JEE MAIN 2024

Paper with Solution

Chemistry | 30th January 2024 _ Shift-1

SECTION – A

1. Given below are two statements :

Statements I : The gas liberated on warming a salt with dil H_2SO_4, turns a piece of paper dipped in lead acetate into black, it is a confirmatory test for sulphide ion.

Statements II : In statement-I the colour of paper turns black because of formation of lead sulphite.

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

(1) Both Statement I and Statement II are false

(2) Statement I is false but Statement II is true

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

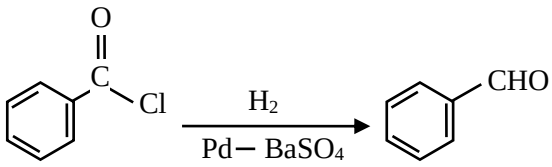
(4) Both Statement I and Statement II are true

Ans. **3**

$$Na_2S + H_2SO_4 \longrightarrow Na_2SO_4 + H_2S$$

$$(CH_3COO)_2Pb + H_2S \longrightarrow \underset{\text{Black lead sulphide}}{PbS} + 2CH_3COOH$$

2.



This reduction reaction is known as :

(1) Rosenmund reduction

(2) Wolff-Kishner reduction

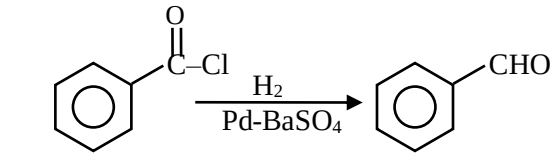
(3) Stephen reduction

(4) Etard reduction

Ans. **1**

Rosenmund reduction

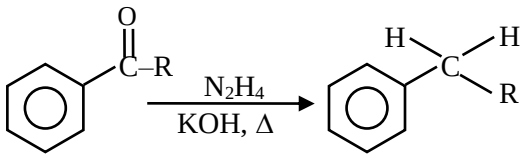
a)



Benzoyl chloride Benzaldehyde

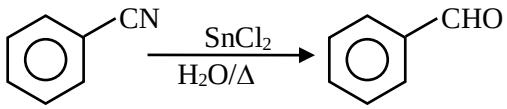
Wolff Kishner

b)



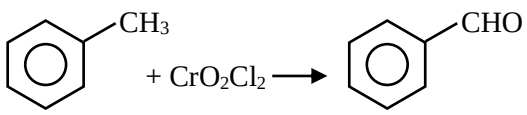
Stephen reduction

(c)



Etard reduction

(d)



3. Sugar which does not give reddish brown precipitate with Fehling's reagent is :

(1) Sucrose (2) Lactose (3) Glucose (4) Maltose

Ans. **1**

Sucrose is non reducing sugar and does not contain free aldehyde group thus does not give reddish brown ppt with fehling reagent.

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

Assertion (A) : There is a considerable increase in covalent radius from N to P. However from As to Bi only a small increase in covalent radius is observed.

Reason (R) : Covalent and ionic radii in a particular oxidation state increases down the group.

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

(1) (A) is false but (R) is true

(2) Both (A) and (R) are true but (R) is not the correct explanation of (A)

(3) (A) is true but (R) is false

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

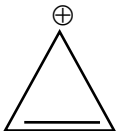
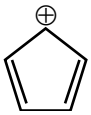
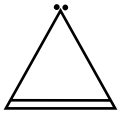
Ans. **2**

Statement – I Factual data

According to NCERT

Statement – II True

5. Which of the following molecule/species is most stable?

(1)  (2)  (3)  (4) 

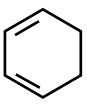
An.s **1**

Stability order Aromatic > Non Aromatic > Anti aromatic

(1) 
$2\pi\ e^-$
Huckel rule aromatic

(2) 
$4\pi\ e^-$
Anti aromatic

(3) 
Carbene

(4) 
Non aromatic

6. Diamagnetic Lanthanoid ions are :

(1) Nd^{3+} & Eu^{3+} (2) La^{3+} & Ce^{4+} (3) Nd^{3+} & Ce^{4+} (4) Lu^{3+} & Eu^{3+}

