Section A

Q. 1. Lithium aluminium hydride can be prepared from the reaction of
(1) LiH and $Al(OH)_3$
(2) LiH and Al_2Cl_6
(3) LiCl and Al_2H_6
(4) LiCl,Al and H_2

Q. 2. Amongst the following compounds, which one is an antacid?
(1) Terfenadine
(2) Meprobamate
(3) Brompheniramine
(4) Ranitidine

Q. 3. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A) : In expensive scientific instruments, silica gel is kept in watch – glasses or in semipermeable membrane bags.
Reason (R) : Silica gel adsorbs moisture from air via adsorption, thus protects the instrument from water corrosion (rusting) and / or prevents malfunctioning.
In the light of the above statements, choose the correct answer from the options given below:
(1) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(2) (A) is false but (R) is true
(3) Both (A) and (R) are true and (R) is the correct explanation of (A)
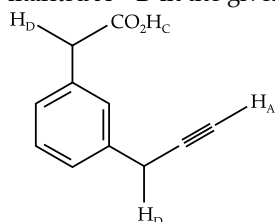(4) (A) is true but (R) is false

Q. 4. Match List I with List II:

LIST I (Atomic number)		LIST II (Block of periodic table)	
A.	37	I.	p – block
B.	78	II.	d – block
C.	52	III.	f – block
D.	65	IV.	s – block

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

Q. 5. What is the correct order of acidity of the protons marked A – D in the given compounds ?
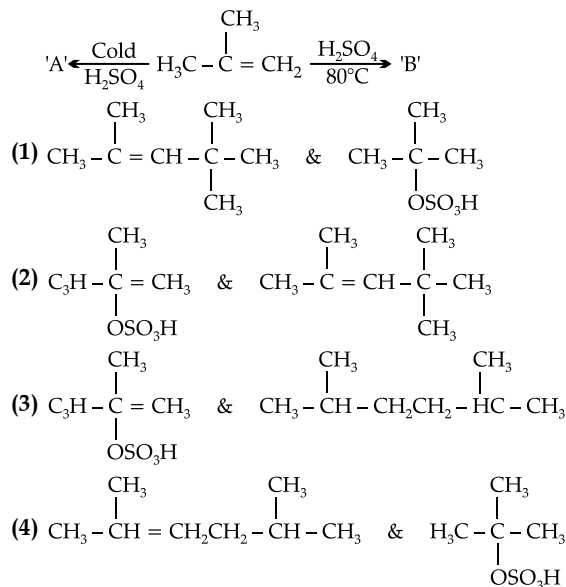

(1) $H_C > H_A > H_D > H_B$
(2) $H_D > H_C > H_B > H_A$
(3) $H_C > H_D > H_B > H_A$
(4) $H_C > H_D > H_A > H_B$

Q. 6. Which of the following compounds would give the following set of qualitative analysis?
(i) Fehling's Test: Positive
(ii) Na fusion extract upon treatment with sodium nitroprusside gives a blood red colour but not prussian blue.
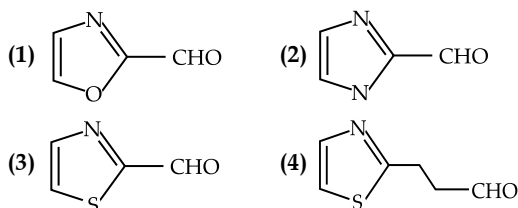
Q. 7. The major products ' A' and ' B ', respectively, are

Q. 8. During the qualitative analysis of SO_3^{2-} using dilute H_2SO_4, SO_2 gas is evolved which turns $K_2Cr_2O_7$ solution (acidified with dilute H_2SO_4):
(1) green
(2) blue
(3) red
(4) black

Q. 9. In the wet tests for identification of various cations by precipitation, which transition element cation doesn't belong to group IV in qualitative inorganic analysis?
(1) Ni^{2+}
(2) Zn^{2+}
(3) Co^{2+}
(4) Fe^{3+}

