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JEE (MAIN) 2024

QUESTIONS & SOLUTIONS

SHIFT-2

DATE & DAY: 01st February 2024 & Thursday

PAPER - 1

Duration: 3 Hrs.
Time: 03:00 PM - 06:00 PM

SUBJECT: CHEMISTRY

REGISTERED & CORPORATE OFFICE (CIN: U80302RJ2007PLC024029):
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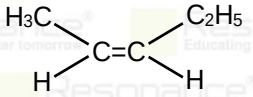
PART : CHEMISTRY

61. In the given reaction identify A and B.

$H_2 + A \xrightarrow{Pd/C}$ 

$CH_3 - C \equiv C - CH_3 + H_2 \xrightarrow{Na/Liquid\,NH_3} "B"$

(1) A : n-Pentane B : Cis-2-Butene (2) A : 2-Pentyne B : Cis-2-Butene

(3) A : n-Pentane B : trans-2-Butene (4) A : 2-Pentyne B : trans-2-Butene

Ans. **(4)**

Sol. Pd/C cause syn hydrogenation of alkyne to cis alkene whereas H_2 in $Na/NH_3(l)$ cause anti hydrogenation of alkyne to trans alkene.

62. Solubility of calcium phosphate (molecular mass M) in water is W g, per 100 ml. at 25°C It's solubility products at 25°C will be approximately.

(1) $10^7\left(\frac{W}{M}\right)^3$ (2) $10^3\left(\frac{W}{M}\right)^5$ (3) $10^7\left(\frac{W}{M}\right)^5$ (4) $10^5\left(\frac{W}{M}\right)^5$

Ans. **(3)**

Sol. $Ca_3(PO_4)_2 \longrightarrow \underset{3S}{3Ca^{+2}} + \underset{2S}{2PO_4^{3-}}$

$S \rightarrow Mol/L$

$S = \frac{10\,W}{M}$

$= (3S)^3 \times (2S)^2$

$= \left(\frac{10\,W}{M}\right)^3 \times \left(\frac{10\,W}{M}\right)^2 \times 3^3 \times 2^2$

$= 108 \times 10^5 \times \left(\frac{W}{M}\right)^5$

$\approx 100 \times 10^5 \times \left(\frac{W}{M}\right)^5 \approx 10^7 \times \left(\frac{W}{M}\right)^5$

63. Given below are two statements :

Statement (I) : SiO_2 and GeO_2 are acidic while SnO and PbO are amphoteric nature.

Statement (II) : Allotropic forms of carbon are due to property of catenation and $p\pi$-$d\pi$ bonds.

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

(1) **Statement I** is false but **Statement II** is true. (2) Both **Statement I** and **Statement II** are false.

(3) Both **Statement I** and **Statement II** are true. (4) **Statement I** is true but **Statement II** is false.

Ans. **(4)**

Sol. Graphite has $p\pi$-$p\pi$ bonds.

64. The set of meta directing functional groups from the following sets is :

(1) $-CH_2$, $-NH_2$, $-NHR$, $-OCH_3$ (2) $-CN$, $-CHO$, $-NHCOCH_3$, $-COOR$

(3) $-NO_2$, $-NH_2$, $-COOH$, $-COOR$ (4) $-NO_2$, $-CHO$, $-SO_3H$, $-COR$

Ans. **(4)**

Sol. $-NO_2$, $-CHO$, $-\overset{O}{\overset{\|}{C}}-R$, $-SO_3H$ groups exhibit strong –M and –I effect, and they are meta directing groups.

65. $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$ are respectively known as :
(1) Inner orbital Complex, Spin paired Complex (2) Spin paired Complex, Spin free Complex
(3) Spin free Complex, Spin paired Complex (4) Outer orbital Complex, Inner orbital Complex
Ans. **(2)**
Sol. $[Co(NH_3)_6]^{+3}$ d^6 system $\{t_2g^{2,2,2}, eg^{0,0}\}$, d^2sp^3 hybridization {inner orbital complex}, spin paired complex.
$[CoF_6]^{3-}$, d^6 system $\{t_2g^{2,1,1}, eg^{1,1}\}$, sp^3d^2 {outer orbital complex}, spin free complex.

