JEE (Main) CHEMISTRY SOLVED PAPER

2023

29th Jan. Shift 1

Section A

Q. 1. "A" obtained by Ostwald's method involving air oxidation of NH_3, upon further air oxidation produces "B". "B" on hydration forms an oxoacid of Nitrogen along with evolution of "A". The oxoacid also produces "A" and gives positive brown ring test.

Identify A and B, respectively.

(1) N_2O_3, NO_2 **(2)** NO_2, N_2O_4

(3) NO_2, N_2O_5 **(4)** NO, NO_2

Q. 2. Correct statement about smog is:

(1) Classical smog also has high concentration of oxidizing agents

(2) Both NO_2 and SO_2 are present in classical smog

(3) NO_2 is present in classical smog

(4) Photochemical smog has high concentration of oxidizing agents

Q. 3. The standard electrode potential (M^{3+}/M^{2+}) for V, Cr, Mn & Co are −0.26 V, −0.41 V, + 1.57 V and + 1.97 V, respectively. The metal ions which can liberate H_2 from a dilute acid are

(1) Mn^{2+} and Co^{2+} **(2)** Cr^{2+} and Co^{2+}

(3) V^{2+} and Cr^{2+} **(4)** V^{2+} and Mn^{2+}

Q. 4. The shortest wavelength of hydrogen atom in Lyman series is λ. The longest wavelength in Balmer series of He^+ is

(1) $\frac{36\lambda}{5}$ **(2)** $\frac{9\lambda}{5}$ **(3)** $\frac{5}{9\lambda}$ **(4)** $\frac{5\lambda}{9}$

Q. 5. The bond dissociation energy is highest for

(1) F_2 **(2)** Br_2 (3) I_2 **(4)** Cl_2

Q. 6. The increasing order of pK_a for the following phenols is

(A) 2, 4 – Dinitrophenol

(B) 4 – Nitrophenol

(C) 2, 4, 5 – Trimethylphenol

(D) Phenol

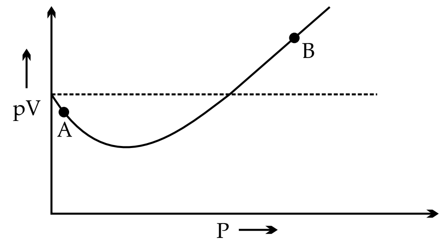
(E) 3 – Chlorophenol

Choose the correct answer from the option given below:

(1) (A), (B), (E), (D), (C) **(2)** (C), (D), (E), (B), (A)

(3) (A), (E), (B), (D), (C) **(4)** (C), (E), (D), (B), (A)

Q. 7. For 1 mol of gas, the plot of pV vs. p is shown below. p is the pressure and V is the volume of the gas



What is the value of compressibility factor at point?

(1) $1+\frac{a}{RTV}$ **(2)** $1-\frac{a}{RTV}$

(3) $1+\frac{b}{bV}$ **(4)** $1-\frac{b}{V}$

Q. 8. Match List I with List II.

List I Antimicrobials	List II Names
(A) Narrow Spectrum Antibiotic	(I) Furacin
(B) Antiseptic	(II) Sulphur dioxide
(C) Disinfectants	(III) Penicillin G
(D) Broad spectrum antibiotic	(IV) Chloramphenicol

Choose the correct answer from the options given below:

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

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

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

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

Q. 9. During the borax bead test with $CuSO_4$, a blue green colour of the bead was observed in oxidising flame due to the formation of

(1) CuO **(2)** $Cu(BO_2)_2$

(3) Cu_3B_2 **(4)** Cu

Q. 10. Which of the following salt solution would coagulate the colloid solution formed when $FeCl_3$ is added to NaOH solution, at the fastest rate?