Q. 10. For OF_2 molecule consider the following:
A. Number of lone pairs on oxygen is 2.
B. FOF angle is less than 104.5°.
C. Oxidation state of O is −2.
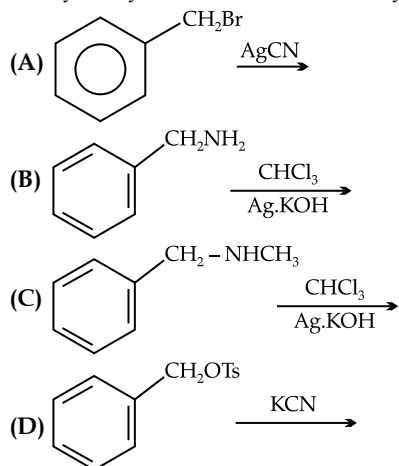D. Molecule is bent ' V ' shaped.
E. Molecular geometry is linear.
Correct options are:
(1) A, C, D only
(2) C, D, E only
(3) A, B, D only
(4) B, E, A only

Q. 11. Caprolactam when heated at high temperature in presence of water, gives
(1) Nylon 6, 6   (2) Nylon 6
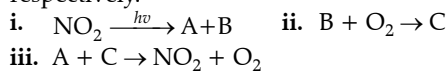(3) Teflon   (4) Dacron

Q. 12. Benzyl isocyanide can be obtained by:

(A) $\xrightarrow{AgCN}$

(B) $\xrightarrow[Ag.KOH]{CHCl_3}$

(C) $\xrightarrow[Ag.KOH]{CHCl_3}$

(D) $\xrightarrow{KCN}$

Choose the correct answer from the options given below:
(1) A and D   (2) Only B
(3) B and C   (4) A and B

Q. 13. Formation of photochemical smog involves the following reaction in which A, B and C are respectively.

i. $NO_2 \xrightarrow{hv} A+B$ ii. $B + O_2 \rightarrow C$
iii. $A + C \rightarrow NO_2 + O_2$

Choose the correct answer from the options given below:

(1) O, N_2O & NO   (2) O, NO & NO_3^-
(3) NO, O & O_3 (4) N, O_2 & O_3

Q. 14. Given below are two statements : one is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A) : Ketoses give Seliwanoff's test faster than Aldoses.
Reason (R) : Ketoses undergo β – elimination followed by formation of furfural.
In the light of the above statements, choose the correct answer from the options given below :
(1) (A) is false but (R) is true
(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) Both (A) and (R) are true and (R) is the correct explanation of (A)

Q. 15. Match List I with List II:

	LIST I (molecules/ions)		LIST II (No. of lone pairs of e⁻ on central atom)
A.	IF_7	I.	Three
B.	ICl_4^-	II.	One
C.	XeF_6	III.	Two
D.	XeF_2	IV.	Zero

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

Q. 16. To inhibit the growth of tumours, identify the compounds used from the following:
A. EDTA
B. Coordination Compounds of Pt
C. D – Penicillamine
D. Cis – Platin
Choose the correct answer from the option given below:
(1) B and D Only   (2) C and D Only
(3) A and C Only   (4) A and B Only

Q. 17. The alkaline earth metal sulphate(s) which are readily soluble in water is/are :
A. $BeSO_4$ B. $MgSO_4$
C. $CaSO_4$ D. $SrSO_4$
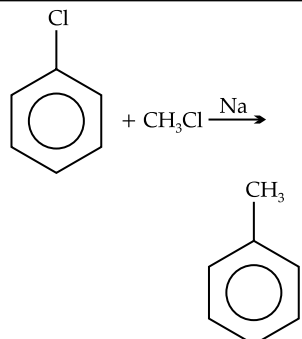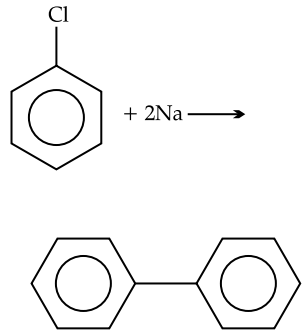E. $BaSO_4$
Choose the correct answer from the options given below :
(1) B only   (2) A and B
(3) B and C   (4) A only

