Chemistry JEE Solutions 2022

Chemistry

1. (White) $P_4 \xrightarrow{\text{Conc.}HNO_3}$

(1) $H_3PO_3 + N_2$ (2) $NO_2 + PH_3$

(3) $H_3PO_4 + NO_2$ (4) $H_3PO_4 + NO_2$

Sol. Answer (3)

$$P_4 + \underset{\text{Conc.}}{20HNO_3} \rightarrow 4H_3PO_4 + 20NO_2 + 4H_2O$$

2. Match the molecules given in column I with their corresponding shapes in column II

Column I	Column II
(i) SF_4	(P) T shaped
(ii) BF_3	(Q) See-Saw
(iii) XeF_4	(R) Trigonal planar
(iv) ClF_3	(S) Square planar

(1) (i) – Q, (ii) – R, (iii) – S, (iv) – P

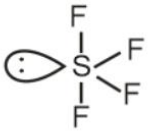
(2) (i) – P, (ii) – Q, (iii) – R, (iv) – S

(3) (i) – R, (ii) – P, (iii) – Q, (iv) – S

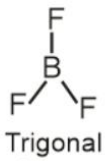
(4) (i) – Q, (ii) – S, (iii) – P, (iv) – R

Sol. Answer (1)

(i) See-Saw shaped

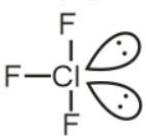


(ii) Trigonal planar



(iii) Square planar

(iv) (T-shaped)



3. Which of the following has maximum CFSE value.

(1) $[Fe(H_2O)_6]^{3+}$ (2) $[Co(H_2O)_6]^{3+}$

(3) $[Co(CN)_6]^{3-}$ (4) $[Fe(H_2O)_6]^{2+}$

Sol. Answer (3)

(i) $[Fe(H_2O)_6]^{3+}$ e^- configuration of Fe^{+3} = $[Ar]3d^5 4s^o$

t_{2g}^3 e_g^2

(ii) $[Co(H_2O)_6]^{3+}$ e^- configuration of Co^{+3} = $[Ar]3d^6 4s^o$

t_{2g}^6 e_g^o

(iii) $[Co(CN)_6]^{3-}$ e^- configuration of Co^{+3} = $[Ar]3d^6 4s^o$

t_{2g}^6 e_g

Since, $\bar{C}N$ is a strong field ligand so |CFSE| is very high.

4. $BeCl_2 + LiAlH_4 \longrightarrow$ Products

(1) $Be, LiAlCl_4, HCl$ (2) $BeH_2, LiCl, AlCl_3$

(3) $AlH_3 + BeH_2 + HCl$ (4) $Be + AlCl_3 + HCl$

Sol. Answer (2)

$$2BeCl_2 + LiAlH_4 \rightarrow 2BeH_2 + LiCl + AlCl_3$$

5. Statement I : Classical smog is formed in cold and humid climate

Statement II : Photochemical smog contains O_3 and PAN

The correct statements are

(1) Both I and II (2) Only I

(3) Only II (4) Neither I nor II

Sol. Answer (1)

Classical smog occurs in cold and humid climate.

Photochemical smog contains O_3 and PAN and NO_x

6. Statement-1 : O^{2-} and Mg^{2+} have same ionic size

Statement 2 : They are isoelectronic species.

(1) Statement-1 is true, Statement-2 is True ; Statement-2 is a correct explanation for statement -1

(2) Statement-1 is true, Statement-2 is True ; Statement-2 is not a correct explanation for statement 1

(3) Statement-1 is true, Statement-2 is false

(4) Statement-1 is false, Statement-2 is true

Sol. Answer (4)

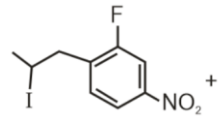
Size of O^{2-} < size of Mg^{2+} because in Mg^{2+} No. of protons is more than no. of electrons Z_{eff} is high.