Ans. **2**

$Ce \rightarrow [Xe]\ 4f^1 5d^1 6s^2$

$Ce^{4+} \Rightarrow$ Diamagnetic

$La \rightarrow [Xe]\ 4f^0 5d^1 6s^2$

$La^{3+} \Rightarrow$ Diamagnetic

7. Aluminium chloride in acidified aqueous solution forms an ion having geometry :

(1) Octahedral (2) Square planar (3) Tetrahedral (4) Trigonal bipyramidal

Ans. **1**

$AlCl_3$ in acidified aqueous solution forms octahedral geometry $[Al(H_2O)_6]^{3+}$

8. Given below are two statements :

Statement (I) : The orbitals having same energy are called as degenerate orbitals.

Statement (II) : In hydrogen atom, 3p and 3d orbitals are not degenerate orbitals.

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

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

(2) Both Statement I and Statement II are true

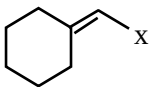
(3) Both Statement I and Statement II are false

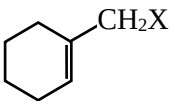
(4) Statement I is false but Statement II is true

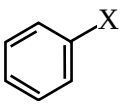
Ans. **1**

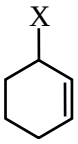
For single electron species the energy depends on principal quantum number(n) only so statement –II is false.

9. Example of vinylic halide is :

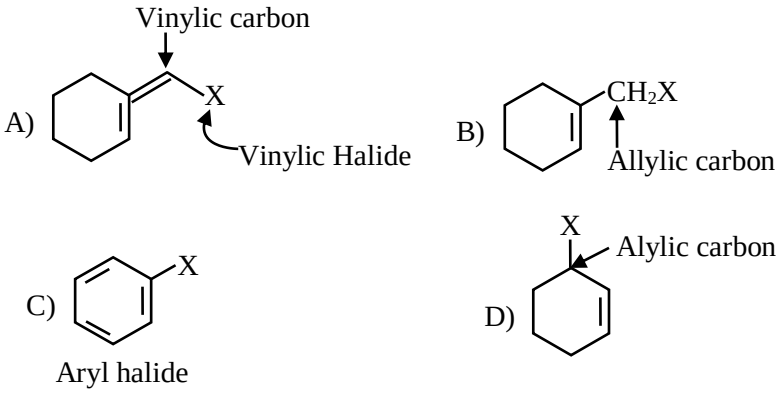
(1) 

(2) 

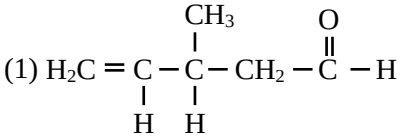
(3) 

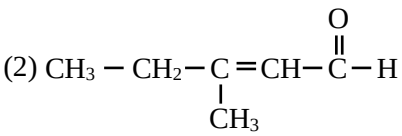
(4) 

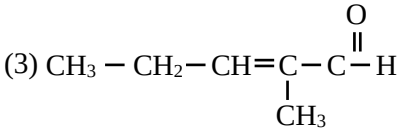
Ans. **1**

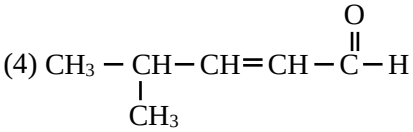


10. Structure of 4-Methylpent-2-enal is :

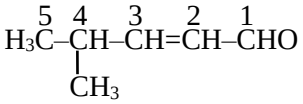
(1) 

(2) 

(3) 

(4) 

Ans. **4**



4-Methyl pent-2-enal

11. Match List – I with List – II.

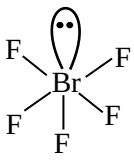
List – I	**List – II**
Molecule	**Shape**
(A) BrF_5	(I) T-shape
(B) H_2O	(II) See saw
(C) ClF_3	(III) Bent
(D) SF_4	(IV) Square pyramidal

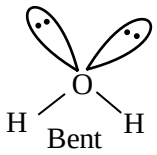
Choose the correct answer from the options given below :

