_4]^{-2} \rightarrow$ is diamagnetic and it is 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 state NH_3 molecules are associated through vander waal's forces, but PH_3 molecules 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 and (R) is not the correct explanation of (A)

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

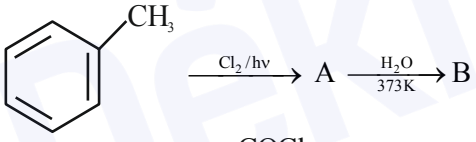
(3) Both (A) and (R) are correct but (R) is the correct explanation of (A)

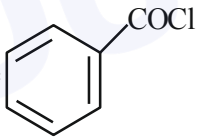
(4) (A) is correct but (R) is not correct

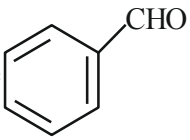
Ans. (4)

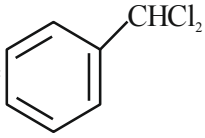
Sol. Unlike NH_3, PH_3 molecules are not associated through hydrogen bonding in liquid state. That is why the boiling point of PH_3 is lower than NH_3.

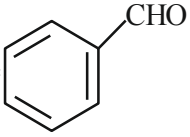
69. Identify A and B in the following sequence of reaction

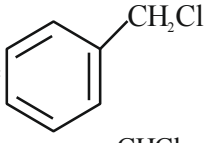


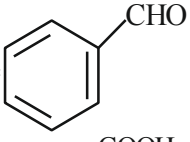
(1) (A) = 

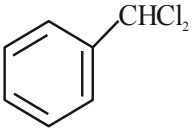
(B) = 

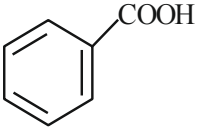
(2) (A) = 

(B) = 

(3) (A) = 

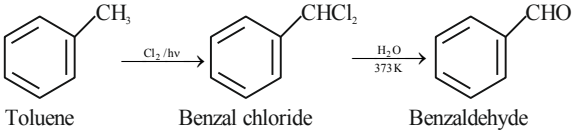
(B) = 

(4) (A) = 

(B) = 

Ans. (2)

Sol.



Toluene — Benzal chloride — Benzaldehyde

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 Statement 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 Statement I and Statement II are incorrect

Ans. (2)

Sol. Aniline is also known as amino benzene.

71. Which of the following complex is homoleptic?

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

(2) $[Ni(NH_3)_2Cl_2]$

(3) $[Fe(NH_3)_4Cl_2]^+$

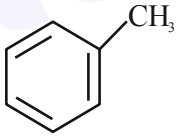
(4) $[Co(NH_3)_4Cl_2]^+$

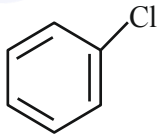
Ans. (1)

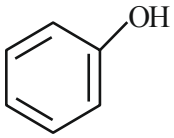
Sol. In Homoleptic complex all the ligand attached with the central atom should be the same. Hence $[Ni(CN)_4]^{2-}$ is a homoleptic complex.

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

(1) 

(2) 

(3) 

(4) 

Ans. (4)

Sol. Higher the electron density in the benzene ring more easily it will be attacked by an electrophile. Phenol has the highest electron density amongst all the given compound.

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

Choose the correct answer from the options given below:

(1) (A) only

(2) (C) only

(3) (B) only

(4) (D) and (E) only

Ans. (3)

Sol. Heterolytic cleavage of Bond lead to formation of ions.

74. Arrange the bonds in order of increasing ionic character in the molecules. LiF, K_2O, N_2, SO_2 and CIF_3.

(1) $CIF_3 < N_2 < SO_2 < K_2O < LiF$

(2) $LiF < K_2O < CIF_3 < SO_2 < N_2$

(3) $N_2 < SO_2 < CIF_3 < K_2O < LiF$

(4) $N_2 < CIF_3 < SO_2 < K_2O < LiF$

Ans. (3)

Sol. Increasing order of ionic character

$N_2 < SO_2 < ClF_3 < K_2O < LiF$

Ionic character depends upon difference of electronegativity (bond polarity).

75. We have three aqueous solutions of NaCl labelled as 'A', 'B' and 'C' with concentration 0.1 M, 0.01M & 0.001 M, respectively. The value of van t' Haft 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. (1)

Sol.

Salt	Values of i (for different conc. of a Salt)		
	0.1 M	0.01 M	0.001 M
NaCl	1.87	1.94	1.94

i approach 2 as the solution become very dilute.

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. Kjeldahl's method is used for estimation of Nitrogen where $CuSO_4$ acts as a catalyst.

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 Statement 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 Statement I and Statement II are incorrect

Ans. (1)

Sol. **Statement (I) :** Potassium hydrogen phthalate is a primary standard for standardisation of sodium hydroxide solution as it is economical and its concentration does not changes with time.

