

FINAL JEE-MAIN EXAMINATION – APRIL, 2024

(Held On Monday 08th April, 2024)

TIME : 9 : 00 AM to 12 : 00 NOON

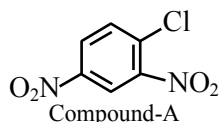
CHEMISTRY

TEST PAPER WITH SOLUTION

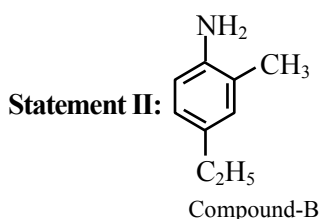
SECTION-A

61. Given below are two statements:

Statement I :



IUPAC name of Compound A is 4-chloro-1,3-dinitrobenzene:



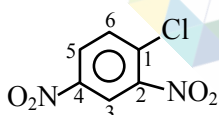
IUPAC name of Compound B is 4-ethyl-2-methylaniline.

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 incorrect but Statement II is correct
- (3) Statement I is correct but Statement II is incorrect
- (4) Both Statement I and Statement II are incorrect

Ans. (2)

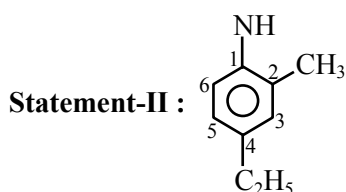
Sol. Statement I :



IUPAC name

⇒ 1-chloro-2,4-dinitrobenzene

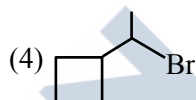
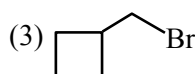
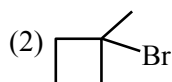
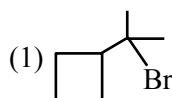
⇒ statement-I is incorrect



⇒ 4-ethyl-2-methylaniline

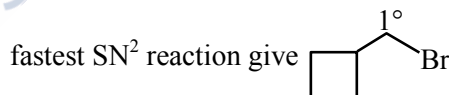
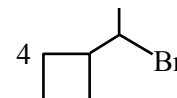
⇒ statement-II is correct

62. Which among the following compounds will undergo fastest S_N2 reaction.



Ans. (3)

Sol.



Rate of S_N2 is Me-x > 1°-x > 2°-x > 3°-x

63. Combustion of glucose (C₆H₁₂O₆) produces CO₂ and water. The amount of oxygen (in g) required for the complete combustion of 900 g of glucose is:

[Molar mass of glucose in g mol⁻¹ = 180]

- (1) 480
- (2) 960
- (3) 800
- (4) 32

Ans. (2)

Sol. C₆H₁₂O_{6(s)} + 6O_{2(g)} → 6CO_{2(g)} + 6H₂O_(l)

$$\frac{900}{180}$$

$$= 5 \text{ mol} \quad 30 \text{ mol}$$

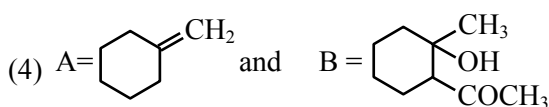
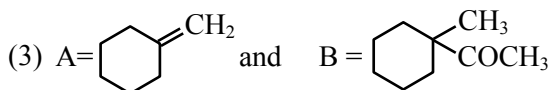
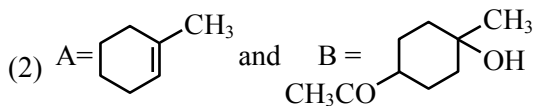
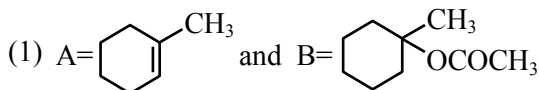
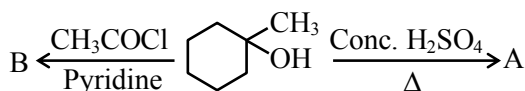
$$\text{Mass of O}_2 \text{ required} = 30 \times 32 = 960 \text{ gm}$$



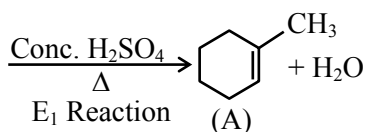
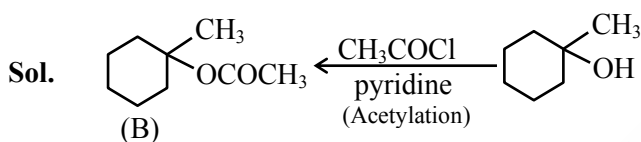
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64. Identify the major products A and B respectively in the following set of reactions.