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

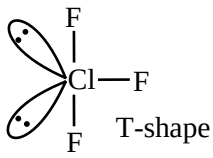
(3) (A) – (III), (B) – (IV), (C) – (I), (D) – (II) (4) (A) – (IV), (B) – (III), (C) – (I), (D) – (II)

Ans. **4**

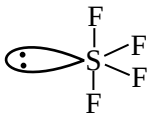
$BrF_5 \Rightarrow$  [Square pyramidal]

$H_2O \Rightarrow$ 

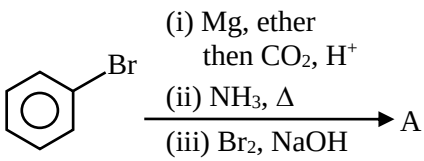
Bent

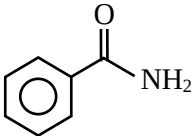
$ClF_3 \Rightarrow$ 

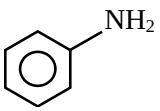
T-shape

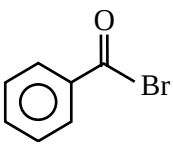
$SF_4 \Rightarrow$  [Sea–saw]

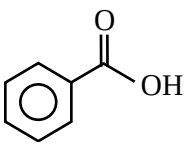
12. The final product A, formed in the following multistep reaction sequence is :



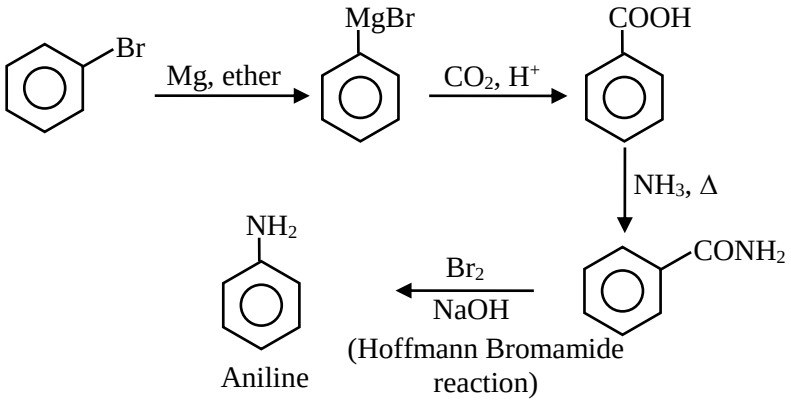
(1) 

(2) 

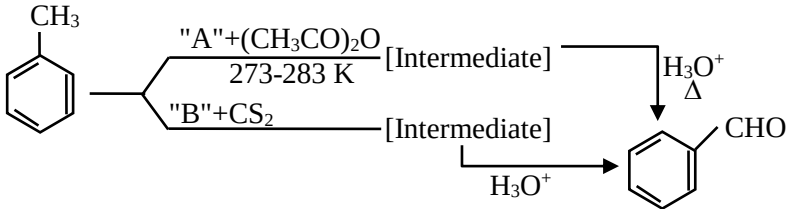
(3) 

(4) 

Ans. **2**

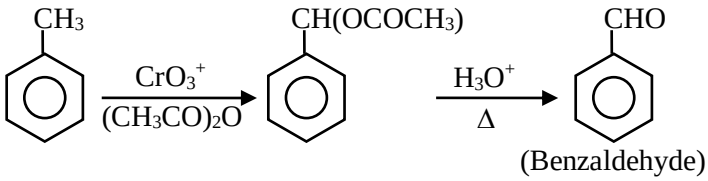


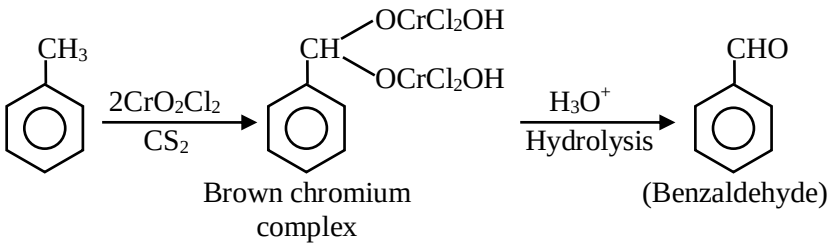
13. In the given reactions, identify the reagent A and reagent B.



