CHEMISTRY

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

1. Which of the following compound can react with Hinsberg reagent?

   (A) Aniline

   (B) N,N-Dimethyl aniline

   (C) Methyl amine

   (D) N-phenyl aniline

   (1) A only (2) A and C only

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

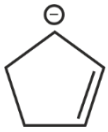
Answer (3)

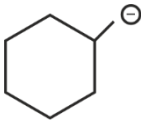
Sol. Primary and secondary amines reacts with Hinsberg reagent.

2. Among the following, the most stable carbanion is

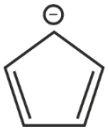
   (1) 

   (2) 

   (3) 

   (4) 

Answer (2)

Sol. Only  is aromatic in the given options hence most stable.

3. Which of the following compound can show fac-mer isomerism?

   (1) $[Co(NH_3)_6]Cl_3$

   (2) $[Co(NH_3)_3Cl_3]$

   (3) $[Co(en)_2(NH_3)_2]Cl_3$

   (4) $[Co(H_2O)_6]Cl_3$

Answer (2)

Sol. $[Ma_3b_3]$ type complex compound can show fac-mer isomerism. Where a, b are monodentate ligands.

4. Which of the following pair of ions have same colour?

   (1) Ti^{4+}, V^{3+}

   (2) Cr^{2+}, Cu^{2+}

   (3) Cr^{3+}, Ni^{2+}

   (4) Mn^{3+}, Fe^{2+}

Answer (2)

Sol.

Ti^{4+} = Colourless V^{3+} = Green	Cr^{2+} = Blue Cu^{2+} = Blue
Cr^{3+} = Violet Ni^{2+} = Green	Mn^{3+} = Violet Fe^{2+} = Green

5. Which of the following does not belong to the same period in the modern periodic table?

   (1) Pd (2) Ir

   (3) Pt (4) Os

Answer (1)

Sol. Os, Ir, Pt belongs to 6^{th} period, while Pd belongs to 5^{th} period of modern periodic table.

6. Identify the product formed in the following reaction

$$CH_3-CH_2-CHO + HCHO \xrightarrow[\text{Reflux}]{OH^-,\ \text{Excess}}$$

(1) $CH_3-C(CH_2OH)_2-CH_2OH$ (2) $CH_3-C(=CH_2)-CHO$

(3) $CH_3-CH(CH_2OH)-CHO$ (4) $CH_3-C(CH_2OH)_2-CHO$

Answer (1)

Sol. Propanal undergoes aldol condensation with excess of HCHO in presence of OH^- ions to 2, 2-dihydroxymethylpropanal which further reacts with HCHO and undergoes Cannizzaro reaction to given 2, 2-dihydroxymethylpropan-1-ol.

$$CH_3-CH_2-CHO + 2HCHO \xrightarrow{OH^-} CH_3-C(CH_2OH)_2-CHO$$

$$CH_3-C(CH_2OH)_2-CHO + HCHO \xrightarrow[\text{Reflux}]{OH^-} CH_3-C(CH_2OH)_2-CH_2OH + HCOO^-$$

7. Incorrect statement among the following is

(1) SO_2 act as oxidising agent but not reducing agent

(2) NO_2 exists as dimer

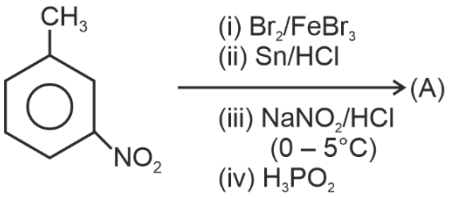
(3) PF_5 exists but NF_5 does not

(4) PH_3 has lower proton affinity than NH_3

Answer (1)

Sol. SO_2 is oxidising as well as reducing agent as sulphur exists in +4 oxidation state.

8. Consider the following sequence of reactions and find the molecular mass of the final product (A) formed in g mol^{-1}.

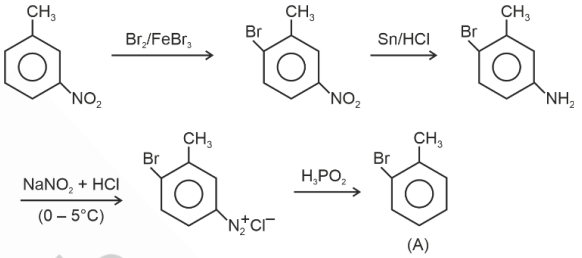


(1) 108 (2) 216

(3) 171 (4) 186

Answer (3)

Sol.