Ans. (1)



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

Assertion A : The stability order of +1 oxidation state of Ga, In and Tl is $\text{Ga} < \text{In} < \text{Tl}$.

Reason R : The inert pair effect stabilizes the lower oxidation state down the group.

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

- (1) Both **A** and **R** are true and **R** is the correct explanation of **A**.
- (2) **A** is true but **R** is false.
- (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. (1)

Sol. The relative stability of +1 oxidation state progressively increases for heavier elements due to inert pair effect.

$$\therefore \text{Stability of } \text{Al}^{+1} < \text{Ga}^{+1} < \text{In}^{+1} < \text{Tl}^{+1}$$

66. Match List I with List-II

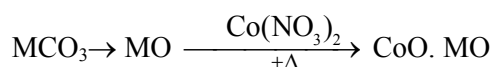
List-I (Name of the test)		List-II (Reaction sequence involved) [M is metal]	
A	Borax bead test	I.	$\text{MCO}_3 \rightarrow \text{MO}$ $\xrightarrow{+\Delta} \text{Co(NO}_3)_2 \rightarrow \text{CoO} \cdot \text{MO}$
B.	Charcoal cavity test	II.	$\text{MCO}_3 \rightarrow \text{MCl}_2 \rightarrow \text{M}^{2+}$
C.	Cobalt nitrate test	III	$\text{MSO}_4 \xrightarrow[\Delta]{\text{Na}_2\text{B}_4\text{O}_7}$ $\text{M(BO}_2)_2 \rightarrow \text{MBO}_2 \rightarrow \text{M}$
D.	Flame test	IV	$\text{MSO}_4 \xrightarrow[\Delta]{\text{Na}_2\text{CO}_3} \text{MCO}_3 \rightarrow$ $\text{MO} \rightarrow \text{M}$

Choose the correct answer from the option below :

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

Ans. (4)

Sol. **Cobalt nitrate test**



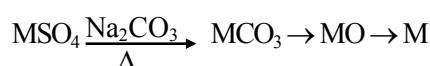
Flame test



Borax Bead test



Charcoal cavity test



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67. Match List I and with List II

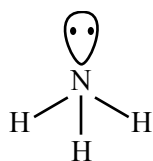
List-I (Molecule)		List-II(Shape)	
A	NH ₃	I.	Square pyramid
B.	BrF ₅	II.	Tetrahedral
C.	PCl ₅	III	Trigonal pyramidal
D.	CH ₄	IV	Trigonal bipyramidal

Choose the **correct** answer from the option below :

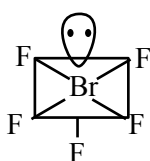
- (1) A-IV, B-III, C-I, D-II
- (2) A-II, B-IV, C-I, D-III
- (3) A-III, B-I, C-IV, D-II
- (4) A-III, B-IV, C-I, D-II

Ans. (3)

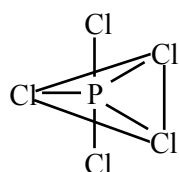
Sol.



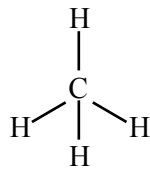
Trigonal pyramidal



Square pyramidal

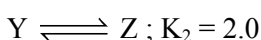


Trigonal bipyramidal

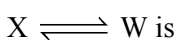


Tetrahedral

68. For the given hypothetical reactions, the equilibrium constants are as follows:

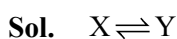


The equilibrium constant for the reaction



- (1) 6.0
- (2) 12.0
- (3) 8.0
- (4) 7.0

Ans. (3)



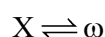
$$k_1 = 1$$



$$k_2 = 2$$



$$k_3 = 4$$

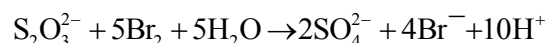
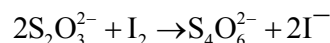


$$k_1 \cdot k_2 \cdot k_3$$

$$k = 1 \times 2 \times 4$$

$$k = 8$$

69. Thiosulphate reacts differently with iodine and bromine in the reaction given below :



Which of the following statement justifies the above dual behaviour of thiosulphate?