(1) 10 mL of 0.1 mol dm^{-3} Na_2SO_4

(2) 10 mL of 0.2 mol dm^{-3} $AlCl_3$

(3) 10 mL of 0.1 mol dm^{-3} $Ca_3(PO_4)_2$

(4) 10 mL of 0.15 mol dm^{-3} $CaCl_2$

Q. 11. Number of cyclic tripeptides formed with 2 amino acids A and B is:

(1) 5 **(2)** 2 (3) 4 (4) 3

Q. 12. The correct order of hydration enthalpies is

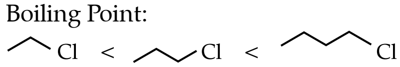
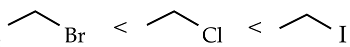
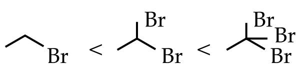
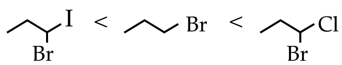
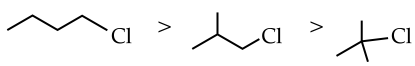
(A) K^+ **(B)** Rb^+ (C) Mg^{2+} (D) Cs^+

(E) Ca^{2+}

Choose the correct answer from the options given below:

(1) E > C > A > B > D **(2)** C > A > E > B > D
(3) C > E > A > D > B **(4)** C > E > A > B > D

Q. 13. Chiral complex from the following is:
Here en = ethylene diamine
(1) cis $^-[PtCl_2(en)_2]^{2+}$
(2) trans $-$ $[PtCl_2(en)_2]^{2+}$
(3) cis $-$ $[PtCl_2(NH_3)_2]$
(4) trans $-$ $[Co(NH_3)_4Cl_2]^+$

Q. 14. Identify the correct order for the given property for following compounds.
(A) Boiling Point:

(B) Density:

(C) Boiling Point:

(D) Density:

(E) Boiling Point:


Choose the correct answer from the option given below:
(1) (B), (C) and (D) only
(2) (A), (C) and (D) only
(3) (A), (B) and (E) only
(4) (A), (C) and (E) only

Q. 15. The magnetic behavior of Li_2O,Na_2O_2 and KO_2, respectively, are
(1) Paramagnetic, paramagnetic and diamagnetic
(2) diamagnetic, paramagnetic and diamagnetic
(3) paramagnetic, diamagnetic and paramagnetic
(4) diamagnetic, diamagnetic and paramagnetic

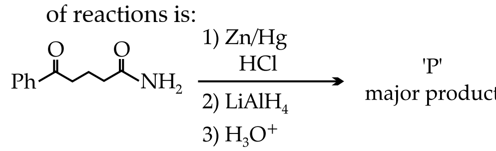
Q. 16. The reaction representing the Mond process for metal refining is__________
(1) ZnO $ZnO + C \xrightarrow{\Delta} Zn + CO$
(2) $Zr + 2I_2 \xrightarrow{\Delta} ZrI_4$
(3) $2\,K[Au(CN)_2] + Zn \xrightarrow{\Delta} K_2[Zn(CN)_4] + 2Au$
(4) $Ni + 4CO \xrightarrow{\Delta} Ni(CO)_4$

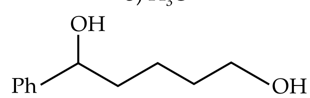
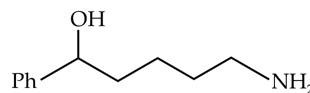
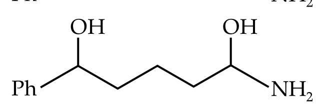
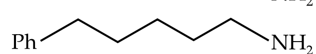
Q. 17. Which of the given compounds can enhance the efficiency of hydrogen storage tank?
(1) Di – isobutylaluminium hydride
(2) $NaNi_5$
(3) Li/P_4
(4) SiH_4

Q. 18. Match List I with List II.

List I Reaction	List II Reagents
(A) Hoffmann Degradation	(I) Conc.KOH,
(B) Clemensen reduction	(II) $CHCl_3$,NaOH/ $H_3O^+O^{\oplus}$
(C) Cannizaro reaction	(III) Br_2,NaOH
(D) Reimer – Tiemann Reaction	(IV) Zn – Hg/HCl

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

Q. 19. The major product 'P' for the following sequence of reactions is:


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

Q. 20. Compound that will give positive Lassaigne's test for both nitrogen and halogen is:
(1) $NH_2OH.HCl$ **(2)** $CH_3NH_2.HCl$
(3) NH_4Cl **(4)** $N_2H_4.HCl$

Section B

Q. 21. Millimoles of calcium hydroxide required to produce 100 mL of the aqueous solution of pH 12 is $x \times 10^{-1}$. The value of x is_______(Nearest integer).
Assume complete dissociation.