66. The transition metal having highest 3rd ionisation enthalpy is :
(1) Mn (2) Fe (3) Cr (4) V
Ans. **(1)**
Sol. (1) Mn – [Ar] $3d^5$, $4s^2$ (3rd electron)
(2) Fe – [Ar] $3d^6$, $4s^2$
(3) Cr – [Ar] $3d^5$, $4s^1$
(4) V – [Ar] $3d^3$, $4s^2$

67. Match **list-I** with **List-II.**

List – I **Compound**	**List – II** **Use**
(A) Carbon tetrachloride	(I) Paint Remover
(B) Methylene chloride	(II) Refrigerators and air conditioners
(C) DDT	(III) Fire extinguisher
(D) Freons	(IV) Non Biodegradable insecticide

Choose the correct from the options given below :
(1) (A) – (II), (B) – (III), (C) – (I), (D) – (IV) (2) (A) – (III), (B) – (I), (C) – (IV), (D) – (II)
(3) (A) – (I), (B) – (II), (C) – (III), (D) – (IV) (4) (A) – (IV), (B) – (III), (C) – (II), (D) – (I)
Ans. **(2)**

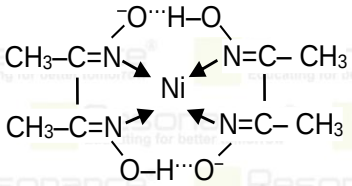
68. Match **List-I** with **List-II**.

List-I **Reactants**	**List-II** **Product**
(A) Phenol, Zn/Δ	(I) Salicylaldehyde
(B) Phenol, $CHCl_3$, NaOH, HCl	(II) Salicylic acid
(C) Phenol, CO_2, NaOH, HCl	(III) Benzene
(D) Phenol, Conc. HNO_3	(IV) Picric acid

Choose the **correct** answer from the options given below :
(1) (A) – (IV), (B) – (I), (C) – (II), (D) – (III) (2) (A) – (III), (B) – (I), (C) – (II), (D) – (IV)
(3) (A) – (IV), (B) – (II), (C) – (I), (D) – (III) (4) (A) – (III), (B) – (IV), (C) – (I), (D) – (II)
Ans. **(2)**

69. Given below are two statements:
Statement (I) : Dimethyl glyoxime forms a six-membered covalent chelate when treated with $NiCl_2$ solution in presence of NH_4OH.
Statement (II) : Prussian blue precipitate contains iron both in (+2) and (+3) oxidation states.
In the light of the above statements, choose the most appropriate 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. **(1)**

Sol.



H-bonded rings are six membered, covalent bonded rings are five membered.

S-II : $Fe_4[Fe(CN)_6]_3$

70. $C_2H_5Br \xrightarrow{alc.KOH} A \xrightarrow[CCl_4]{Br_2} B \xrightarrow[Excess]{KCN} C \xrightarrow[Excess]{H_3O^+} D$

Acid (D) formed in above reaction is:

(1) Malonic acid (2) Oxalic acid (3) Succinic acid (4) Gluconic acid

Ans. **(3)**

Sol. $C_2H_5Br \xrightarrow{alc.KOH} CH_2=CH_2 \xrightarrow[CCl_4]{Br_2} \underset{\displaystyle Br}{\overset{\displaystyle Br}{\overset{|}{CH_2}-\overset{|}{CH_2}}} \xrightarrow[Excess]{KCN} \underset{\displaystyle CH_2-C\equiv N}{\overset{\displaystyle CH_2-C\equiv N}{\overset{|}{\overset{|}{}}}} \xrightarrow[Excess]{H_3O^+} \underset{\displaystyle CH_2-COOH}{\overset{\displaystyle CH_2-COOH}{\overset{|}{\overset{|}{}}}}$

Succinic acid

71. Lassaigne's test is used for detection of :

(1) Phosphorous and halogens only

(2) Nitrogen, Sulphur and Phosphorous only

(3) Nitrogen, Sulphur, Phosphorous and halogens

(4) Nitrogen and Sulphur Only

Ans. **(3)**

Sol. Lassaigne's test is generally used for the detection of N, S, P and halogen in organic compound.