- (1) Bromine undergoes oxidation and iodine undergoes reduction by iodine in these reactions
- (2) Thiosulphate undergoes oxidation by bromine and reduction by iodine in these reaction
- (3) Bromine is a stronger oxidant than iodine
- (4) Bromine is a weaker oxidant than iodine

Ans. (3)

Sol. In the reaction of $S_2O_3^{2-}$ with I_2 , oxidation state of sulphur changes to +2 to +2.5

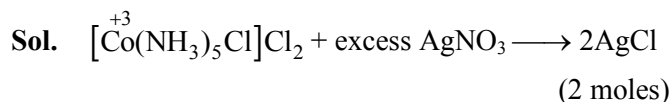
In the reaction of $S_2O_3^{2-}$ with Br_2 , oxidation state of sulphur changes from +2 to +6.

\therefore Both I_2 and Br_2 are oxidant (oxidising agent) and Br_2 is stronger oxidant than I_2 .

70. An octahedral complex with the formula $CoCl_3nNH_3$ upon reaction with excess of $AgNO_3$ solution given 2 moles of $AgCl$. Consider the oxidation state of Co in the complex is 'x'. The value of "x + n" is _____.

- (1) 3
- (2) 6
- (3) 8
- (4) 5

Ans. (3)



$$x + 0 - 1 - 2 = 0$$

$$x = +3$$

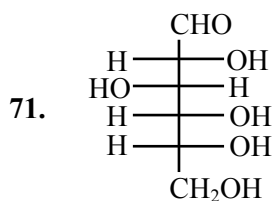
$$n = 5$$

$$\therefore x + n = 8$$



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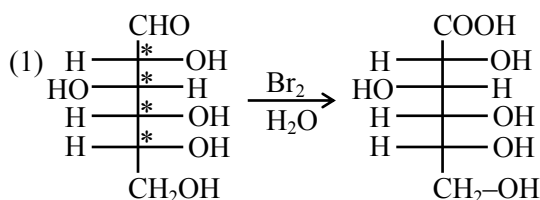


The **incorrect** statement regarding the given structure is

- (1) Can be oxidized to a dicarboxylic acid with Br_2 water
- (2) despite the presence of $-\text{CHO}$ does not give Schiff's test
- (3) has 4-asymmetric carbon atom
- (4) will coexist in equilibrium with 2 other cyclic structure

Ans. (1)

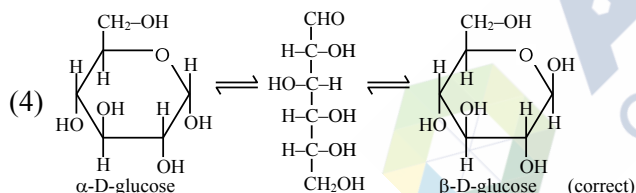
Sol.



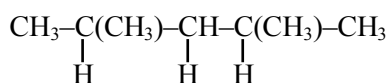
statement 1 is incorrect (monocarboxylic acid)

(2) correct

(3) c.c. is 4 (correct)

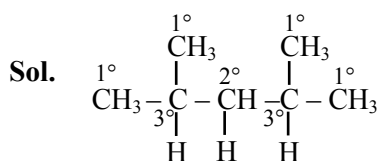


72. In the given compound, the number of 2° carbon atom/s is _____.



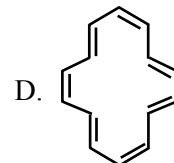
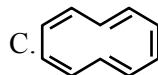
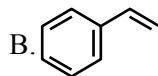
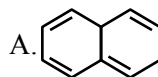
- (1) Three
- (2) One
- (3) Two
- (4) Four

Ans. (2)



only one 2° carbon is present in this compound.