Q. 18. Which of the following is correct order of ligand field strength ?

(1) $CO<en<NH_3<C_2O_4^{2-}<S^{2-}$

(2) $NH_3<en<CO<S^{2-}<C_2O_4^{2-}$

(3) $S^{2-}<C_2O_4^{2-}<NH_3<en<CO$

(4) $S^{2-}<NH_3<en<CO<C_2O_4^2$

Q. 19. Match List I with List II:

	LIST I		LIST II
A.		I.	Fitting reaction
B.		II.	Wurtz Fitting reaction

| C. | | III. | Finkelstein reaction |
| D. | $C_2H_5Cl + NaI \rightarrow C_2H_5I + NaCl$ | IV. | Sand Meyer reaction |

Choose the correct answer from the options given below:

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

Q. 20. In the extraction of copper, its sulphide ore is heated in a reverberatory furnace after mixing with silica to:

(1) remove FeO as $FeSiO_3$
(2) decrease the temperature needed for roasting of Cu_2S
(3) separate CuO as $CuSiO_3$
(4) remove calcium as $CaSiO_3$

Section B

Q. 21. 600 mL of 0.01MHCl is mixed with 400 mL of $0.01MH_2SO_4$. The pH of the mixture is _____ $\times 10^{-2}$. (Nearest integer)
[Given log2 2 = 0.30
log 3 = 0.48   log 5 = 0.69
log 7 = 0.84   log 11 = 1.04]

Q. 22. The energy of one mole of photons of radiation of frequency 2×10^{12} Hz in $J \, mol^{-1}$ is. (Nearest integer)
[Given : h = 6.626×10^{-34}Js
N_A = $6.022 \times 10^{23} \, mol^{-1}$]

Q. 23. Consider the cell
$Pt_{(s)} | H_2(g, 1 \, atm) | H^+ (aq, 1M) || Fe^{3+} (aq), Fe^{2+} (aq) | Pt(s)$
When the potential of the cell is 0.712 V at 298 K, the ratio $[Fe^{2+}]/[Fe^{3+}]$ is (Nearest integer)
Given : $Fe^{3+}/Fe^{2+} = 0.771V$
$\dfrac{2.303RT}{F} = 0.06V$

Q. 24. The number of electrons involved in the reduction of permanganate to manganese dioxide in acidic medium is

Q. 25. A 300 mL bottle of soft drink has $0.2MCO_2$ dissolved in it. Assuming CO_2 behaves as an ideal gas, the volume of the dissolved CO_2 at STP is _____ mL. (Nearest integer)
Given : At STP, molar volume of an ideal gas is 22.7 L mol^{-1}

Q. 26. A trisubstituted compound 'A', $C_{10}H_{12}O_2$ gives neutral $FeCl_3$ test positive. Treatment of compound 'A' with NaOH and CH_3Br gives $C_{11}H_{14}O_2$, with hydroiodic acid gives methyl iodide and with hot conc. NaOH gives a compound B, $C_{10}H_{12}O_2$. Compound 'A' also decolorises alkaline $KMnO_4$. The number of π bond/s present in the compound 'A' is

Q. 27. If compound A reacts with B following first order kinetics with rate constant $2.011 \times 10^{-3} \, s^{-1}$. The time taken by A (in seconds) to reduce from 7 g to 2 g will be (Nearest Integer)
[log 5 = 0.698, log 7 = 0.845, log 2 = 0.301]

Q. 28. A solution containing 2 g of a non – volatile solute in 20 g of water boils at 373.52 K. The molecular mass of the solute is _____ g mol^{-1}. (Nearest integer)
Given, water boils at 373 K, K_b for water = 0.52 K kg mol^{-1}