72. The strongest reducing agent among the following is :

(1) SbH_3 (2) NH_3 (3) BiH_3 (4) PH_3

Ans. **(3)**

Sol. In periodic table, on moving down the group the reducing power increases so, BiH_3 has highest reducing power.

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

Assertion (A) : In aqueous solution Cr^{2+} is reducing while Mn^{3+} is oxidising in nature.

Reason (R) : Extra stability to half filled electronic configuration is observed than incompletely filled electronic configuration.

In the light of the above statements, choose the most appropriate answer from the option 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) Both (A) and (R) are true but (R) is **not** the correct explanation of (A)

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

Ans. **(2)**

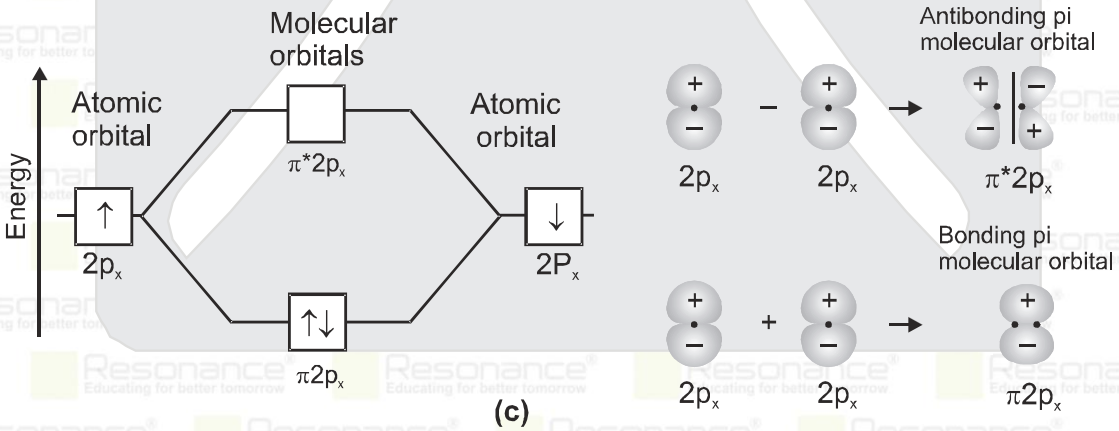
Sol. Cr^{2+} is reducing as its configuration changes from d^4 to d^3, the latter having a half-filled t_{2g} level. On the other hand, the change from Mn^{3+} to Mn^{2+} results in the half-filled (d^5) configuration which has extra stability.

74. The functional group that shows negative resonance effect is :
(1) –OH (2) –OR (3) –COOH (4) $–NH_2$
Ans. **(3)**
Sol. It is fact.

75. The number of radial node/s for 3p orbital is :
(1) 3 (2) 2 (3) 1 (4) 4
Ans. **(3)**
Sol. ℓ = angular nodes
(n – 1) = total nodes
Radial nodes = n – ℓ – 1 = 3 – 1 – 1 = 1

76. Which among the following has highest boiling point ?
(1) $CH_3CH_2CH_2CH_2–OH$ (2) $CH_3CH_2CH_2CH_3$
(3) $CH_3CH_2CH_2CHO$ (4) $H_5C_2–O–C_2H_5$
Ans. **(1)**
Sol. Butanol has highest boiling point as it has intermolecular hydrogen bonding.

77. Given below are two statements :
Statement (I) : A π bonding MO has lower electron density above and below the inter-nuclear axis.
Statement (II) : The π^* antibonding MO has a node between the nuclei.
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 true (2) Both Statement I and Statement II are false.
(3) Statement I is true but Statement II is false. (4) Statement I is false but Statement II is true.
Ans. **(4)**
Sol.



(c)

78. Given below are two statements :
Statement (I) : Both metals and non-metals exist in p and d-block elements.
Statement (II) : Non-metals have higher ionisation enthalpy and higher electronegativity than the metals.
In the light of the above statements, choose the most appropriate answer from the option given below :
(1) Both Statement I and Statement II are false. (2) Both Statement I and Statement II are true.
(3) Statement I is false but Statement II is true. (4) Statement I is true but Statement II is false.
Ans. **(3)**
Sol. Theory based.