Q. 22. Water decomposes at 2300 K

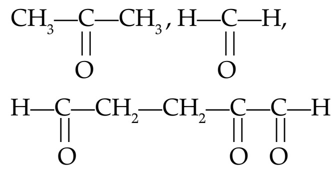
$$H_2O\,(g) \rightarrow H_2\,(g) + \frac{1}{2}O_2\,(g)$$

The percent of water decomposing at 2300 K and 1 bar is_______(Nearest integer).
Equilibrium constant for the reaction is 2×10^{-3} at 2300 K.

Q. 23. The sum of bridging carbonyls in $W(CO)_6$ and $Mn_2(CO)_{10}$ is_______.

Q. 24. Solid Lead nitrate is dissolved in 1 litre of water. The solution was found to boil at 100.15°C. When 0.2 mol of NaCl is added to the resulting solution, it was observed that the solution froze at $-0.8\,^0C$. The solubility product of $PbCl_2$ formed is_____$\times 10^{-6}$ at 298 K. (Nearest integer)
(Given: $K_b = 0.5$ K kgmol^{-1} and $K_f = 1.8$ K kg mol^{-1}. Assume molality to be equal to molarity in all cases.)

Q. 25. 17mg of a hydrocarbon (M.F. $C_{10}H_{16}$) takes up 8.40 mL of the H_2 gas measured at 0°C and 760 mm of Hg. Ozonolysis of the same hydrocarbon yields



The number of double bond/s present in the hydrocarbon is_______

Q. 26. Consider the following reaction approaching equilibrium at 27°C and 1 atm pressure

$$A + B \underset{k_r = 10^2}{\overset{K_f = 10^3}{\rightleftharpoons}} C + D$$

The standard Gibb's energy change ($\Delta_r G^\theta$) at 27°C is (–) ______ kJ mol^{-1}

(Nearest integer).

(Given: R = 8.3 J K^{-1} mol^{-1} and ln 10 = 2.3)

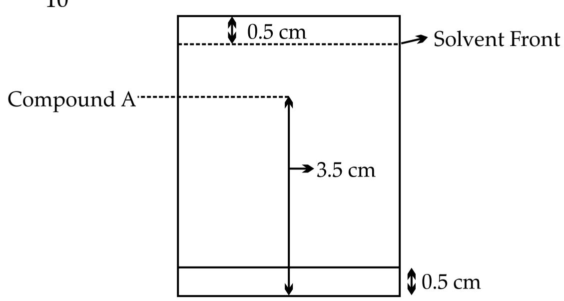
Q. 27. The number of molecules or ions from the following, which do not have odd number of electrons are______

(A) NO_2 **(B)** ICl_4^- (C) BrF_3 (D) ClO_2

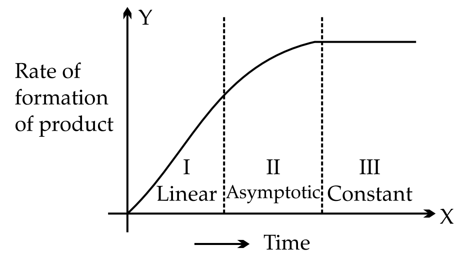
(E) NO_2^+ **(F)** NO

Q. 28. Following chromatogram was developed by adsorption of compound 'A' on a 6 cm TLC glass plate.

Retardation factor of the compound 'A' is ______ × 10^{-1}



Q. 29. For certain chemical reaction $X \rightarrow Y$, the rate of formation of product is plotted against the time as shown in the figure. The number of correct statement/s from the following is_____



(A) Over all order of this reaction is one

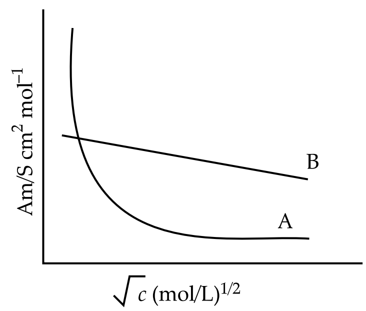
(B) Order of this reaction can't be determined

(C) In region I and III, the reaction is of first and zero order respectively

(D) In region – II, the reaction is of first order

(E) In region – II, the order of reaction is in the range of 0.1 to 0.9.