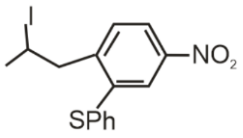
So statement-1 is false

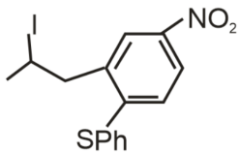
Number of e^- in O^{2-} = 10

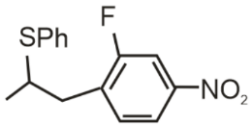
Number of e^- in Mg^{2+} = 10

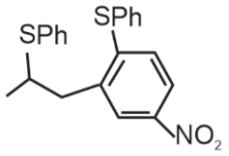
So they are isoelectronic species

7.  + PhS^- ⟶ Major product (P). P is

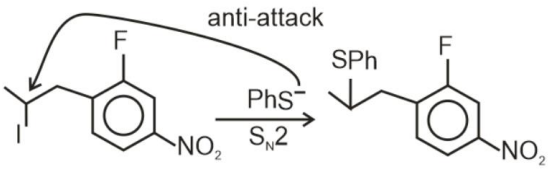
(1) 

(2) 

(3) 

(4) 

Sol. Answer (3)



8. Match the column I having process and elements with their corresponding ores/reagents or process used in extraction

Column I	Column II
(i) Blister copper	P. Sulphide ore
(ii) Froth floatation	Q. Electrolytic refining
(iii) Gold extraction	R. $[Au(CN)_2]^-$

(1) (i) → P, (ii) → Q,P, (iii) → R,P

(2) (i) → Q,P, (ii) → P, (iii) → Q,R

(3) (i) → R,P, (ii) → Q, (iii) → P

(4) (i) → Q,P, (ii) → R,Q, (iii) → Q,P

Sol. Answer (2)

(i) Blister copper – Electrolytic refining and sulphide ore ($CuFeS_2$)

(ii) Froth floatation – Sulphide ore

(iii) $4Au + 8\,NaCN + O_2 \xrightarrow{H_2O}$

$$4Na[Au(CN)_2] + 4NaOH$$

$$Zn + 2[Au(CN)_2]^- \rightarrow 2Au + \left[Zn(CN)_4\right]^{2-}$$

(iii) → R,Q

(ii) → P

(i) → P,Q

9. What is the product formed when barium peroxide is treated with sulphuric acid.

(1) BaO and H_2O_2 (2) BaS and H_2O_2

(3) $BaSO_4$ and H_2O_2 (4) $BaSO_4$ and H_2O

Sol. Answer (3)

$$BaO_2 \cdot 8H_2O(s) + H_2SO_4(aq)$$

$$\downarrow$$

$$H_2O_2(aq) + BaSO_{4(s)} + 8H_2O(\ell)$$

10. Correct match of column I with Colum II is

Column I	Column II
(i) Emulsion	(a) Protective colloid
(ii) Positively charged colloid	(b) $FeCl_3$ + NaOH

(iii) Negatively charged (c) $FeCl_3$ + hot water colloid

(iv) Lyophilic colloid (d) Liquid-liquid sol.

(1) (i) – d, (ii) – c, (iii)-b, (iv)-d

(2) (i) – a, (ii) – b, (iii)-c, (iv)-d

(3) (i) –c, (ii) – a, (iii)-d, (iv)-b

(4) (i) – a, (ii) – d, (iii)-c, (iv)-b

Sol. Answer (1)

(i) emulsion $\rightarrow$ liquid-liquid sol. will from emulsion

(i) $\rightarrow$ D

(ii) $FeCl_3 + \underset{(hot)}{H_2O} \xrightarrow{\Delta} Fe(OH)_3 \downarrow Fe_2O_2.xH_2O$

i.e positively charged sol.

$\therefore$ (ii) $\rightarrow$ C

(iii) $FeCl_3 + NaOH \rightarrow Fe(OH)_3$

$Fe(OH)_3 / \overline{O}H$ ie negatively charged sol.