Q. 29. When 2 litre of ideal gas expands isothermally into vacuum to a total volume of 6 litre, the change in internal energy is J. (Nearest integer)

Q. 30. Some amount of dichloromethane (CH_2Cl_2) is added to 671.141 mL of chloroform ($CHCl_3$) to prepare 2.6×10^{-3}M solution of CH_2Cl_2 (DCM). The concentration of DCM is ppm (by mass).
Given : atomic mass : C = 12, H = 1, Cl = 35.5
density of $CHCl_3$ = 1.49 g cm^{-3}

Answer Key

| Q. No.	Answer	Topic Name	Chapter Name
1	(2)	Compounds of hydrogen	Hydrogen
2	(4)	Antacid	Chemistry in everyday life
3	(3)	Semi permeable membrane	Liquid solution
4	(3)	Classification of elements	Periodic classification of elements
5	(2)	Order of acidic strength	General organic chemistry
6	(4)	Qualitative analysis of compounds	Qualitative analysis
7	(2)	Properties of alkene	Hydrocarbon
8	(1)	Identification of acidic radical	Qualitative analysis
9	(4)	Identification of basic radical	Qualitative analysis
10	(3)	Structural formula	Chemical bonding
11	(2)	Name of monomers	Polymer

12	(4)	Formation of isocyanide	Amines
13	(3)	Photochemical smog	Environmental chemistry
14	(2)	Properties of carbohydrates	Biomolecules
15	(4)	Number of electron pair calculation	Chemical bonding
16	(1)	Medicinal use of coordination compounds	Coordination chemistry
17	(2)	Solubility of sulphate	s block
18	(3)	Strength of ligands	Coordination chemistry
19	(1)	Mixed name reaction	Halo alkanes and Halo arenes
20	(1)	Extraction of metals	Metallurgy
21	[186]	Calculation of pH	Ionic equilibrium
22	[798]	Calculation of number of photon	Structure of atom
23	[10]	Standard reduction potential	Electro chemistry
24	[3]	Calculation of number of electrons	d and f block
25	[1362]	Calculation of volume	States of matter
26	[4]	Calculation of number of bonds	Alcohol phenol and ether
27	[623]	First order reaction	Chemical kinetics
28	[100]	Calculation of molar mass	Some basic concept of chemistry
29	[0]	Calculation of change in internal energy	Thermodynamics
30	[148]	Concentration value	Some basic concepts of chemistry

Solutions

Section A

1. Option (2) is correct.

Lithium aluminium hydride can be prepared by the reaction of lithium hydride and dialuminium hexachloride.

$8LiH + Al_2Cl_6 \rightarrow 2LiAlH_4 + 6LiCl$
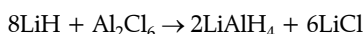
2. Option (4) is correct.

Antacids is a class of drug which neutralises stomach acidity and is used to relieve heartburn, indigestion or upset stomach.

The different classification of given drugs are as follows:

Terfenadine- antihistamine

Meprobamate- tranquilizers

Bromopheniramine- antihistamine
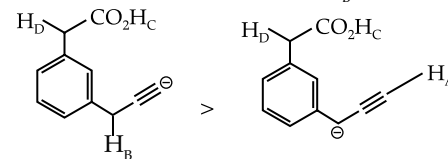
Ranitidine- antacid

3. Option (3) is correct.
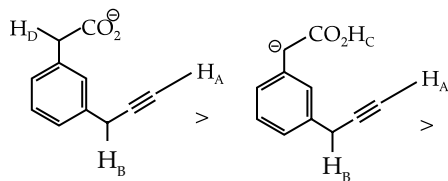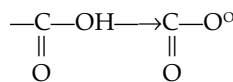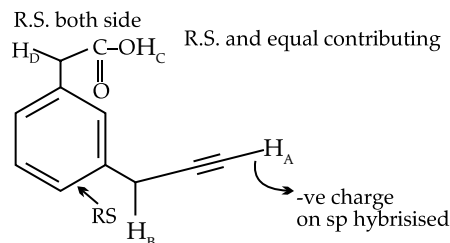
Silica gel prevents water corrosion (rusting) and instrument malfunction by adsorbing moisture from the air.