Q. 30. Following figure shows dependence of molar conductance of two electrolytes on concentration. Λ m is the limiting molar conductivity.



The number of incorrect statement(s) from the following is________

(A) Λ m for electrolyte A is obtained by extrapolation

(B) For electrolyte B, Λm vs $\sqrt{c}$ graph is a straight line with intercept equal to Λ m

(C) At infinite dilution, the value of degree of dissociation approaches zero for electrolyte B.

(D) Λ m for any electrolyte A or B can be calculated using λ° for individual ions

Answer Key

Q. No.	Answer	Topic Name	Chapter Name
1	(4)	Ostwald process	P block
2	(4)	Smog formation	Environmental chemistry
3	(3)	Standard electrode potential	Electro chemistry
4	(2)	Hydrogen spectrum	Structure of atom
5	(4)	Bond energy	P block
6	(1)	Acidic nature of phenol	Alcohol ether and phenol
7	(2)	Compressibility factor	States of matter
8	(4)	Classification of drugs	Chemistry in every day life
9	(2)	Borax bead test	Qualitative analysis
10	(2)	Coagulation value	Surface chemistry
11	(3)	Number of cyclic peptides	Biomolecules
12	(4)	Hydration enthalpy	S block
13	(1)	Chiral complex	Coordination chemistry

14	**(4)**	Physical properties of halo Alkane	Alkyl and aryl halides
15	**(4)**	Magnetic substances of metal oxides	S block
16	**(4)**	Refining of metals	Metallurgy
17	**(2)**	Efficiency of hydrogen	Hydrogen
18	**(1)**	Mixed name reaction	Amines, aldehyde and ketones
19	**(4)**	Clemmensen reduction	Aldehyde and ketone
20	**(2)**	Lassaigne test	Qualitative analysis
21	**[5]**	pH of the solution	Ionic equilibrium
22	**[2]**	Percentage dissociation	Equilibrium
23	**[0]**	Carbonyl compounds	Coordination chemistry
24	**[13]**	Solubility products	Ionicequilibrium
25	**[3]**	Ozonolysis of organic compounds	Hydrocarbons
26	**[6]**	Standard Gibbs energy change	Thermodynamics
27	**[3]**	Number of electrons in a molecule	Chemical bonding
28	**[6]**	Chromatography technique	General organic chemistry
29	**[1]**	Order of reaction.	Chemical kinetics
30	**[2]**	Limiting molar conductivity	Electrochemistry

Solutions

Section A

1. **Option (4) is correct.**

In an ostwald process, formation of nitric acid takes place.

The formation of nitric acid takes place via following steps

(1) $4NH_3 + 5O_2 \rightarrow \underset{(A)}{4\,NO} + 6H_2O$

(2) $\underset{(A)}{2NO} + O_2 \rightarrow \underset{(B)}{2NO_2}$

(3) $3NO_2 + H_2O \rightarrow 2HNO_3 + \underset{(A)}{NO}$

2. **Option (4) is correct.**

Classical smog contain smoke, fog and SO_2 smog and it is known as reducing smog because here SO_2 acts as reducing agent.

Similarly NO_2 is produced when NO and O_3 reacts together in presence of sunlight.

Photochemical smog has high concentration of oxidizing agent. Therefore it is also known as oxidising smog. The main components result from the action of sunlight on unsaturated hydrocarbon & nitrogen oxides produced by automobile & factories.

3. **Option (3) is correct.**

Given	Element	$E^{o}_{\frac{M^{3+}}{M^{2+}}}$
	V	– 0. 26 V
	Cr	– 0. 41 V
	Mn	+ 1. 57 V
	Co	+ 1. 97 V

We know that,

The metal ion which have less value of standard reduction potential can easily releases H_2 gas on reaction with dilute acid.

Here the value of V^{2+} and Cr^{2+} are – 0. 26 V and – 0. 41V respectively which is less compared to the standard reduction potential of H_2, so both ion are capable of releasing H_2 gas on reaction with dilute acid.