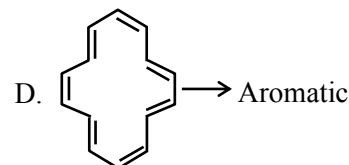
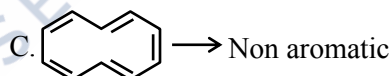
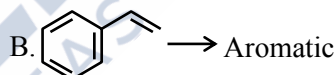
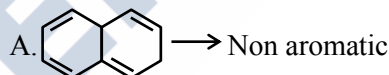
73. Which of the following are aromatic?



- (1) B and D only
- (2) A and C only
- (3) A and B only
- (4) C and D only

Ans. (1)

Sol.



74. Among the following halogens

F_2 , Cl_2 , Br_2 and I_2

Which can undergo disproportionation reaction?

- (1) Only I_2
- (2) Cl_2 , Br_2 and I_2
- (3) F_2 , Cl_2 and Br_2
- (4) F_2 and Cl_2

Ans. (2)

Sol. F_2 do not disproportionate because fluorine do not exist in positive oxidation state however Cl_2 , Br_2 & I_2 undergoes disproportionation.



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75. Given below are two statements:

Statement I : $N(CH_3)_3$ and $P(CH_3)_3$ can act as ligands to form transition metal complexes.

Statement II: As N and P are from same group, the nature of bonding of $N(CH_3)_3$ and $P(CH_3)_3$ is always same with transition metals.

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) Statement I is correct but Statement II is incorrect
 (4) Both Statement I and Statement II are incorrect

Ans. (3)

Sol. $N(CH_3)_3$ and $P(CH_3)_3$ both are Lewis base and acts as ligand, However, $P(CH_3)_3$ has a π -acceptor character.

76. Match List I with List II

List-I (Elements)		List-II(Properties in their respective groups)	
A	Cl, S	I.	Elements with highest electronegativity
B.	Ge, As	II.	Elements with largest atomic size
C.	Fr, Ra	III	Elements which show properties of both metals and non metal
D.	F, O	IV	Elements with highest negative electron gain enthalpy

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

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

Ans. (3)

Sol. Elements with highest electronegativity \rightarrow F, O

Elements with largest atomic size \rightarrow Fr, Ra

Elements which shows properties of both metal and non-metals i.e. metalloids \rightarrow Ge, As

Elements with highest negative electron gain enthalpy \rightarrow Cl, S

77. Iron (III) catalyses the reaction between iodide and persulphate ions, in which

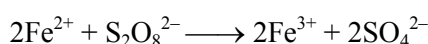
- A. Fe^{3+} oxidises the iodide ion
 B. Fe^{3+} oxidises the persulphate ion
 C. Fe^{2+} reduces the iodide ion
 D. Fe^{2+} reduces the persulphate ion

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

- (1) B and C only (2) B only
 (3) A only (4) A and D only

Ans. (4)

Sol. $2Fe^{3+} + 2I^- \longrightarrow 2Fe^{2+} + I_2$



Fe^{+3} oxidises I^- to I_2 and convert itself into Fe^{+2} . This Fe^{+2} reduces $S_2O_8^{2-}$ to SO_4^{2-} and converts itself into Fe^{+3} .

78. Match List I with List II

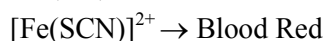
List-I (Compound)		List-II (Colour)	
A	$Fe_4[Fe(CN)_6]_3 \cdot xH_2O$	I.	Violet
B.	$[Fe(CN)_5NOS]^{4-}$	II.	Blood Red
C.	$[Fe(SCN)]^{2+}$	III.	Prussian Blue
D.	$(NH_4)_3PO_4 \cdot 12MoO_3$	IV.	Yellow

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

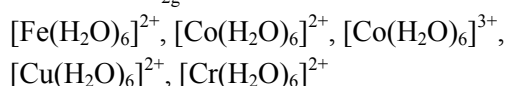
- (1) A-III, B-I, C-II, D-IV
 (2) A-IV, B-I, C-II, D-III
 (3) A-II, B-III, C-IV, D-I
 (4) A-I, B-II, C-III, D-IV