Molecular mass of (A) = 171 g mol^{-1}

9. Match the Column I with Column II and choose the correct option.

	Column I		Column II
A.	BF_3	(i)	Odd e^- species
B.	CCl_4, CO_2	(ii)	Expanded octet
C.	PCl_5, BrF_5	(iii)	Complete octet
D.	NO	(iv)	Electron deficient

(1) A – (iii), B – (iv), C – (i), D – (ii)

(2) A – (iv), B – (ii), C – (iii), D – (i)

(3) A – (iv), B – (iii), C – (ii), D – (i)

(4) A – (i), B – (ii), C – (iii), D – (iv)

Answer (3)

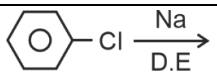
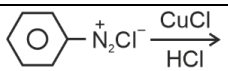
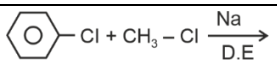
Sol. • $BF_3 \Rightarrow 6\ e^-$ in central atom, octet incomplete, e^- deficient

- CCl_4, $CO_2 \Rightarrow 8e^-$ in central atom $\Rightarrow$ Complete octet
- $PCl_5 \Rightarrow 10e^-$ in central atom, $BrF_5 \Rightarrow 12e^-$ in central atom

  $\therefore$ PCl_5, BrF_5 = Expanded octet
- NO $\Rightarrow$ It is an odd electron species $\left[\ddot{\underset{\cdot}{N}} = O\right]$

  $\Rightarrow$ 1 odd e^- is present

10. Match the column and choose the correct option

	Column-I		Column-II
(A)		(P)	Sandmeyer reaction
(B)		(Q)	Fittig reaction
(C)		(R)	Wurtz-Fittig reaction
(D)	$CH_3 - Cl + AgF \rightarrow$	(S)	Swarts reaction

(1) (A) – (Q), (B) – (P), (C) – (R), (D) – (S)

(2) (A) – (Q), (B) – (P), (C) – (S), (D) – (R)

(3) (A) – (Q), (B) – (R), (C) – (S), (D) – (P)

(4) (A) – (P), (B) – (Q), (C) – (R), (D) – (S)

Answer (1)

Sol. $2Ph - Cl \xrightarrow[D.E]{Na} Ph - Ph$ (Fittig reaction)

$Ph - N_2Cl \xrightarrow[HCl]{CuCl} Ph - Cl$ (Sandmeyer reaction)

$Ph - Cl + CH_3Cl \xrightarrow[D.E]{Na} Ph - CH_3$ (Wurtz Fittig reaction)

$CH_3 - Cl + AgF \rightarrow CH_3F$ (Swarts reaction)

11. Co^{2+} is forming an octahedral complex with spin only magnetic moment 3.83 BM. The correct electronic configuration for cobalt in the complex is?

(1) $t_{2g}^5 e_g^2$

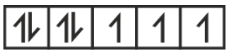
(2) $t_{2g}^6 e_g^1$

(3) $t_{2g}^4 e_g^3$

(4) $e^4 t_2^3$

Answer (1)

Sol. Since Co^{2+} has spin only magnetic moment = 3.83 BM

$Co^{2+} = 3d^7$; 

μ = 3.83 BM, means it has 3 unpaired electrons, so ligand should be WFL.

So electronic configuration is $t_{2g}^5 e_g^2$.

12. Given below are two statements :

Statement-I : During Lassaigne's test, covalent compound is converted to ionic compound.

Statement-II : $Na_4[Fe(CN)_6]$ gives Prussian blue colour on reaction with $Fe_2(SO_4)_3$.

(1) S-I is correct, S-II is incorrect

(2) S-I is incorrect, S-II is correct

(3) Both S-I and S-II are correct

(4) Both S-I and S-II are incorrect

Answer (3)

Sol. $3Na_4[Fe(CN)_6] + 2Fe_2(SO_4)_3 \rightarrow \underset{\text{(Prussian blue)}}{Fe_4[Fe(CN)_6]_3} + 6Na_2SO_4$

$\therefore$ Both S-I and S-II are correct.

13. $A(g) \rightarrow 2B(g)$

For the given reaction, initial pressure was 0.6 atm and rate constant is 4.606×10^{-2} sec^{-1}. Find the pressure at 100 sec

(1) 0.6 atm (2) 1.194 atm

(3) 0.594 atm (4) 0.006 atm

Answer (2)

Sol.

	$A(g)$	$\rightarrow$	$2B(g)$
$t = 0$	0.6		
$t = 100$ sec.	$0.6 - p$		$2p$

$$kt = 2.303 \log \frac{0.6}{0.6 - p}$$

$$4.606 \times 10^{-2} \times 100 = 2.303 \log \frac{0.6}{0.6 - p}$$

$$(0.6 - p)100 = 0.6$$

$$60 - 100p = 0.6$$

$$\boxed{p = 0.594 \text{ atm}}$$

Total pressure = 0.6 + p

= 0.6 + 0.594

= 1.194 atm

14. Consider the following statements and choose the correct option.

Statement-I: Fructose does not contain aldehyde group but it gives Tollen's test.

Statement-II: In disaccharides, if the reducing groups are bonded, these are non-reducing sugar e.g., sucrose. If these functional groups are free then they are reducing sugar e.g. maltose and Lactose.