(1) A-CrO_3 B-CrO_3
(2) A-CrO_3 B-CrO_2Cl_2
(3) A-CrO_2Cl_2 B-CrO_2Cl_2
(4) A-CrO_2Cl_2 B-CrO_3

Ans. **2**





14. Given below are two statements : one is labelled as Assertion (A) and the other is labelled Reason (R).
Assertion (A) : $CH_2=CH-CH_2-Cl$ is an example of allyl halide.
Reason (R) : Allyl halides are the compounds in which the halogen atom is attached to sp^2 hybridized carbon atom.
In the light of the above statements, choose the most appropriate answer from the options given below :
(1) (A) is true but (R) is false
(2) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(3) (A) is false but (R) is true
(4) Both (A) and (R) are true and (R) is the correct explanation of (A)

Ans. **1**
C = C–C–Cl is an example of allyl halide.
Allyl halide – Halogen atom is bonded to sp^3 hybridised carbon atom adjacent to C = C to an allyic carbon.

15. What happens to freezing point of benzene when small quantity of naphthalene is added to benzene?

(1) Increases (2) Remains unchanged

(3) First decreases and then increases (4) Decreases

Sol. **4**

When small amount of naphthalene is added to benzene, depression in freezing point takes place and freezing point of benzene decreases.

16. Match List I with List II :

List I (Species)		**List II (Electronic distribution)**	
A.	Cr^{+2}	I.	$3d^8$
B.	Mn^{+}	II.	$3d^3 4s^1$
C.	Ni^{+2}	III.	$3d^4$
D.	V+	IV.	$3d^5 4s^1$

Choose the correct answer from the options given below :

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

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

Ans. **2**

$Cr \rightarrow [Ar]3d^5 4s^1$, $Cr^{2+} \Rightarrow [Ar]3d^4$

$Mn \rightarrow [Ar]3d^5 4s^2$, $Mn^{+} \Rightarrow [Ar]3d^5 4s^1$

$Ni \rightarrow [Ar]3d^8 4s^2$, $Ni^{2+} \Rightarrow [Ar]3d^8$

$V \rightarrow [Ar]3d^3 4s^2$, $V^{+} \Rightarrow [Ar]\ 3d^3 4s^1$

17. Compound A formed in the following reaction reacts with B gives the product C. Find out A and B.

$$CH_3-C\equiv CH + Na \longrightarrow A \xrightarrow{B} \underset{(C)}{CH_3-C\equiv C-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH_2}}} + NaBr$$

(1) $A = CH_3-C\equiv \overset{-}{C}\overset{+}{Na}$, $B = CH_3-CH_2-CH_2-Br$

(2) $A = CH_3-CH=CH_2$, $B = CH_3-CH_2-CH_2-Br$

(3) $A = CH_3-CH_2-CH_3$, $B = CH_3-C\equiv CH$

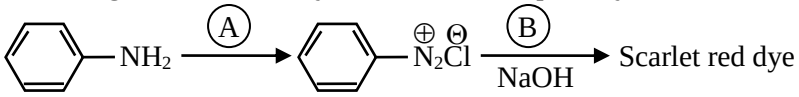
(4) $A = CH_3-C\equiv \overset{-}{C}\overset{+}{Na}$, $B = CH_3-CH_2-CH_3$

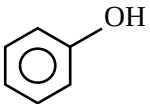
Ans. **1**

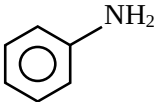
$CH_3–C \equiv CH + Na \longrightarrow CH_3–C \equiv C^-Na^+$ (A)

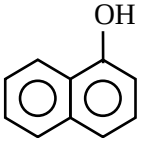
(A) $\xrightarrow{C–C–C–Br\ (B)}$ $C–C \equiv C–C–C–C + NaBr$

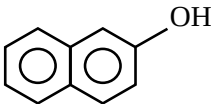
18. Following is a confirmatory test for aromatic primary amines. Identify reagent (A) and (B).