4. **Option (2) is correct.**

Formula wed

$$\bar{\upsilon} = \frac{1}{\lambda} = R_H \times Z^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Where Z = atomic number

n_1 = Lower energy state

n_2 = Higher energy state

R_H = Rydberg constant

For Lyman series (shortest wavelength)

$n_1 = 1, n_2 = \infty$

For H: $\frac{1}{\lambda} = R_H \times 1^2\left(\frac{1}{1^2} - \frac{1}{\infty^2}\right)$ ...(i)

For Balmer series (longest wavelength)

$n_1 = 2, n_2 = 3$

For He^+: $\frac{1}{\lambda} = R_H \times 2^2\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$ ...(ii)

From i & ii

$$\frac{\lambda_{He^+}}{\lambda_H} = \frac{9}{5} \text{ or } \lambda_{He^+} = \frac{9\lambda}{5}$$

5. **Option (4) is correct.**

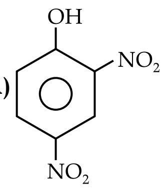
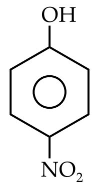
The decreasing order of bond energy of halogen is as follows

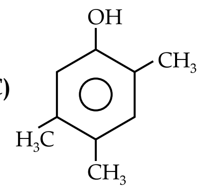
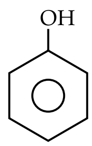
$Cl_2 > Br_2 > F_2 > I_2$

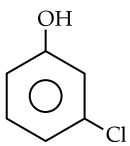
The general trend of bond energy is that it decreases down the groups due to increases in atomic sige. but The bond energy of F_2 is less than Cl_2 due to lone pair – lone pair repulsion because the size of fluorine atom is very small as compared to chlorine atom.

6. Option (1) is correct.

The Structure of the given phenol is

(A)  (B) 

(C)  (D) 

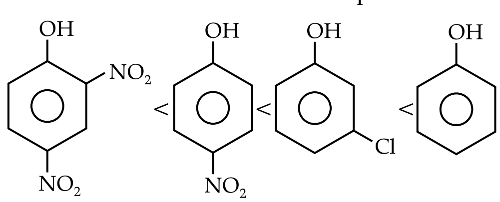
(E) 

Here $-NO_2$ and $-Cl$ are e^- (withdrawing) group which decreases the e^- density of benzene ring while $-CH_3$ is e^- donating group which increases the e^- density of benzene ring.

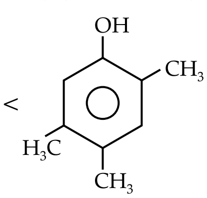
e^- donating group decreases the acidic nature while the e^- withdrawing group increases the acidic nature.

The relation between acidic nature and the value of pka is as follows –

Strength of acidic nature $\propto$ Ka $\propto \dfrac{1}{\text{pka}}$



(A) (B) (C) (D)

< 

(E)

7. Option (2) is correct.

For 1 more of gas

$Z = \dfrac{PV}{RT}$ Z represent compressibility factor

In the given graph, point A represent low pressure and high volume.

From Vander waal gas equation.

$$\left(P+\frac{an^2}{V^2}\right)(V - nb)= nRT$$

At point A, V is very high $\therefore$ b Can be neglected.

For one more equation can be represented as-

$$\left(P+\frac{a}{V^2}\right)(V)= RT$$

$$P v + \frac{a}{V} = RT$$

Divide whole eq^n by RT

$$\frac{PV}{RT} + \frac{a}{RTV} = \frac{RT}{RT}$$

$$Z + \frac{a}{RTV} = 1$$

Or $\quad Z = 1 - \dfrac{a}{RTV}$

8. Option (4) is correct.

	Antimicrobial		Names
A.	Narrow Spectrum Antibiotic	III.	Penicillin–G
B.	Antiseptic	I.	Furacin
C.	Disinfectants	II.	Sulphur dioxide
D.	Broad Spectrum antibiotic	IV.	Chloramphenicol

9. Option (2) is correct.

Borax bead test is an example of dry test in which metal ion reacts with a sample of borax ($Na_2B_4O_7.10H_2O$) which gives characteristics colour beads.

$$Na_2B_4O_7 \xrightarrow{\Delta} 2NaBO_2 + B_2O_3$$

$$CuSO_4 \xrightarrow{\Delta} CuO + SO_3$$

$$CuO + B_2O_3 \rightarrow Cu(BO_2)_2$$

Copper (II) metaborate (blue–green color)

10. Option (2) is correct.

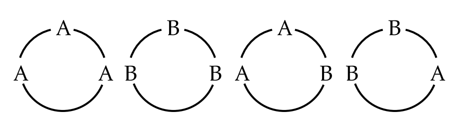
When $FeCl_3$ is added to NaOH solution formation of negatively charged sol takes place.

