FINAL JEE–MAIN EXAMINATION – JANUARY, 2024

(Held On Wednesday 31st January, 2024) **TIME : 9 : 00 AM to 12 : 00 NOON**

CHEMISTRY — TEST PAPER WITH SOLUTION

SECTION-A

61. Give below are two statements:

Statement-I : Noble gases have very high boiling points.

Statement-II: Noble gases are monoatomic gases. They are held together by strong dispersion forces. Because of this they are liquefied at very low temperature. Hence, they have very high boiling points.

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

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

(2) Both Statement I and Statement II are true.

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

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

Ans. **(4)**

Sol. Statement I and II are False

Noble gases have low boiling points

Noble gases are held together by weak dispersion forces.

62. For the given reaction, choose the correct expression of K_C from the following :-

$$Fe^{3+}_{(aq)} + SCN^{-}_{(aq)} \rightleftharpoons (FeSCN)^{2+}_{(aq)}$$

(1) $K_C = \dfrac{[FeSCN^{2+}]}{[Fe^{3+}][SCN^{-}]}$

(2) $K_C = \dfrac{[Fe^{3+}][SCN^{-}]}{[FeSCN^{2+}]}$

(3) $K_C = \dfrac{[FeSCN^{2+}]}{[Fe^{3+}]^2[SCN^{-}]^2}$

(4) $K_C = \dfrac{[FeSCN^{2+}]^2}{[Fe^{3+}][SCN^{-}]}$

Ans. **(1)**

Sol. $K_C = \dfrac{\text{Products ion conc.}}{\text{Reactants ion conc.}}$

$$K_C = \frac{[FeSCN^{2+}]}{[Fe^{3+}][SCN^{-}]}$$

63. Identify the mixture that shows positive deviations from Raoult's Law

(1) $(CH_3)_2CO + C_6H_5NH_2$

(2) $CHCl_3 + C_6H_6$

(3) $CHCl_3 + (CH_3)_2CO$

(4) $(CH_3)_2CO + CS_2$

Ans. **(4)**

Sol. $(CH_3)_2CO + CS_2$ Exibits positive deviations from Raoult's Law

64. The compound that is white in color is

(1) ammonium sulphide

(2) lead sulphate

(3) lead iodide

(4) ammonium arsinomolybdate

Ans. **(2)**

Sol. Lead sulphate-white

Ammonium sulphide-soluble

Lead iodide-Bright yellow

Ammonium arsinomolybdate-yellow

65. The metals that are employed in the battery industries are

A. Fe

B. Mn

C. Ni

D. Cr

E. Cd

Choose the correct answer from the options given below:

(1) B, C and E only

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

(3) A, B, C and D only

(4) B, D and E only

Ans. **(1)**

Sol. Mn, Ni and Cd metals used in battery industries.

66. A species having carbon with sextet of electrons and can act as electrophile is called

(1) carbon free radical

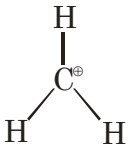
(2) carbanion

(3) carbocation

(4) pentavalent carbon

Ans. **(3)**

Sol.



Six electron species

67. Identify the factor from the following that does not affect electrolytic conductance of a solution.

(1) The nature of the electrolyte added.

(2) The nature of the electrode used.

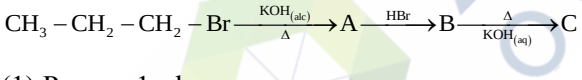
(3) Concentration of the electrolyte.

(4) The nature of solvent used.

Ans. **(2)**

Sol. Conductivity of electrolytic cell is affected by concentration of electrolyte, nature of electrolyte and nature of solvent.

68. The product (C) in the below mentioned reaction is:



(1) Propan-1-ol

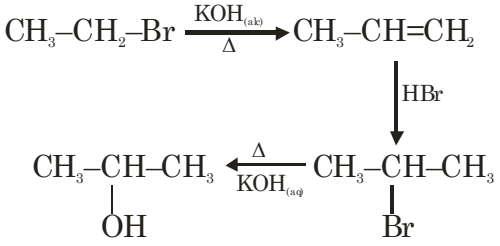
(2) Propene

(3) Propyne

(4) Propan-2-ol

Ans. **(4)**

Sol.