4. Option (3) is correct.

Atomic number	Block
37 (K)	s-block
78 (Pt)	d-block
52 (Te)	p-block
65 (Tb)	f-block

5. Option (2) is correct.

Acidity of an acid depends upon the stability of its conjugate base.
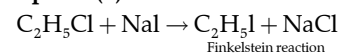

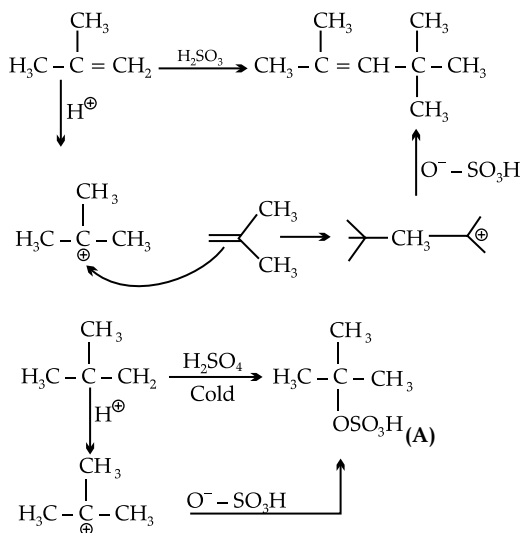So order $H_C > H_D > H_A > H_B$

6. Option (4) is correct.

Aromatic aldehydes do not give Fehling's test. Both nitrogen and sulphur must be present to obtain blood red colour. Sodium nitroprusside gives blood red colour with S & N.
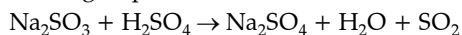
$Na + N + C + S \rightarrow NaSCN$ (Sodium thiocyanate)
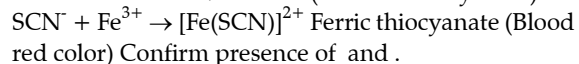
$SCN^- + Fe^{3+} \rightarrow [Fe(SCN)]^{2+}$ Ferric thiocyanate (Blood red color) Confirm presence of and .

7. Option (2) is correct.
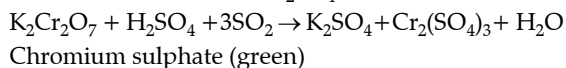
$C_2H_5Cl + NaI \rightarrow C_2H_5I + NaCl$

Finkelstein reaction

8. Option (1) is correct.

On treating sulphite with warm dil. H_2SO_4, SO_2 gas is evolved which is suffocating with the smell of burning sulphur.

$Na_2SO_3 + H_2SO_4 \rightarrow Na_2SO_4 + H_2O + SO_2$

The gas turns potassium dichromate paper green when acidified with dil. H_2SO_4, -

$K_2Cr_2O_7 + H_2SO_4 + 3SO_2 \rightarrow K_2SO_4 + Cr_2(SO_4)_3 + H_2O$
Chromium sulphate (green)