(1) Statement-I and Statement-II are correct

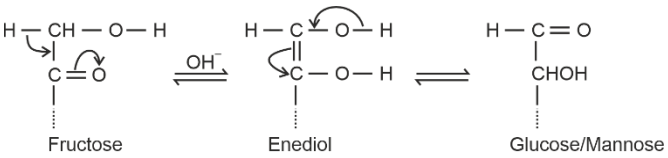
(2) Statement-I is correct and Statement-II is incorrect

(3) Statement-I in incorrect Statement-II is correct

(4) Statement-I and Statement-II both are incorrect

Answer (1)

Sol. Fructose has α-hydroxy ketone group which tautomerises to aldehyde group in presence of base. Therefore, it reduces Tollen's reagent.



Sucrose is non reducing sugar because the aldehyde group of glucose and ketonic group of function are bounded. Maltose and Lactose are reducing sugar.

15. For a sample of Hydrogen atom, the wavelength observed is 656 nm during a transition. The transition and corresponding series in hydrogen spectrum will be

(1) $3 \rightarrow 2$, Balmer (2) $4 \rightarrow 1$, Lyman

(3) $5 \rightarrow 2$, Balmer (4) $4 \rightarrow 3$, Paschen

Answer (1)

Sol. $$\frac{1}{\lambda} = R_H z^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$$\frac{1}{656 \times 10^{-7}} = 109677 \times (1)^2 \times \left[\frac{1}{2^2} - \frac{1}{n_2^2}\right] cm^{-1}$$

$$0.139 = 0.25 - \frac{1}{n_2^2}$$

$$\frac{1}{n_2^2} = 0.111$$

$n_2 = 3$

16.

17.

18.

19.

20.

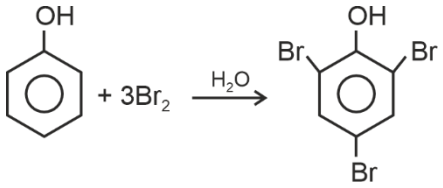
SECTION - B

Numerical Value Type Questions: This section contains 5 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

21. If 2 g phenol is allowed to react with Br_2/H_2O. How much Br_2 (in g) will be required to produce 2, 4, 6 tribromophenol (Rounded off to nearest integer).

Answer (10)

Sol.



3 moles Br_2 will be required to react with 1 mole phenol.

Br_2 required for 2 g phenol $= \frac{2}{94} \times 160 \times 3$

$= 10.2$ g

22. When 10^{21} molecules are removed from x mg of CO_2(g), then 2.4×10^{-3} moles of CO_2 are left. Calculate the value of x. [Take $\Rightarrow N_A = 6 \times 10^{23}$]

Answer (179)

Sol. Number of moles of CO_2 removed

$$= \frac{10^{21}}{6 \times 10^{23}}$$

$= 0.167 \times 10^{-2}$ mol

Number of moles of CO_2 left $= 2.4 \times 10^{-3}$ mol

Total moles $= 2.4 \times 10^{-3} + 1.67 \times 10^{-3}$

$= 4.07 \times 10^{-3}$ mol

Mass of CO_2 present $= 4.07 \times 44 \times 10^{-3}$

$= 179 \times 10^{-3}$ g

$= 179$ mg

23. Consider the following Latimer diagram

$$FeO_4^{2-} \xrightarrow{2.0\ V} Fe^{3+} \xrightarrow{0.8\ V} Fe^{2+} \xrightarrow{-0.5\ V} Fe^0$$

Find $E^\circ_{FeO_4^{2-}/Fe^{2+}}$

Answer (2)

Sol. $FeO_4^{2-} + 4e^- \longrightarrow Fe^{2+}$

$\Delta G^\circ = -4 \times F \times E^0$

$FeO_4^{2-} + 3e^- \longrightarrow Fe^{3+}$

$\Delta G_1^\circ = -3 \times F \times (2)$

$Fe^{3+} + e^- \longrightarrow Fe^{2+}$

$\Delta G_2^\circ = -1 \times F \times (0.8)$

$\Delta G^\circ = \Delta G_1^\circ + \Delta G_2^\circ$

$-4 \times F \times E^0 = -3 \times F \times 2 + (-F \times 0.8)$

$-4E^\circ = -6.8$

$E^\circ = 1.7$ V

24. Consider the given values :

$\Delta H = 55$ kJ mol^{-1}

$\Delta S = 175$ J mol^{-1} K^{-1}

$T = 25°C$

Calculate the value of Gibbs free energy change (ΔG) in J mol^{-1}.

Answer (2850)

Sol. $\Delta G = \Delta H - T\Delta S$

$\Delta G = 55000 - 298 \times 175$ J mol^{-1}

$\Delta G = 55000 - 52150$

$\Delta G = 2850$ J mol^{-1}

25. In estimation of sulphur by Carius method, 160 g of organic compound gives 466 g of Barium sulphate. % of sulphur in the organic compound is _____.

Answer (40)

Sol. 233 g of $BaSO_4$ contains 32 g of sulphur.

466 g of $BaSO_4$ will have 64 g of sulphur.

$\therefore$ % sulphur $= \frac{64}{160} \times 100 = 40\%$