(iii) $\rightarrow$ B

(iv) Lyophilic colloid acts as protective colloid for lyophobic colloids

11. Match the following

1.	Polystyrene	(i)	Electrical switches
2.	Polyvinly chloride	(ii)	Paints and lacquers
3.	Glyptal	(iii)	Wrapping material
4.	Bakelite	(iv)	Pipes

(1) $1-(iii), 2-(iv), 3-(ii), 4-(i)$

(2) $1-(iv), 2-(iii), 3-(i), 4-(ii)$

(3) $1-(iii), 2-(i), 3-(iv), 4-(ii)$

(4) $1-(iv), 2-(i), 3-(iii), 4-(ii)$

Sol. Answer (1)

Polystyrene $\rightarrow$ wrapping material

Polyvinyl Chloride $\rightarrow$ water pipes

Glyptal $\rightarrow$ paints and Lacquers

Bakelite $\rightarrow$ Electrical switched

12. Which of following is separating funnel

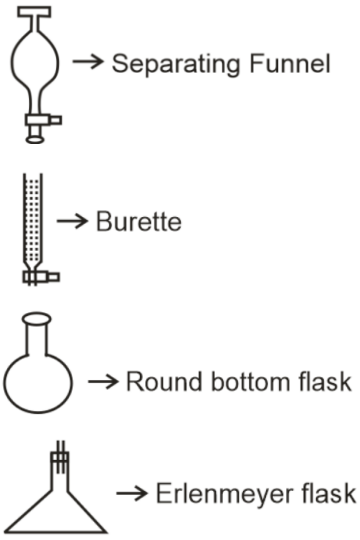
(1) 

(2) 

(3) 

(4) 

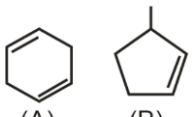
Sol. Answer (1)

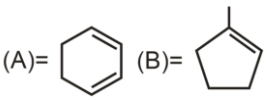


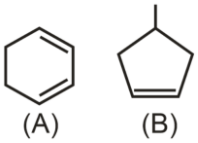
13. Compound A $\xrightarrow[Zn/H_2O]{O_3}$ Glyoxal + butane-1, 4-dial

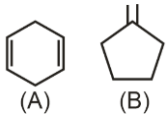
Compound B $\xrightarrow[Zn/H_2O]{O_3}$ 5-oxohexanal

Then compound A and B are respectively

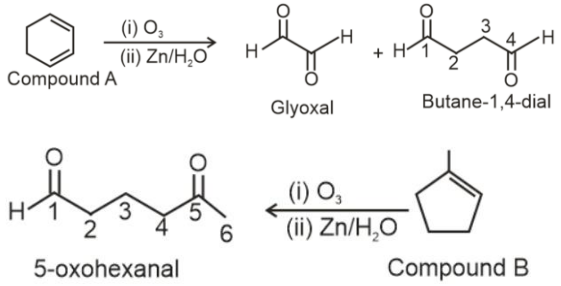
(1) 

(2) 

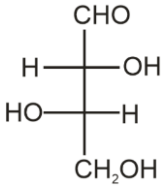
(3) 

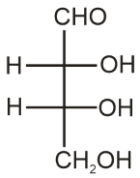
(4) 

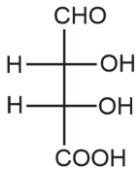
Sol. Answer (2)



14. A compound X having four carbon atoms can reacts with 3 moles of CH_3COO^- ion during acetylation reaction. The compound X also give positive tollen's reagent test. It reacts with bromine water to form an optically active compound, but reacts with conc. HNO_3 to form an optically inactive compound. Compound X is

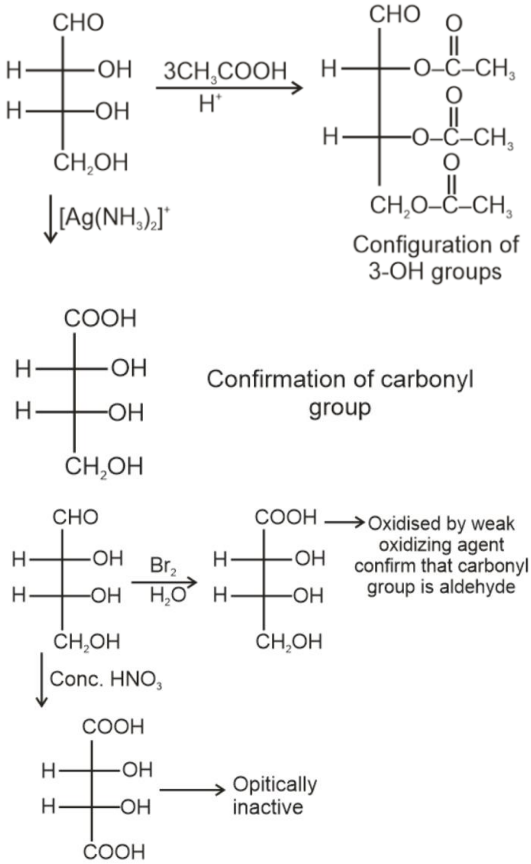
(1) 