Ans. (1)

Sol. $Fe_4[Fe(CN)_6]_3 \cdot xH_2O \rightarrow$ Prussian Blue



79. Number of complexes with even number of electrons in t_{2g} orbitals is -



- (1) 1 (2) 3
 (3) 2 (4) 5

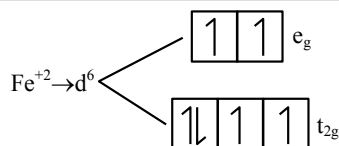
Ans. (2)



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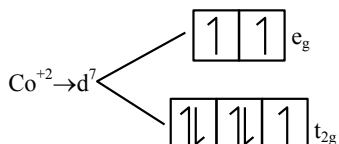
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Sol. $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$



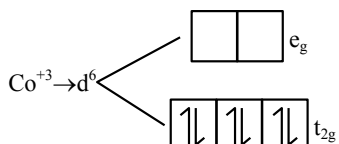
Electron in $t_{2g} = 4$ (even)

$[\text{Co}(\text{H}_2\text{O})_6]^{2+}$



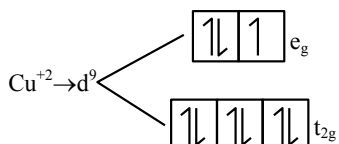
Electron in $t_{2g} = 5$ (odd)

$[\text{Co}(\text{H}_2\text{O})_6]^{3+}$



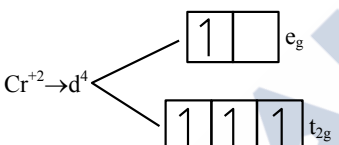
Electron in $t_{2g} = 6$ (even)

$[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$



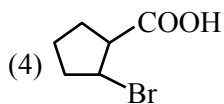
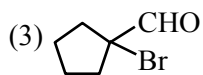
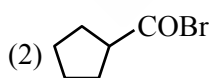
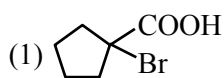
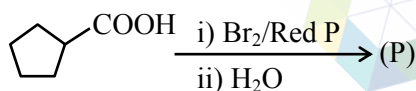
Electron in $t_{2g} = 6$ (even)

$[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$



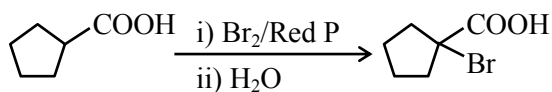
Electron in $t_{2g} = 3$ (odd)

80. Identify the product (P) in the following reaction:



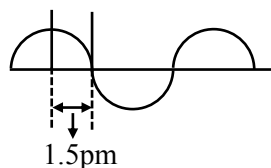
Ans. (1)

Sol. HVZ Reaction



SECTION-B

81. A hypothetical electromagnetic wave is shown below.



The frequency of the wave is $x \times 10^{19}$ Hz.

$x =$ _____ (nearest integer)

Ans. (5)

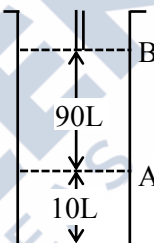
Sol. $\lambda = 1.5 \times 4 \text{ pm}$
 $= 6 \times 10^{-12} \text{ meter}$

$$\lambda \nu = C$$

$$6 \times 10^{-12} \times \nu = 3 \times 10^8$$

$$\nu = 5 \times 10^{19} \text{ Hz}$$

82.



Consider the figure provided.

1 mol of an ideal gas is kept in a cylinder, fitted with a piston, at the position A, at 18°C . If the piston is moved to position B, keeping the temperature unchanged, then 'x' L atm work is done in this reversible process.