9. Option (4) is correct.

Wet chemical analysis involves identifying and quantifying the desired elements present in a liquid sample using several methods. During this test Fe^{3+} form insoluble hydroxides and is thus precipitated out. Therefore it doesn't belong to group-IV. It belongs to group-III.
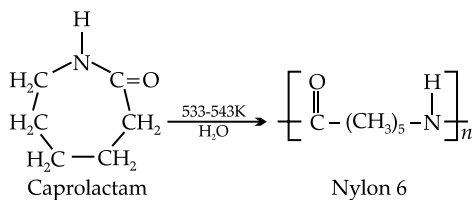
10. Option (3) is correct.
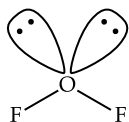
Two lone pair on oxygen
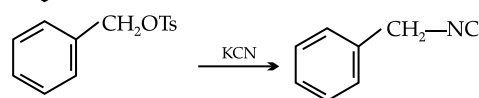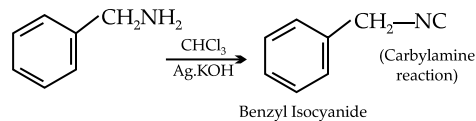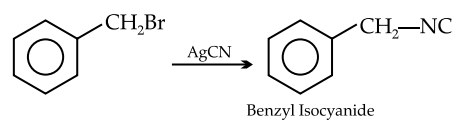Molecule is ' v ' shaped
F-O-F Bond angle is less than 104.5° (102°)
Oxidation state of ' O ' is +2
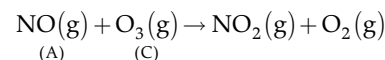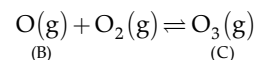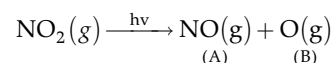
11. Option (2) is correct.

Nylon-6 is the synthetic polymer prepared by using caprolactam. It is obtained by heating caprolactam with water at a high temperature. Nylon 6 is used for the manufacture of tyre cords, fabrics, and ropes.

12. Option (4) is correct.

secondary amine will not give carbylamine test.

13. Option (3) is correct.

$$NO_2(g) \xrightarrow{\ hv\ } \underset{(A)}{NO(g)} + \underset{(B)}{O(g)}$$

$$\underset{(B)}{O(g)} + O_2(g) \rightleftharpoons \underset{(C)}{O_3(g)}$$

$$\underset{(A)}{NO(g)} + \underset{(C)}{O_3(g)} \rightarrow NO_2(g) + O_2(g)$$
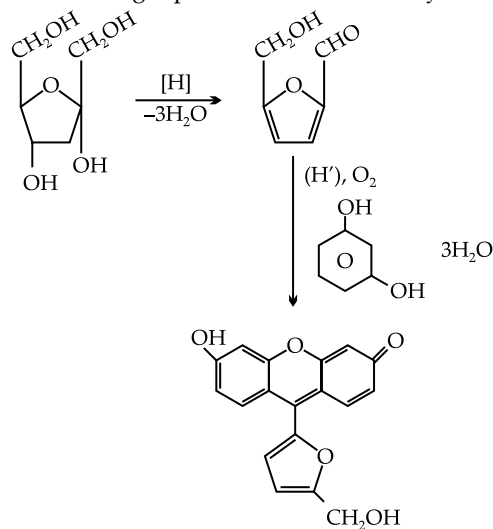
14. Option (2) is correct.

Seliwanoff 's test is a differentiating test for Ketose and aldose. This test relies on the principle that the keto hexose are more rapidly dehydrated to form 5-hydroxy methyl furfural when heated in acidic medium which on condensation with resorcinol, Cherry red or brown red coloured complex is formed rapidly indicating a positive test.

Ketose → Red color formed immediately
Aldose → light pink color formed slowly

15. Option (4) is correct.
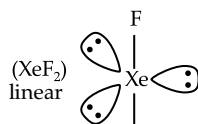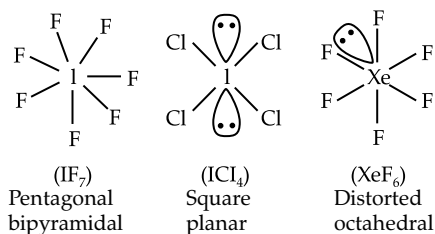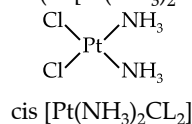
IF_7 zero lone pair