Phenophthalin can acts as indicator in acid base titration as it shows colour in pH range 8.3 to 10.1

78. Match List – I with List –II.

	List – I (Reactions)		List – II (Reagents)
(A)	$CH_3(CH_2)_5-\underset{\underset{O}{\|}}{C}-OC_2H_5 \rightarrow CH_3(CH_2)_5CHO$	(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)	$CH_3COCH_2COOC_2H_5 \rightarrow CH_3\underset{\underset{H}{\|}}{C}(OH)CH_2COOC_2H_5$	(IV)	DIBAL-H, H_2O

Choose the correct answer from options given below:

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

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

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

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

Ans. (2)

Sol. $CH_3(CH_2)_5COOC_2H_5 \xrightarrow{DIBAL-H,\ H_2O} CH_3(CH_2)_5CHO$

$C_6H_5COC_6H_5 \xrightarrow{Zn(Hg)\ \&\ conc.\ HCl} C_6H_5CH_2C_6H_5$

$C_6H_5CHO \xrightarrow[H_2O]{CH_3MgBr} C_6H_5CH(OH)CH_3$

$CH_3COCH_2COOC_2H_5 \xrightarrow{NaBH_4,\ H^+} CH_3CH(OH)CH_2COOC_2H_5$

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. During free expansion of an ideal gas under adiabatic condition $q = 0, \Delta T = 0, w = 0$.

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 not undergo 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 Statement I and Statement II are correct

(2) Both Statement 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. The NH_2 group in Aniline is ortho and para directing and a powerful activating group as NH_2 has strong +M effect.

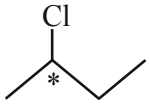
Aniline does not undergo Friedel-Craft's reaction (alkylation and acylation) as Aniline will form complex with $AlCl_3$ which will deactivate the benzene ring.

SECTION-B

81. Number of optical isomers possible for

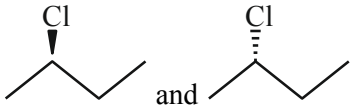
2 – chlorobutane ……

Ans. (2)

Sol. 

There is one chiral centre present in given compound.

So, Total optical isomers = 2



82. The potential for the given half cell at 298K is

(-)…… $\times 10^{-2}$ V.

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

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

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

Ans. (1)

Sol. $E = E^{o}_{H^+/H_2} - \frac{0.06}{2}\log\frac{P_{H_2}}{[H^+]^2}$

$E = 0.00 - \frac{0.06}{2}\log\frac{2}{[1]^2}$

$E = -0.03 \times 0.3 = -0.9 \times 10^{-2}\,V$

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. $SrSO_4$ – white

$Mg(NH_4)PO_4$ – white

$BaCrO_4$ – yellow

$Mn(OH)_2$ – white

$PbSO_4$ – white

$PbCrO_4$ – yellow

AgBr – pale yellow

PbI_2 – yellow

CaC_2O_4 – white

$[Fe(OH)_2(CH_3COO)]$ – Brown Red

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. (17190)

Sol. $\frac{^{14}\quad\ ^{12}}{\text{wood sample}}$

As per the question,

$$\frac{(^{14}C/^{12}C)_{wood}}{(^{14}C/^{12}C)_{atmosphere}} = \frac{1}{8}$$

So, $\lambda t = \ln 8$

$$\frac{\ln 2}{t_{1/2}}t = \ln 8$$

$t = 3 \times t_{1/2} = 17190$ years

85. The number of molecules/ion/s having trigonal bipyramidal shape is …….. .

PF_5, BrF_5, PCl_5, $[PtCl_4]^{2-}$, BF_3, $Fe(CO)_5$

Ans. (3)

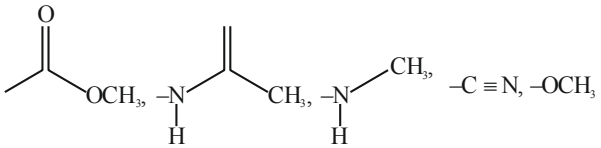
Sol. PF_5, PCl_5, $Fe(CO)_5$; Trigonal bipyramidal

BrF_5 ; square pyramidal

$[PtCl_4]^{-2}$; square planar

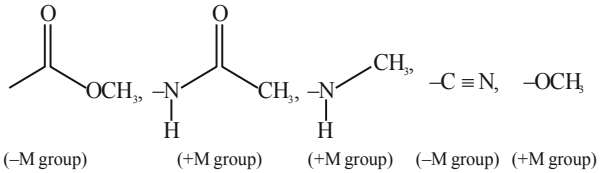
BF_3 ; Trigonal planar

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



Ans. (2)

Sol.



(–M group) (+M group) (+M group) (–M group) (+M group)

87. Lowest Oxidation number of an atom in a compound A_2B is -2. The number of an electron in its valence shell is

Ans. (6)

Sol. $A_2B \rightarrow 2A^+ + B^{-2}$, B^{-2} has complete octet in its di-anionic form, thus in its atomic state it has 6 electrons in its valence shell. As it has negative charge, it has acquired two electrons to complete its octet.

88. Among the following oxide 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. Acidic oxide: Cl_2O_7, SiO_2, N_2O_5

Neutral oxide: CO, NO, N_2O

Amphoteric oxide: Al_2O_3 , SnO_2 , PbO_2

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 amount of $Pb_3(PO_4)_2$ formed is …… mmol. (nearest integer)

Ans. (24)

Sol. Limiting Reagent is $PbCl_2$

mmol of $Pb_3(PO_4)_2$ formed

$$= \frac{\text{mmol of } PbCl_2 \text{ reacted}}{3}$$

= 24 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. $$pH = \frac{pK_w + pK_a - pK_b}{2}$$

$pK_a = pK_b$

$$\Rightarrow pH = \frac{pK_w}{2} = 7$$