$x =$ _____ L atm. (nearest integer)

[Given : Absolute temperature = $^\circ\text{C} + 273.15$,
 $R = 0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1}$]

Ans. (55)

Sol. $\omega = -nRT \ln \left(\frac{V_2}{V_1} \right)$

$$= -1 \times 0.08206 \times 291.15 \ln \left(\frac{100}{10} \right)$$

$$= -55.0128$$

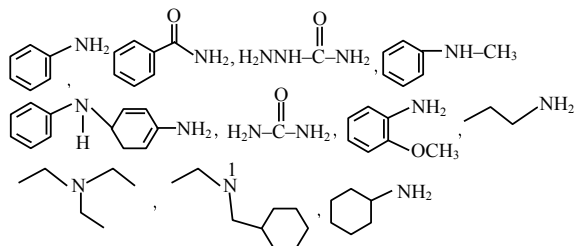
Work done by system $\approx 55 \text{ atm lit.}$



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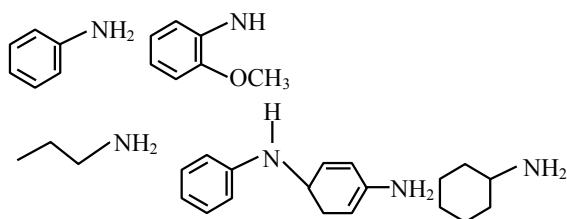
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83. Number of amine compounds from the following giving solids which are soluble in NaOH upon reaction with Hinsberg's reagent is _____.

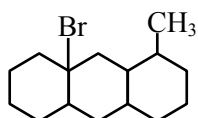


Ans. (5)

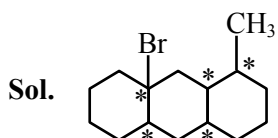
Sol. Primary amine give an ionic solid upon reaction with Hinsberg reagent which is soluble in NaOH.



84. The number of optical isomers in following compound is : _____.



Ans. (32)



Total chiral centre = 5

No. of optical isomers = $2^5 = 32$.

85. The 'spin only' magnetic moment value of MO_4^{2-} is _____ BM. (Where M is a metal having least metallic radii. among Sc, Ti, V, Cr, Mn and Zn). (Given atomic number : Sc = 21, Ti = 22, V = 23, Cr = 24, Mn = 25 and Zn = 30)

Ans. (0)

Sol. Metal having least metallic radii among Sc, Ti, V, Cr, Mn & Zn is Cr.

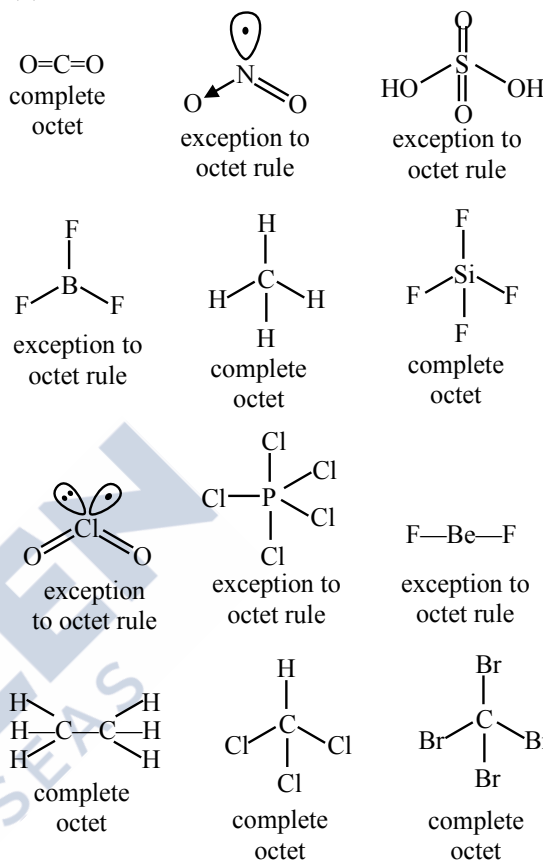
Spin only magnetic moment of CrO_4^{2-} .

Here Cr^{+6} is in d^0 configuration (diamagnetic).