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

Assertion A: Alcohols react both as nucleophiles and electrophiles.

Reason R: Alcohols react with active metals such as sodium, potassium and aluminum to yield corresponding alkoxides and liberate hydrogen.

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

(1) A is false but R is true.

(2) A is true but R is false.

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

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

Ans. **(4)**

Sol. As per NCERT, Assertion (A) and Reason (R) is correct but Reason (R) is not the correct explanation.

70. The correct sequence of electron gain enthalpy of the elements listed below is

A. Ar

B. Br

C. F

D. S

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

(1) C > B > D > A

(2) A > D > B > C

(3) A > D > C > B

(4) D > C > B > A

Ans. **(2)**

Sol.

Element	$\Delta_{eg}H$(kJ/mol)
F	–333
S	–200
Br	–325
Ar	+96

71. Identify correct statements from below:

A. The chromate ion is square planar.

B. Dichromates are generally prepared from chromates.

C. The green manganate ion is diamagnetic.

D. Dark green coloured K_2MnO_4 disproportionates in a neutral or acidic medium to give permanganate.

E. With increasing oxidation number of transition metal, ionic character of the oxides decreases.

Choose the correct answer from the options given below:

(1) B, C, D only

(2) A, D, E only

(3) A, B, C only

(4) B, D, E only

Ans. (4)

Sol. A. CrO_4^{2-} is tetrahedral

B. $2Na_2CrO_4 + 2H^+ \rightarrow Na_2Cr_2O_7 + 2Na^+ + H_2O$

C. As per NCERT, green manganate is paramagnetic with 1 unpaired electron.

D. Statement is correct

E. Statement is correct

72. 'Adsorption' principle is used for which of the following purification method?

(1) Extraction

(2) Chromatography

(3) Distillation

(4) Sublimation

Ans. (2)

Sol. Principle used in chromotography is adsorption.

73. Integrated rate law equation for a first order gas phase reaction is given by (where P_i is initial pressure and P_t is total pressure at time t)

(1) $k = \frac{2.303}{t} \times \log \frac{P_i}{(2P_i - P_t)}$

(2) $k = \frac{2.303}{t} \times \log \frac{2P_i}{(2P_i - P_t)}$

(3) $k = \frac{2.303}{t} \times \log \frac{(2P_i - P_t)}{P_i}$

(4) $k = \frac{2.303}{t} \times \frac{P_i}{(2P_i - P_t)}$

Ans. (1)

Sol.

A	$\rightarrow$	B	+	C
P_i		0		0
$P_i - x$		x		x

$P_t = P_i + x$

$P_i - x = P_i - P_t + P_i$

$= 2P_i - P_t$

$K = \frac{2.303}{t} \log \frac{P_i}{2P_i - P_t}$

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

Assertion A: pK_a value of phenol is 10.0 while that of ethanol is 15.9.

Reason R: Ethanol is stronger acid than phenol.

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) A is false but R is true.

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

(4) Both A and R are true but R is NOT the correct explanation of A.

Ans. (1)

Sol. Phenol is more acidic than ethanol because conjugate base of phenoxide is more stable than ethoxide.

75. Given below are two statements:

Statement I: IUPAC name of $HO–CH_2–(CH_2)_3–CH_2–COCH_3$ is 7-hydroxyheptan-2-one.

Statement II: 2-oxoheptan-7-ol is the correct IUPAC name for above compound.

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

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

(2) Both Statement I and Statement II are incorrect.