79. Which of the following compounds show colour due to d-d transition ?

(1) $K_2Cr_2O_7$ (2) $CuSO_4.5H_2O$ (3) $KMnO_4$ (4) K_2CrO_4

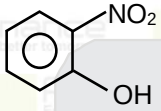
Ans. **(2)**

Sol. Cu : $[Ar]3d^{10}4s^1$

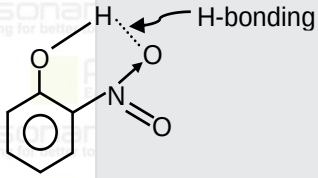
Cu^{+2} : $[Ar]3d^9$

d-electron (unpaired electron)

80. Select the compound from the following that will show intermolecular hydrogen bonding.

(1)  (2) H_2O (3) C_2H_5OH (4) NH_3

Ans. **(1)**

Sol. 

81. The number of tripeptides formed by three different amino acid using each amino acid once is _____

Ans. **(6)**

Sol. If A, B and C are three amino acid, then six tripeptides will form. These are

A–B–C, A–C–B, B–A–C, B–C–A, C–A–B and C–B–A

82. Mass of ethylene glycol (antifreeze) to be added to 18.6 kg of water to protect the freezing point at – 24ºC is _____ kg (Molar mass in g mol^{-1} for ethylene glycol 62, K_f of water = 1.86 K kg mol^{-1})

Ans. **(15)**

Sol. ΔT_f or $|\Delta T_f| = i \times K_f \times m$

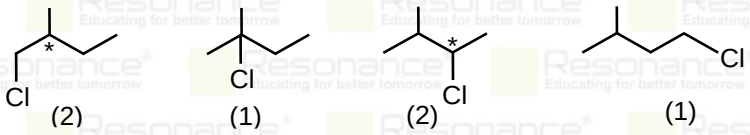
$i = 1;$

$$24 = \frac{1.86 \times X \times 1000}{62} \times \frac{1}{18.6}$$

$$X = \frac{24 \times 62 \times 18.6}{18.6 \times 1000} \approx 15$$

83. Total number of isomeric compounds (including stereoisomers) formed by monochlorination of 2-methylbutane is.

Ans. **(6)**

Sol. 

84. The following data were obtained during the first order thermal decomposition of a gas A at constant volume :

$A(g) \longrightarrow 2B(g) + C(g)$

S.No.	Time/s	Total pressure/(atm)
1.	0	0.1
2.	115	0.28

The rate constant of the reaction is _____ $\times 10^{-2}$ s^{-1} (nearest integer)

Ans. **(2)**

Sol.

$$A(g) \longrightarrow 2B(g) + C(g)$$

t = 0	0.1 atm	0	0
t = 115	0.1–x	2x	x

$P_T = 0.1 + 2x$

$0.28 = 0.1 + 2x \Rightarrow x = 0.09$

$(P_A)_t = 0.1 - x = 0.01$

$$K = \frac{2.303}{t} \log \frac{0.1}{0.01}$$

$$K = \frac{2.303}{115} \log 10$$

$K = 0.02$

$K = 2 \times 10^{-2}$

Ans. (2)

85. For a certain reaction at 300 K, K = 10, then $\Delta G°$ for the same reaction is _____ $\times 10^{-1}$ kJ mol^{-1} (Given R = 8.314 JK^{-1} mol^{-1})

Ans. **(57)**

Sol. $\Delta_r G^0 = -RT \ln K_{eq}$.

$= -2.303\ RT \log K_{eq}$

$= -2.303 \times 8.314 \times 300 \log(10)$

$$= \frac{-2.303 \times 8.314 \times 300}{1000} \text{ kJ/Mol}$$

$= 5.74$ J/Mol

$= 57.4 \times 10^{-1}$ kJ/Mol

$\sim 57 \times 10^{-1}$ kJ/Mol

86. The amount of electricity in Coulomb required for the oxidation of 1 mol of H_2O to O_2 is _____ $\times 10^5$ C.

Ans. **(2)**

Sol. $$H_2O \rightarrow \frac{1}{2} O_2 + 2H^+ + 2e^-$$

1 mol

1 mol $H_2O \rightarrow 2$ mole $e^- \Rightarrow 2F$

Electricity required = 2F

$= 2 \times 96500$

$= 1.93 \times 10^5$

$\approx 2 \times 10^5$ C

87. Following Kjeldahl's method, 1 g of organic compound released ammonia, that neutralised 10 ml of 2 M H_2SO_4. The percentage of nitrogen in the compound is _____ %.