$FeCl_3 + NaOH \rightarrow Fe(OH)_3/OH^-$

The precipitation / coagulation of above negatively charged sol mainly takes place in the presence of positive ion and it can be done at faster rate when number of positive charge on ion is maximum $\therefore$ 10ml of 0.2 mol dm^{-3} $AlCl_3$ coagulate at faster rate.

11. Option (3) is correct.

The Possible number of cyclic tripeptides formed with this amino acid A and B are as follow



12. Option (4) is correct.

When an ion dissolves into water, then the ion is surrounded with water molecule via ion dipole interaction, this phenomenon is known as hydration and the energy released is known as hydration energy,

The magnitude of hydration energy depends on the following factor

Size of ion $\propto \frac{1}{\text{hydration energy}}$

Number of charges $\propto$ Hydration energy.

Among the given ions Mg^{2+} having smallest size and high charge density while Cs^{+} having largest size and the less charge density.

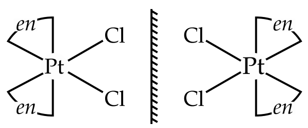
The correct order of hydration enthalpies is–

$Mg^{2+} > Ca^{2+} > K^{+} > Rb^{+} > Cs^{+}$

(C) (E) (A) (B) (D)

13. Option (1) is correct.

Chiral complex are those complex which have non (superimposable) mirror images and form optically active molecule



cis – $[Pt\,Cl_2\,(en)_2]^{2+}$ is an optically active molecule.

14. Option (4) is correct.

The boiling point alkyl halide depends on the following factor–

(a) Size of halogen atom

Boiling point $\propto$ size of halogen atom

(b) Mass of halogen atom

Boiling point $\propto$ mass of halogen atom

(c) Number of halogen atom

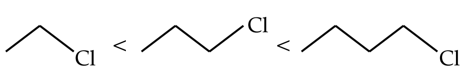
Boiling point $\propto$ Number of halogen atom

(d) Branching

Boiling point $\propto \frac{1}{\text{Branching}}$

(e) Number of C–atom in main chain.

Boiling point $\propto$ No of c–atom in main chain Order (A) is correct order, where number of C-atom increases in a main chain



Order (B) is correct, the density of alkyl halide increases with the mass of halogen atom and size of main chain.

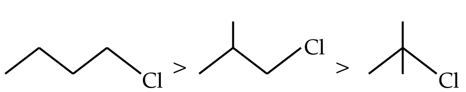
Order (C) is correct.

Boiling point $\propto$ No. of halogen atom.

Order (D) is incorrect the density of alkyl halide increases with the mass of halogen atom and size of main chain.

Order (E) is correct

Boiling point $\propto \frac{1}{\text{Branching}}$



15. Option (4) is correct.

Species	Ionic species	Number of unpaired e^-	$\boxed{\text{Magnetic Nature}}$
Li_2O	O^{2-}	0	Diamagnetic
Na_2O_2	O_2^{2-}(Peroxidide)	0	Diamagnetic
KO_2	O_2^{-} (Superoxide)	1	Paramagnetic

16. Option (4) is correct.

Mond process is an example of vapour phase refining in which metal is converted into its volatile compound & collected elsewhere when then decomposed to give pure metal,

Here, nickel is heated in a stream of carbon monoxide (CO) to form volatile complex, nickel tetracarbonyl

$Ni + 4CO \xrightarrow{330\text{-}350K} Ni(CO)_4$

The carbonyl is subjected to higher temperature so it is decomposed to give pure metal

$Ni(CO)_4 \xrightarrow{450\text{-}470K} Ni + 4CO$

17. Option (2) is correct.

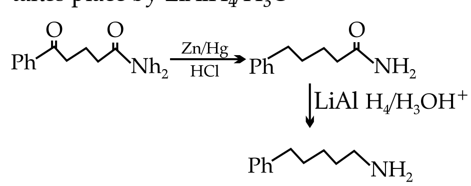
H_2 gas is converted into liquid state by cooling to 20 K, it would require expensive insulated tanks of metal alloy like $NaNi_5$, Ti–Ti H_2, Mg– MgH_2 etc.