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

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

Ans. (1)

Sol. 7-Hydroxyheptan-2-one is correct IUPAC name

76. The correct statements from following are:

A. The strength of anionic ligands can be explained by crystal field theory.

B. Valence bond theory does not give a quantitative interpretation of kinetic stability of coordination compounds.

C. The hybridization involved in formation of $[Ni(CN)_4]^{2-}$complex is dsp^2.

D. The number of possible isomer(s) of cis-$[PtC1_2(en)_2]^{2+}$ is one

Choose the correct answer from the options given below:

(1) A, D only

(2) A, C only

(3) B, D only

(4) B, C only

Ans. (4)

Sol. B. VBT does not explain stability of complex

C. Hybridisation of $[Ni(CN)_4]^{-2}$ is dsp^2.

77. The linear combination of atomic orbitals to form molecular orbitals takes place only when the combining atomic orbitals

A. have the same energy

B. have the minimum overlap

C. have same symmetry about the molecular axis

D. have different symmetry about the molecular axis

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

(1) A, B, C only

(2) A and C only

(3) B, C, D only

(4) B and D only

Ans. (2)

Sol. * Molecular orbital should have maximum overlap

* Symmetry about the molecular axis should be similar

78. Match List I with List II

LIST-I		LIST-II	
A.	Glucose/$NaHCO_3/\Delta$	I.	Gluconic acid
B.	Glucose/HNO_3	II.	No reaction
C.	Glucose/HI/ Δ	III.	n-hexane
D.	Glucose/Bromine water]	IV.	Saccharic acid

Choose the correct answer from the options given below:

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

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

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

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

Ans. (2)

Sol. Glucose $\xrightarrow[\Delta]{NaHCO_3}$ no reaction

Glucose $\xrightarrow[\Delta]{HNO_3}$ saccharic acid

Glucose $\xrightarrow[\Delta]{HI}$ n-hexane

Glucose $\xrightarrow[\Delta]{Br_2}$ Gluconic acid

79. Consider the oxides of group 14 elements SiO_2, GeO_2, SnO_2, PbO_2, CO and GeO. The amphoteric oxides are

(1) GeO, GeO_2

(2) SiO_2, GeO_2

(3) SnO_2, PbO_2

(4) SnO_2, CO

Ans. (3)

Sol. SnO_2 and PbO_2 are amphoteric

80. Match List I with List II

LIST I (Technique)		LIST II (Application)	
A.	Distillation	I.	Separation of glycerol from spent-lye
B.	Fractional distillation	II.	Aniline - Water mixture
C.	Steam distillation	III.	Separation of crude oil fractions
D.	Distillation under reduced pressure	IV.	Chloroform-Aniline

Choose the correct answer from the options given below:

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

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

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

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

Ans. (2)

Sol. Fact (NCERT)

SECTION-B

81. Molar mass of the salt from NaBr, $NaNO_3$, KI and CaF_2 which does not evolve coloured vapours on heating with concentrated H_2SO_4 is _____ g mol^{-1}, (Molar mass in g mol^{-1} : Na : 23, N : 14, K : 39,

O : 16, Br : 80, I : 127, F : 19, Ca : 40

Ans. **(78)**

Sol. **CaF_2** does not evolve any gas with concentrated H_2SO_4.

NaBr $\rightarrow$ evolve Br_2

$NaNO_3 \rightarrow$ evolve NO_2

KI $\rightarrow$ evolve I_2

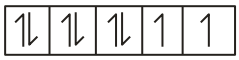
82. The 'Spin only' Magnetic moment for $[Ni(NH_3)_6]^{2+}$ is_____$\times 10^{-1}$ BM.

(given = Atomic number of Ni : 28)

Ans. **(28)**

Sol. NH_3 act as WFL with Ni^{2+}

$Ni^{2+} = 3d^8$



No. of unpaired electron = 2

$$\mu = \sqrt{n(n+2)} = \sqrt{8} = 2.82 \text{ BM}$$

$$= 28.2 \times 10^{-1} \text{ BM}$$

$$x = 28$$

83. Number of moles of methane required to produce 22g $CO_{2(g)}$ after combustion is $x \times 10^{-2}$ moles. The value of x is