Ans. **(56)**

Sol. m.moles of H_2SO_4 used = 10 mL × 2 M = 20 m.mole

m.moles of NH_3 neutralised = 2 × 20 = 40 m.mole

m.moles of N atom = 40 m.mole

$$\text{wt. of N} = \frac{40 \times 14}{1000}$$

$$\text{\% of N} = \frac{40 \times 14}{1000} \times 100 = 56\%$$

88. Consider the following redox reaction:

$MnO_4^- + H^+ + H_2C_2O_4 \rightleftharpoons M^{2+} + H_2O + CO_2$

The standard reduction potentials are given as below (E^o_{red})

$E^o_{MnO_4^-/Mn^{2+}}$ = +1.51 V

$E^o_{CO_2/H_2C_2O_4}$ = –0.49 V

If the equilibrium constant of the above reaction is given as $K_{eq} = 10^x$, then the value of x = _____. (nearest integer)

Ans. **(338)**

Sol. $[Mn^{+7} + 5e^- \longrightarrow Mn^{+2}] \times 2$

$[C_2O_4^{2-} \longrightarrow 2CO_2 + 2e^-] \times 5$

$Mn^{+7} + 5C_2O_4^{2-} \longrightarrow 2Mn^{+2} + 10\ CO_2$

$E^o_{Cell} = 0.49 + 1.51 = 2$

$E^o_{Cell} = \frac{0.0591}{n} \log K_{eq}$

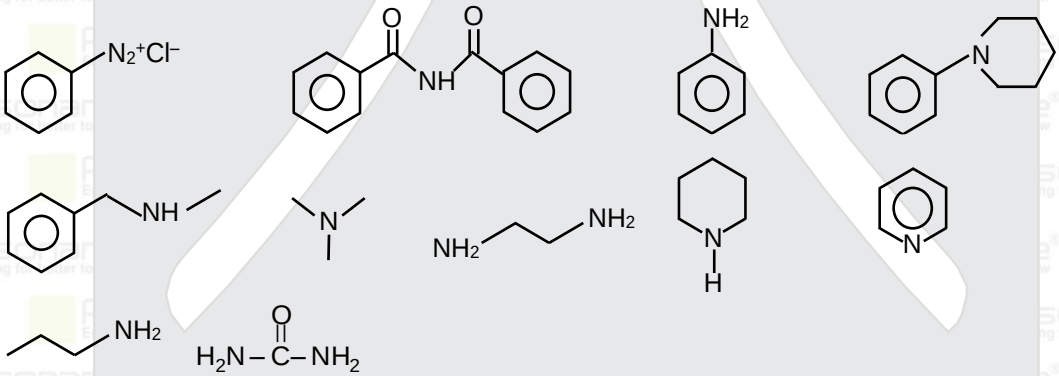
$\frac{E^o_{cell} \times n}{0.059} = \log K_{eq}.$

$\frac{2 \times 10}{0.0591} = \log K_{eq}.$

$338 = \log K_{eq}.$

$K_{eq.} = 10^{338} \Rightarrow x = 338$

89. Number of compounds which giv reaction with Hinsberg's reagent is _____.



Ans. **(5)**

Sol. Both 1° and 2° amine gives ppt. with Hinsberg's reagent but precipitate of 1° amine is soluble in aq. KOH.

90. 10 ml. of gaseous hydrocarbon on combustion gives 40 ml. of CO_2(g) and 50 ml. of water vapour. Total number of carbon and hydrogen atoms in the hydrocarbon is _____.

Ans. **(14)**

Sol. $C_XH_Y + \left(x + \frac{y}{4}\right) O_2 \longrightarrow XCO_2 + \frac{Y}{2} H_2O$

10 ml	40 ml	50 ml
1 mol	4 mol	10 mol

$V \propto n$ (at constant T,P)

C_4H_{10} (Butane)

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