18. Option (1) is correct.

	Reaction		Reagent used
A.	Hofmann degradation	III.	$Br_2/NaOH$
B.	Clemensen reduction	IV.	Zn–Hg/HCl
C.	Cannizaro reaction	I.	conc. KOH, Δ
D.	Reimer – Tiemann reaction	II.	$CHCl_3$, $NaOH / H_3O^{+}$

19. Option (4) is correct.

The reduction of carbonyl group takes place via Zn–Hg/ HCl while reduction of amide ($-CONH_2$) group takes place by $LiAlH_4/H_3O^{+}$



20. Option (2) is correct.

Lassaigne's test is used for The detection of N, sand heloged in an organic compound.

CH_3NH_2.HCl gives positive Lassaigne's test for both nitrogen and halogen.

$CH_3NH_2.\,HCl \xrightarrow[\text{Fusion}]{Na} NaCN + NaCl$

NaCN gives positive test for nitrogen while Nacl give positive test for halogen.

Section B

21. The correct answer is [5].

Given pH = 12

From pH + pOH = 14

POH = 14–12 = 2

POH = –log $[OH^-]$

$[\overline{O}H] - 10^{-2}$ N

$$\text{Molarity of } Ca(OH)_2 = \frac{\text{Normality}}{Vf}$$

$$= \frac{10^{-2}}{2} = 5 \times 10^{-3} \text{ M}$$

molarity of $Ca(OH)_2$ = moles of $Ca(OH)_2$

moleo of $Ca(OH)_2 = 5\times10^{-3}$ M

millimoles of Ca $(OH)_2 = 5\times10^{-3}\times 1000$

= 5 millimoles

In 1000 mL, Millimoles of $Ca(OH)_2$ = 5 mmol

So 100 mL, millimoles of $Ca(OH)_2 = \dfrac{5\times100}{1000}$

= 0. 5

$\approx 5 \times 10^{-1}$ mmol

22. The correct answer is [2].

Let the degree of dissociation be x and the initial pressure = 1 bar

$$H_2O_{(g)} \rightleftharpoons H_{2(g)} + \frac{1}{2}O_{2(g)}$$

Initial (bar)	1	–	–
Equilibrium (bar)	$1-x$	x	$\frac{x}{2}$

$$K_P = \frac{(P_{H_2})(P_{O_2})^{\frac{1}{2}}}{P_{H_2O}}$$

$$2\times10^{-3} = \frac{x\times\left(\frac{x}{2}\right)^{\frac{1}{2}}}{(1-x)}$$

As $\quad 1-x \approx 1$

So $\quad 2\times10^{-3} = \dfrac{x\times\sqrt{x}}{\sqrt{2}}$

On Solving $x = 2\times10^{-2}$

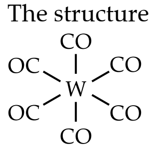
Percent dissociation = $x \times 100\%$

$= 2\times10^{-2}\times 100$

$= 2\%$

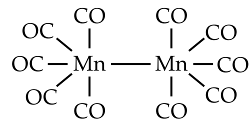
23. The correct answer is [0].

The structure of W $(CO)_6$



Number of bridge CO = zero (0)

The structure of Mn_2 $(CO)_{10}$



Number of bridge CO = Zero (0)

The sum of bridging carbonyl in W $(CO)_6$ and $Mn_2(CO)_{10}$ are zero.

24. The correct answer is [13].

$PbCl_2$ is a sparingly soluble salt where solubility decreases on addition of strong electrolyte $Pb(NO_3)_2$ due to common ion effect.

Let x mole $Pb(NO_3)_2$ is added.