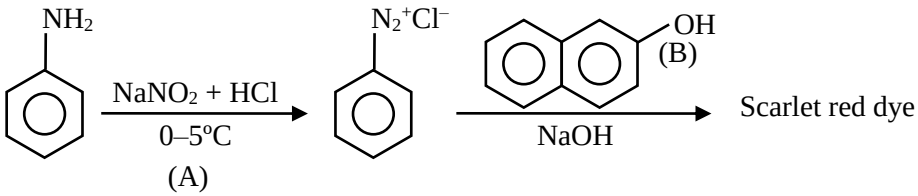
(1) A = HNO_3/H_2SO_4 B = 

(2) A = $NaNO_2$ + HCl, 0 – 5°C; B = 

(3) A = $NaNO_2$ + HCl, 0 – 5°C; B = 

(4) A = $NaNO_2$ + HCl, 0 – 5°C; B = 

Ans. **4**



19. The Lassiagne's extract is boiled with dil HNO_3 before testing for halogens because,

(1) AgCN is soluble in HNO_3 (2) Silver halides are soluble in HNO_3

(3) Ag_2S is soluble in HNO_3 (4) Na_2S and NaCN are decomposed by HNO_3

Ans. **4**

If Nitrogen or Sulphur is present in the compound the sodium Fusion extract is boiled with concentrate HNO_3 to decomposed sulphide or cyanide of sodium during lassiagne's test.

20. Choose the correct statements from the following :

(A) Ethane-1, 2-diamine is a chelating ligand.

(B) Metallic aluminium is produced by electrolysis of aluminium oxide in presence of cryolite.

(C) Cyanide ion is used as ligand for leaching of silver.

(D) Phosphine act as a ligand in Wilkinson catalyst.

(E) The stability constants of Ca^{2+} and Mg^{2+} are similar with EDTA complexes.

Choose the correct answer from the options given below :

(1) (B), (C), (E) only (2) (C), (D), (E) only (3) (A), (B), (C) only (4) (A), (D), (E) only

Ans. **3**

(A) (en) is chelating ligand (B) Fact (C) Fact

SECTION – B

21. The rate of First order reaction is 0.04 mol L^{-1} s^{-1} at 10 minutes and 0.03 mol L^{-1} s^{-1} at 20 minutes after initiatation. Half life of the reaction is _____ minutes. (Given log2 = 0.3010, log3 = 0.4771)

Ans. **24**

$r_1=K[A_1]$

$0.04 = K\,[A_1]$

$r_2=K[A_2]$

$0.03=K[A_2]$

$$\frac{A_1}{A_2}=\frac{0.04}{0.03}=\frac{4}{3}$$

let A_1 be the intial and A_2 be the final concentration after a given gap of 10 min

$$\text{then } K=\frac{2.303}{t}\log\left[\frac{A_1}{A_2}\right]$$

$$K=\frac{2.303}{10}\log\frac{4}{3}=2.855\times10^{-2}\ \text{min}^{-1}$$

$$\because t_{1/2}=\frac{0.693}{k}=\frac{0.693}{2.855\times10^{-2}}=24.08$$

= 24 min.

22. The pH at which $Mg(OH)_2$ [K_{sp}] = 1×10^{-11}] begins to precipitate from a solution containing 0.10 M Mg^{2+} ions is _____.

Ans. **9**

$[Mg^{2+}]\,[OH^-]^2 = K_{sp}$

$[0.1]\,[OH^-]^2 = 1\times10^{-11}$

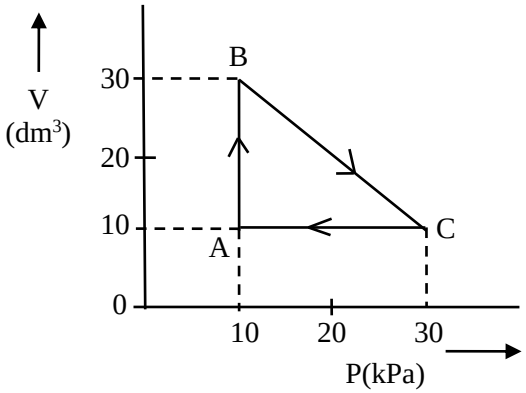
$[OH^-]=10^{-5}$ M

$P^{OH} = -\log(10^{-5})=5$

$pH=14-P^{OH}$

pH = 14–5=9

23.