86. Number of molecules from the following which are exceptions to octet rule is _____.
 CO_2 , NO_2 , H_2SO_4 , BF_3 , CH_4 , SiF_4 , ClO_2 , PCl_5 , BeF_2 , C_2H_6 , CHCl_3 , CBr_4

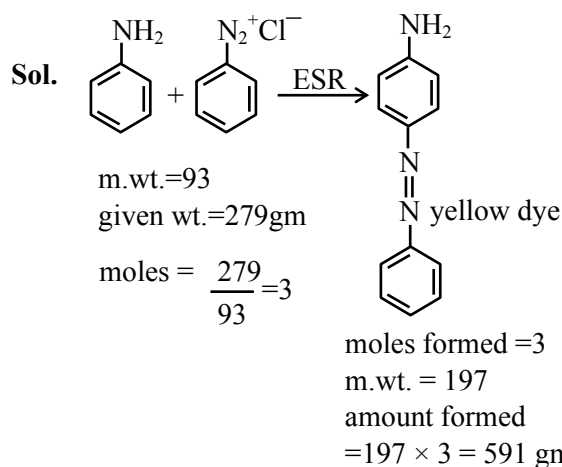
Ans. (6)

Sol.



87. If 279 g of aniline is reacted with one equivalent of benzenediazonium chloride, the maximum amount of aniline yellow formed will be _____ g. (nearest integer) (consider complete conversion)

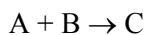
Ans. (591)



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88. Consider the following reaction



The time taken for A to become $1/4^{\text{th}}$ of its initial concentration is twice the time taken to become $1/2$ of the same. Also, when the change of concentration of B is plotted against time, the resulting graph gives a straight line with a negative slope and a positive intercept on the concentration axis.

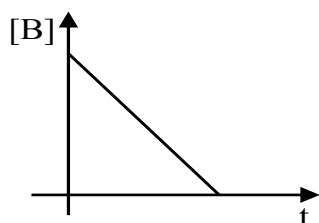
The overall order of the reaction is ____.

Ans. (1)

Sol. For 1^{st} order reaction

$$75\% \text{ life} = 2 \times 50\% \text{ life}$$

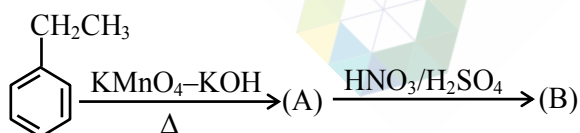
So order with respect to A will be first order.



So order with respect to B will be zero.

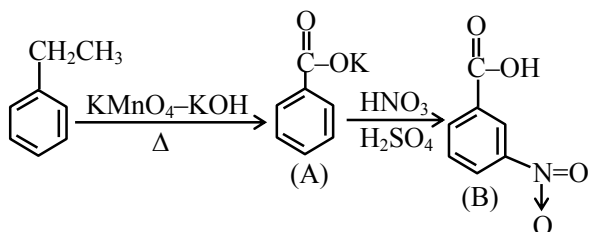
$$\text{Overall order of reaction} = 1 + 0 = 1$$

89. Major product B of the following reaction has ____ π -bond.



Ans. (5)

Sol. Major product B is \rightarrow



Total number of π bonds in B are 5

90. A solution containing 10g of an electrolyte AB_2 in 100g of water boils at 100.52°C . The degree of ionization of the electrolyte (α) is ____ $\times 10^{-1}$.

(nearest integer)

[Given : Molar mass of $\text{AB}_2 = 200\text{g mol}^{-1}$. K_b (molal boiling point elevation const. of water) = $0.52\text{ K kg mol}^{-1}$, boiling point of water = 100°C ; AB_2 ionises as $\text{AB}_2 \rightarrow \text{A}^{2+} + 2\text{B}^-$]

Ans. (5)

Sol. $\text{AB}_2 \rightarrow \text{A}^{2+} + 2\text{B}^-$

$$i = 1 + (3 - 1)\alpha$$

$$i = 1 + 2\alpha$$

$$\Delta T_b = k_b im$$

$$0.52 = 0.52 (1 + 2\alpha) \frac{10}{100} \frac{200}{1000}$$

$$1 = (1 + 2\alpha) \frac{10}{20}$$

$$2 = 1 + 2\alpha$$

$$\alpha = 0.5$$

$$\text{Ans. } \alpha = 5 \times 10^{-1}$$



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