$Pb(NO_3)_2 \rightarrow Pb^{2+} + 2NO_3^-$

From $\Delta T_b = K_b m$

$\Delta T_b = 0.15 \; K_b = 0.5$

$$m = \frac{3x \text{ mole}}{1L} = 3x$$

$0.15 = 3x \times 0.5$

$0.15 = 1.5x$

$$x = \frac{0.15}{1.5} = 0.1$$

Given 0.2 mole NaCl

$NaCl \rightarrow Na^+ + Cl^-$

0.2

Now for $PbCl_2$

$Pb^{2+} + 2Cl^- \rightarrow PbCl_{2(s)}$

0.1 0. 2

t=0

t=∞ $\quad 0.1-x \quad 0.2-2x$

In the Final Solution

$\Delta T_f = K_f m$

$$0.8 = 1.8 \times \left[\frac{0.3-3x+0.2+0.2}{1}\right]$$

$$x = \frac{2.3}{27}$$

$[Pb^{2+}] = 0.1 - [Cl^-] = 0.2 - 2\times\dfrac{2.3}{27}$

$K_{SP} = [Pb^{2+}][Cl^-]^2$

$$K_{Sp} = \left(0.1-\frac{2.3}{27}\right)\left(0.2-\frac{4.6}{27}\right)^2 = 13\times10^{-6}$$

$K_{Sp} = 13\times10^{-6}$

25. The correct answer is [3].

Molar Mass of Hydrocarbon = 10 (C) × 12 + 16 (H) × 1

= 120 + 16 = 136 g

Mass of hydrocarbon = 17 mg

$= 17\times10^{-3}$ g

Number of moles of Hydrocarbon

$$(\text{M. F.} = C_{10}H_{16}) = \frac{\text{mass}}{\text{Molar Mass}}$$

$$= \frac{17\times10^{-3}\text{g}}{136} = 1.25\times10^{-4}$$

Moles of H_2 gas can be calculated by using ideal gas equation

$PV = nRT$

$P = 760mmHg = 1atm$

$V = 8.40\ mL = 8.4 \times 10^{-3}\ L$

$T = 0^0C = 273\ K$

$R = 0.0821\ \dfrac{L \times atm}{K \times mol}$

$n = \dfrac{PV}{RT} = \dfrac{1atm \times 8.4 \times 10^{-3}L}{0.0821\dfrac{L \times atm}{Kmol} \times 273K}$

$n = 3.75 \times 10^{-4}$ mole

$$\text{No. of double bond} = \frac{\text{No of mol of } H_2}{\text{No. of moe of hydrocarbon}}$$

$$= \frac{3.75 \times 10^{-4}}{1.25 \times 10^{-4}} = 3$$

26. The correct answer is [6].

From $\Delta G^0 = -2.303\ RT\ logK$

$$K = \frac{K_f}{K_b}$$

Given $K_f = 10^3$ $K_b = 10^2$

$$K = \frac{10^3}{10^2} = 10$$

$\Delta G^0 = -2.303RT\ log\ K$

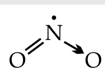
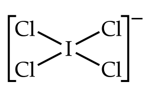
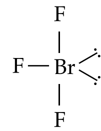
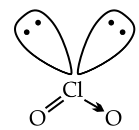
$= -2.303 \times 8.314 \times 300 \times log\ 10$

$= -5744$ J/mol

$\Delta G^0 \approx -5.744$ kJ/mol

$\Delta G^0 \approx -6$ kJ/mol

27. The correct answer is [3].

Species	Structure	No. of Odd e^-
NO_2		1
ICl_4^-		0
BrF_3		0
ClO_2		1
NO_2	$O = \overset{\oplus}{N} \rightarrow O$	0
NO	$:\dot{N} = O$	1

From the given species ICl_4^-, BrF_3 and $NO_2^{\oplus}$ do not have odd number of e^-.

28. The correct answer is [6].

$$R_f = \frac{\text{Distance moved by the substance from base line}}{\text{Distance moved by solvent from baseline}}$$

$$= \frac{3.0\,cm}{5.0\,cm} = 0.6 \approx 6 \times 10^{-1}$$

29. The correct answer is [1].

In region I and II, slope of the graph is positive, So the reaction has a nagative order.

In region III, slope of the graph is zero, So the order of the reaction is zero.

$\therefore$ Order of the reaction can't be determind.

30. The correct answer is [2].

Statement (A) is incorrect.

$\wedge_M^0$ for electrolyte (A) can't be obtained by extrapolation.

Statement (C) is incorrect.

At infinite dilution, the value of degree of dissociation cannot approaches zero for electrolyte B.

At infinite dilution, the degree of dissociation of each & every electrolyte approaches to 100% and they behave as strong electrolyte.