Ans. **(50)**

Sol. $$CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(\ell)}$$

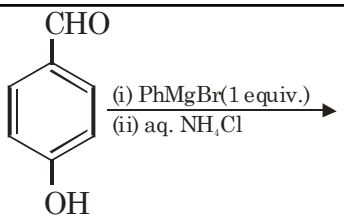
$$n_{CO_2} = \frac{22}{44} = 0.5 \text{ moles}$$

So moles of CH_4 required = 0.5 moles

i.e. 50×10^{-2} mole

x = 50

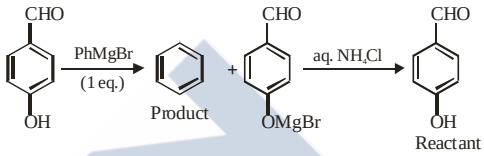
84. The product of the following reaction is P.



The number of hydroxyl groups present in the product P is_____.

Ans. **(0)**

Sol. Product benzene has zero hydroxyl group



85. The number of species from the following in which the central atom uses sp^3 hybrid orbitals in its bonding is_____.

NH_3, SO_2, SiO_2, $BeCl_2$, CO_2, H_2O, CH_4, BF_3

Ans. **(4)**

Sol. $NH_3 \rightarrow sp^3$

$SO_2 \rightarrow sp^2$

$SiO_2 \rightarrow sp^3$

$BeCl_2 \rightarrow sp$

$CO_2 \rightarrow sp$

$H_2O \rightarrow sp^3$

$CH_4 \rightarrow sp^3$

$BF_3 \rightarrow sp^2$

86. $CH_3CH_2Br + NaOH \xrightarrow[H_2O]{C_2H_5OH}$ Product A / Product B

The total number of hydrogen atoms in product A and product B is_____.

Ans. **(10)**

Sol. $CH_3CH_2Br + NaOH \xrightarrow[H_2O]{C_2H_5OH} CH_2=CH_2$ / CH_3-CH_2-OH

Total number of hydrogen atom in A and B is 10

87. Number of alkanes obtained on electrolysis of a mixture of CH_3COONa and C_2H_5COONa is_____.

Ans. (3)

Sol. $CH_3COONa \rightarrow \dot{C}H_3$

$C_2H_5COONa \rightarrow \dot{C}_2H_5$

$2\dot{C}_2H_5 \rightarrow CH_3-CH_2-CH_2-CH_3$

$2\dot{C}H_3 \rightarrow CH_3-CH_3$

$\dot{C}H_3+\dot{C}_2H_5 \rightarrow CH_3-CH_2-CH_3$

88. Consider the following reaction at 298 K.

$\frac{3}{2}O_{2(g)} \rightleftharpoons O_{3(g)}, K_P = 2.47\times10^{-29}$.

Δ_rG^Θ for the reaction is _____ kJ. (Given R = 8.314 JK^{-1} mol^{-1})

Ans. (163)

Sol. $\frac{3}{2}O_{2(g)} \rightleftharpoons O_{3(g)}, K_P = 2.47\times10^{-29}$.

$\Delta_rG^\Theta = -RT\ln K_P$

$= -8.314 \times 10^{-3} \times 298 \times \ln(2.47 \times 10^{-29})$

$= -8.314 \times 10^{-3} \times 298 \times (-65.87)$

$= 163.19$ kJ

89. The ionization energy of sodium in kJ mol^{-1}. If electromagnetic radiation of wavelength 242 nm is just sufficient to ionize sodium atom is_____.

Ans. (494)

Sol. $E = \frac{1240}{\lambda(nm)}eV$

$= \frac{1240}{242}eV$

$= 5.12$ eV

$= 5.12 \times 1.6 \times 10^{-19}$

$= 8.198 \times 10^{-19}$ J/atom

$= 494$ kJ/mol

90. One Faraday of electricity liberates $x \times 10^{-1}$ gram atom of copper from copper sulphate, x is_____.

Ans. (5)

Sol. $Cu^{2+} + 2e^- \rightarrow Cu$

2 Faraday $\rightarrow$ 1 mol Cu

1 Faraday $\rightarrow$ 0.5 mol Cu deposit

0.5 mol = 0.5 g atom = 5×10^{-1}

x = 5