An ideal gas undergoes a cyclic transformation starting from the point A and coming back to the same point by tracing the path A → B → C → A as shown in the diagram above. The total work done in the process is _____ J.

Ans. **200**

W = Area of ΔABC

$$= \frac{1}{2}(30-10)(30-10)$$

$$= \frac{1}{2} \times 20 \times 20$$

$$= \frac{400}{2} = 200J$$

24. If IUPAC name of an element is "Unununnium" then the element belongs to n^{th} group of Periodic table. The value of n is _____.

Ans. **11**

Atomic number $\rightarrow$ 111

Group No. $\rightarrow 11^{th}$

25. The total number of molecular orbitals formed from 2s and 2p atomic orbitals of a diatomic molecule is _____.

Ans. **8**

Two molecular orbital $\sigma 2s$ and $\sigma^* 2s$

six molecular orbital $\sigma 2pz$, $\sigma^* 2pz$ $\pi 2px$, $\pi^* 2px$, $\pi 2py$, $\pi^* 2py$

Total = 2 + 6 = 8

26. On a thin layer chromatographic plate, an organic compound moved by 3.5 cm, while the solvent moved by 5 cm. The retardation factor of the organic compound is _____ $\times 10^{-1}$.

Ans. **7**

R_f (retardation factor) = $\frac{\text{Distance travelled by solute}}{\text{Distance travelled by solvent}}$

$$= \frac{3.5}{5} = 0.7 = 7 \times 10^{-1}$$

27. The compound formed by the reaction of ethanal with semicarbazine contains _____ number of nitrogen atoms.

Ans. **3**

$CH_3–CHO + H_2N–NH\,CONH_2 \xrightarrow{H^+} CH_3–CH=N–NH\,CONH_2 + H_2O$

Ethanal — Semicarbazide — (Semicarbazone derivative)

28. 0.05 cm thick coating of silver is deposited on a plate of 0.05 m^2 area. The number of silver atoms deposited on plate are _____ $\times 10^{23}$. (At mass Ag = 108, d = 7.9 g cm^{-3})

Ans. **11**

Volume of Ag deposited = 0.05×10^4 $cm^2 \times 0.05$ cm

= 25 cm^3

Mass of Ag deposited = V×d

Number of Ag atom = $\frac{V \times d}{108} \times N_A$

$$= \frac{25 \times 7.9 \times 6.023 \times 10^{23}}{108}$$

$= 1.1 \times 10^{24}$

$= 11 \times 10^{23}$

29. $2MnO_4^- + bI^- + cH_2O \rightarrow xI_2 + yMnO_2 + z\overline{O}H$

If the above equation is balanced with integer coefficients, the value of z is _____.

Ans. **8**

$2\overset{+7}{Mn}o_4^- + b\overset{-1}{I^-} + cH_2O \rightarrow x\overset{o}{I_2} + y\overset{+4}{Mn}O_2 + zOH^-$

$n_f=3 \quad n_f = 1$

$2MnO_4^- + 6I^- + 4H_2O \longrightarrow 3I_2 + 2MnO_2 + 8OH^-$

30. The mass of sodium acetate (CH_3COONa) required to prepare 250 mL of 0.35 M aqueous solution is _____ g. (Molar mass of CH_3COONa is 82.02 g mol^{-1})

Ans. **7**

0.35 M $\Rightarrow$ 1000 ml Solution contains 0.35 mole of CH_3COONa

then 250 ml solution. contains $\frac{0.35}{1000} \times 250$ mole of CH_3COONa

$= 0.0875$ moles

Mass of $CH_3COONa = 0.0875 \times 82.02$

$= 7.17$ gm

$= 7$ gm

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