(2) 

(3) 

(4) None of these

Sol. Answer (2)



15. Consider the following statement regarding Hoffman Bromamide degradation reaction.

Statement I : One alkyl (R) group migrates from carbonyl carbon to N-atom

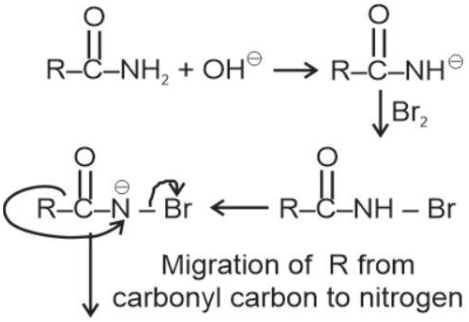
Statement-II : Migration of alkyl group takes place towards electron deficient N atom

The correct statements are

(1) Both (I) and (II) (2) Only (I)

(2) Only (II) (4) Neither (I) nor (II)

Sol. Answer (1)



$O = C = N–R$

Migration of R and removal of Br takes place simultaneously. As the Br start leaving, the nitrogen centre start becoming electron deficient as that moment alkyl group start migrating. So both statement are correct

16. Match the following

(a) Laundry soap filler	(i) Cetyltrimethyl ammonium bromide
(b) Hair conditioner	(ii) Non-ionic detergent
(c) Liquid dishwasher	(iii) Sodium dodecylbenzene sulphonate
(d) House-hold detergent	(iv) Na_2CO_3, sodium rosinate

Choose the correct

(1) a-iv, b-i, c-ii, d-iii (2) a-iii, b-iv, c-i, d-ii

(3) a-ii, b-iii, c-iv, d-i (4) a-ii, b-i, c-iii, d-iv

Sol. Answer (1)

Laundry soaps filler $\rightarrow$ Sodium rosinate (Na_2CO_3) i.e. (a) $\rightarrow$ (iv)

Hair conditioner $\rightarrow$ Cetyltrimethyl ammonium Bromide i.e. (b) $\rightarrow$ (i)

Liquid dishwasher $\rightarrow$ Non-ionic detergents i.e. (c) $\rightarrow$ (ii)

House-hold detergent → Sodium dodecylbenzene sulphonate i.e. (d) → (iii)

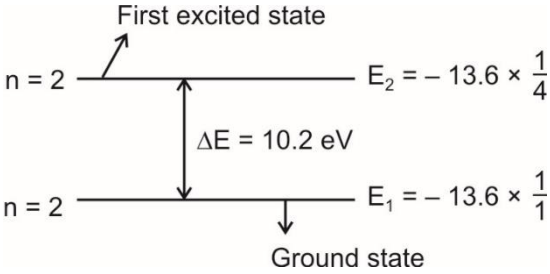
17. The change in angular momentum during transition of an electron from the ground state of H-atom. It is given that the electron absorb 10.2 eV energy during the transition from ground state to an excited state

(1) $\frac{h}{\pi}$ (2) $\frac{h}{2\pi}$

(3) $\frac{3h}{2\pi}$ (4) $\frac{2h}{\pi}$

Sol. Answer (2)

$$E_n = -13.6\frac{z^2}{n^2}eV$$



Angular momentum = $\frac{nh}{2\pi}$

Angular momentum in first shell = $1\times\frac{h}{2\pi}$

Angular momentum n 2nd shell = $2\times\frac{h}{2\pi}$

Change in angular momentum

$$= 2\times\frac{h}{2\pi} - \frac{h}{2\pi} = \frac{h}{2\pi}$$

18. $Fe_{0.93}O$ has metal deficiency defect. Calculate the percentage of Fe^{+2} ions in $Fe_{0.93}O$ compound. [Round off to nearest integer]

Sol. Answer (85.00)