ICl_4^- two lone pair
XeF_6 one lone pair
XeF_2 three lone pair

(IF$_7$)
Pentagonal
bipyramidal

(ICl$_4$)
Square
planar

(XeF$_6$)
Distorted
octahedral

(XeF$_2$)
linear

16. Option (1) is correct.

Cis - Platin is used in chemotherapy to inhibits the growth of tumors.(cis[Pt(NH$_3$)$_2$Cl$_2$])

cis [Pt(NH$_3$)$_2$CL$_2$]
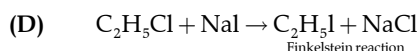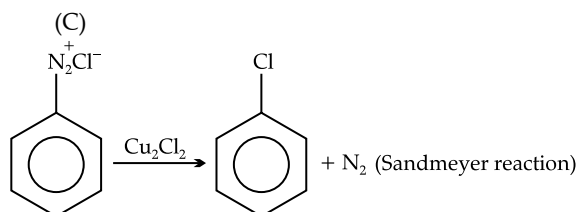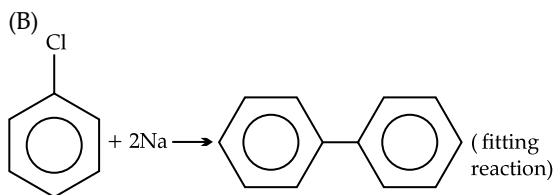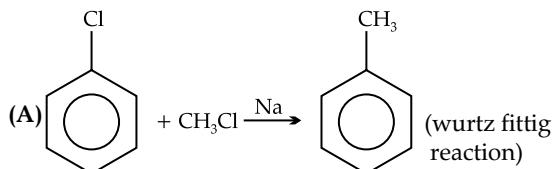
17. Option (2) is correct.

Due to high hydration energy and small size of Be^{2+} and Mg^{2+}, BeSO$_4$ and MgSO$_4$ are readily soluble in water.

CaSO$_4$ is partially soluble

SrSO$_4$ & BaSO$_4$is insoluble

18. Option (3) is correct.

In general, ligands can be arranged in a series in the order of increasing field strength. Such series are known as spectrochemical series which is given below:

I$^-$ < Br$^-$ < SCN$^-$ < Cl$^-$ < S^{2-} < F$^-$ < OH$^-$ C$_2$O$_4^{2-}$ < H$_2$O < NCS$^-$ < edta^{4-} < NH^3 < en < CN$^-$ < CO

19. Option (1) is correct.

(A)

+ CH$_3$Cl $\xrightarrow{\text{Na}}$ (wurtz fittig reaction)

(B)

+ 2Na $\longrightarrow$ (fitting reaction)

(C)

$\xrightarrow{\text{Cu}_2\text{Cl}_2}$ + N$_2$ (Sandmeyer reaction)

(D) C$_2$H$_5$Cl + NaI $\rightarrow$ C$_2$H$_5$I + NaCl
Finkelstein reaction
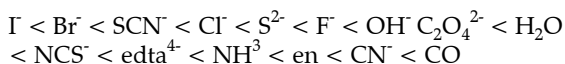
20. Option (1) is correct.

The copper ore contains iron, it is mixed with silica before heating in reverberatory furnace. FeO slags off as FeSiO$_3$. SiO$_3$ (Silica) is a flux material. It removes impurities as slag.

FeO + SiO$_2$ → FeSiO$_3$
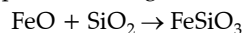
Section B

21. The correct answer is [186].

Total milimoles of H$^+$ = milimoles of HCl +milimoles of H$_2$SO$_4$ (600 × 0.01) + (400 × 0.01 × 2)

$$= 14$$
$$[H^+] = \frac{14}{1000} = 14 \times 10^{-3}$$
$$pH = 3 - \log 14$$
$$= 1.86$$
$$= 186 \times 10^{-2}$$