Total Fe = 0.93

Let's assume Fe^{2+} = x

Then Fe^{3+} = 0.93 – x

Applying charge balance

x × (+ 2) + (0.93 – x) × (+3) + 1 × (–2) = 0

2x + 2.79 – 3x = 2

–x = 2 – 2.79

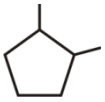
x = 0.79

$$\% \text{ of } Fe^{2+} = \frac{0.79}{0.93}\times 100$$

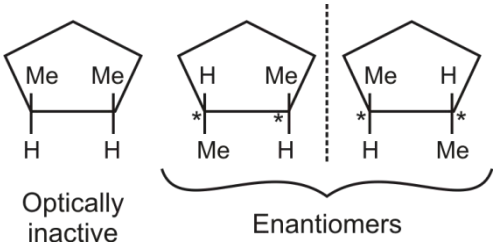
= 84.95%

≈ 85%

19. Find out the number of stereoisomers formed by



Sol. Answer (03.00)



Total no. of stereoisomers = 3

20. Find the spin only magnetic moment (in B.M) of Mn containing species which is formed by $KMnO_4$ in acidic medium.

[Round off to the nearest integer]

Sol. Answer (06.00)

In acidic medium $KMnO_4$ changes to Mn^{2+}

Mn = [Ar] $3d^5\ 4s^2$

Mn^{2+} = [Ar] $3d^5$

Mn^{2+} = | ↑ | ↑ | ↑ | ↑ | ↑ |

n = 5 (where n = no. of unpaired electrons)

spin only magnetic moment = $\sqrt{n(n+2)}$ B.M

$= \sqrt{5(5+2)}$ B.M

$= \sqrt{35}$ B.M

≈ 6 B.M

21. What is the molar conductivity of AgI at zero concentration if the Λ^∞ value of NaI, $AgNO_3$ and $NaNO_3$ are respectively $12\Omega^{-1}cm^2mol^{-1}$, $16\Omega^{-1}cm^2mol^{-1}$ and $10\Omega^{-1}cm^2mol^{-1}$.

Sol. Answer (18.00)

$$\Lambda^\infty_{AgI} = \Lambda^\infty_{AgNO_3} + \Lambda^\infty_{NaI} - \Lambda^\infty_{NaNO_3}$$

= 16 + 12 – 10

= $18\Omega^{-1}$ cm^2 mol^{-1}

22. Consider the following equilibrium,

$2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$

The reaction is started with 2 moles of NOCl in 1 litre closed container and allowed to attain equilibrium. At equilibrium, the moles of NO was found to be 0.4. The equilibrium constant (K_c) for the reaction is $x \times 10^{-3}$. Then the value of x is

Sol. Answer (12.50)

	$2NOCl(g)$	$\rightleftharpoons$	$2NO(g)$	+	$Cl_2(g)$
t = 0	2 moles		0		0
t = t	2-2a		2a		a

$2a = 0.4$ (because $n_{NO} = 0.4$)

$a = 0.2$

$$\therefore K_c = \frac{[NO]^2 [Cl_2]}{[NOCl]^2}$$

$$= \frac{(0.4)^2 \times 0.2}{(1.6)^2}$$

$$= \frac{1}{80} \quad \text{or } 12.5 \times 10^{-3}$$

$\therefore x = 12.5$

23. Calculate the wavelength (in A^0) of the radiation absorbed during transition of an electron from ground state of Li^{2+} to it's second excited state.

[Round off to the nearest integer]

Sol. Answer (114.00)

For Li^{2+}, z = 3

For ground state = $n_1 = 1$

Second Excited state = $n_2 = 3$

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

$$\frac{1}{\lambda} = R_H \times 3^2 \left[\frac{1}{1^2} - \frac{1}{3^2}\right]$$

$$\frac{1}{\lambda} = R_H \times 9 \left[\frac{9-1}{9}\right]$$

$$\frac{1}{\lambda} = 8R_H$$

$$\lambda = \frac{1}{8 \times R_H} = \frac{1}{8 \times 109677} \text{cm}$$

$$\lambda = 1.14 \times 10^{-6} \text{cm}$$

$$= 114 \times 10^{-8} \text{cm}$$

$$= 114 \overset{0}{\text{A}}$$

$$\lambda = 114 \overset{0}{\text{A}}$$

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