22. The correct answer is [798].

For one photon E = hv

For one mole photon,

E = 6.023 × 10^{23} × 6. 626 × 10^{-34} × 2 × 10^{12}

= 798.16 J

≈ 798 J

23. The correct answer is [10].

Pt$_{(s)}$ |H$_2$ (g, 1atm)| H$^+$(aq, 1M) ‖ Fe^{3+} (aq), Fe^{2+} (aq)|Pt(s)

at anode H$_2$ → 2H$^+$ + 2e$^-$

At cathode Fe^{3+}(aq) + e$^-$ →Fe$^{2+}_{aq}$

E° = E° Fe^{3+}/Fe^{2+} - E° H$^+$/H Fe^{3+}/Fe^{2+} = 0.771 V
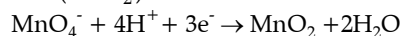
$$E = E° - \frac{0.06}{1} \log \frac{Fe^{2+}}{Fe^{3+}}$$

$$0.712 = (0.771) - \frac{0.06}{1} \log \frac{Fe^{2+}}{Fe^{3+}}$$

$$\log \frac{Fe^{2+}}{Fe^{3+}} = \frac{0.059}{0.06} \approx 1$$

$$\frac{Fe^{2+}}{Fe^{3+}} = 10$$

24. The correct answer is [3].

Conversion of permanganate into manganese dioxide (MnO$_2$) in acidic medium.

MnO$_4^-$ + 4H$^+$+ 3e$^-$ → MnO$_2$ +2H$_2$O

x + (−2) × 4 = −1; x + (−2)2 = 0

x = +7 x − 4 = 0

    x = +4

Change in number of electrons = 7 – 4 = 3

25. The correct answer is [1362].

No. of Moles of CO$_2$ = 0.2M × (300 × 10^{-3})L

= 0.06 Mole

Volume of 0.06 mole CO$_2$ at S.T.P

= 0.06 × 22.7

= 1.362 L = 1362 ml

26. The correct answer is [4].

Since A compound Gives neutral $FeCl_3$ Test Positive, then it Should be an trisubstiluted phenal compound.

Also Compound 'A' With naoH and cH_3 Br gives $C_{11}H_{14}O_2$ confirms the presemce of alcoholigroup. As compound A gives methyl iodide with hydroiodic acid shows the alcohol. is directly attached in method It also decolorises group alhalial $KMnO_4$ conforms the Presence of an athene on the substituted Phenal. Thus the compound would have 4 x bonds (3x bonds present in the benzone ring and i present in the Substituent chain).

27. The correct answer is [623].

$$t = \frac{2.303}{k}\log\frac{C_0}{C_t}$$

$$= \frac{2.303}{2.011\times10^{-3}}\log\frac{7}{2}$$

$$= \frac{2.303\times10^3}{2.011}(.845 - .301)$$

$$= 622.99$$

$$\approx 623 \text{ sec}$$

28. The correct answer is [100].

$$\Delta T_b = T_b - T_b^\circ$$

$$\Delta T_b = K_b \times \frac{\text{No ofmoles of solute}}{\text{Mass ofsolvent}}\times 1000$$

$$= K_b \times \frac{M_{solute}}{M_{solute}\times M_{solvent}}\times1000$$

29. The correct answer is [0].

For ideal gas under isothermal expansion.

$\Delta V = C_V \Delta T$

For isothermal expansion

$\Delta T = 0$

$\therefore \Delta V = 0$

30. The correct answer is [148].

$$\text{Molarity} = \frac{\text{No of moles of solute}}{\text{Volume of the solution (L)}}$$

$$= \frac{m_{solute}}{m_{solute}\times V_{solution}}$$

Let the gives mass of solute be x.

$$2.16\times10^{-3} = \frac{x}{85\times0.67141}$$

$\Rightarrow \qquad x = 0.148 \text{ g.}$

Concentration of DCM in PPm

$$= \frac{\text{mass of DCM}}{\text{Totalmass of solution}} \times 10^6$$

Mass of $CHCl_3$ = Density × Volume

$$= 1.49 \times 671.141$$

$$= 1000 \text{ g}$$

Since M $CHCl_3 >> M_{DCM}$

$\therefore$ For the mass of solution we will only consider mass of $CHCl_3$

$$\text{Conc. of DCM in PPM} = \frac{0.14\,s}{1000} \times 10^6$$

$$= 148 \text{ PPM}$$