Section A

Q. 1. 'A' and 'B' formed in the following set of reactions are:

(1) A = , B =

(2) A = , B =

(3) A = , B =
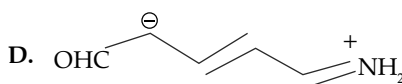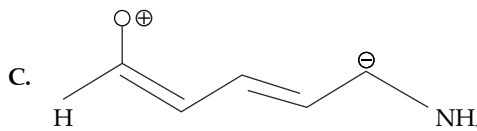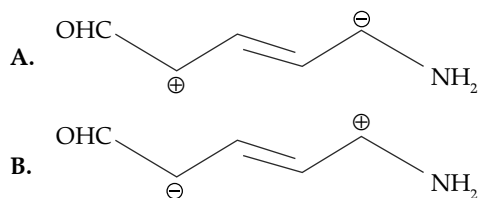
(4) A = , B =
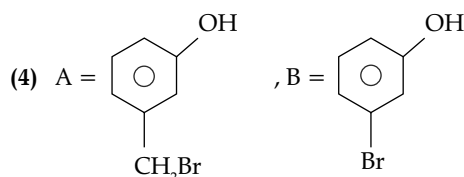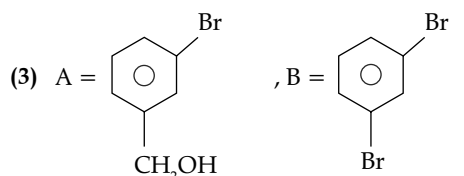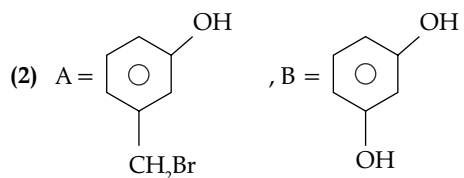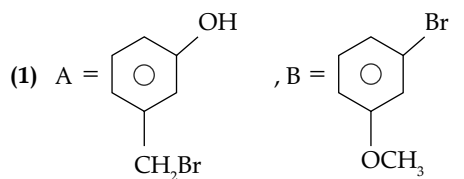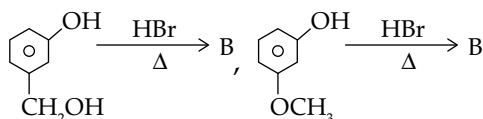
Q. 2. Decreasing order of the hydrogen bonding in following forms of water is correctly represented by

A. Liquid water **B.** Ice
C. Impure water

Choose the correct answer from the options given below:

(1) B > A > C (2) A > B > C
(3) A = B > C (4) C > B > A

Q. 3. Increasing order of stability of the resonance structures is:

A.

B.

C.

D.

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

Q. 4. 'R' formed in the following sequence of reactions is:

(1)

(2)

(3)

(4)
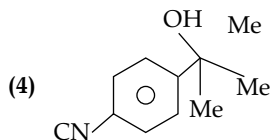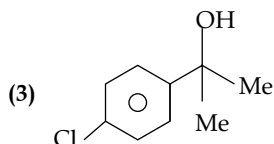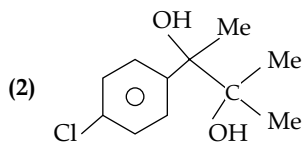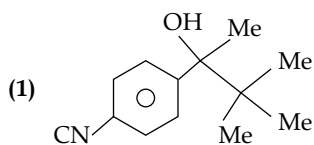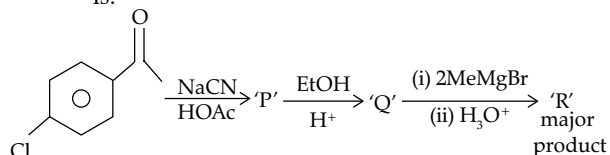
Q. 5. The primary and secondary valencies of cobalt respectively in $[Co(NH_3)_5Cl]Cl_2$ are:

(1) 3 and 6 (2) 2 and 6 (3) 3 and 5 (4) 2 and 8

Q. 6. An ammoniacal metal salt solution gives a brilliant red precipitate on addition of dimethylglyoxime. The metal ion is:

(1) Co^{2+} (2) Ni^{2+} (3) Fe^{2+} (4) Cu^{2+}

Q. 7. Reaction of BeO with ammonia and hydrogen fluoride gives A which on thermal decomposition gives BeF_2 and NH_4 F. What is 'A' ?

(1) $(NH_4)_2BeF_4$ (2) H_3NBeF_3
(3) $(NH_4)Be_2 F_5$ (4) $(NH_4)BeF_3$

Q. 8. Match List I with List II

	List I		List II
A.	Reverberatory furnace	**I.**	Pig Iron
B.	Electrolytic cell	**II.**	Aluminum
C.	Blast furnace	**III.**	Silicon
D.	Zone Refining furnace	**IV.**	Copper

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

Q. 9. Match List I with List II

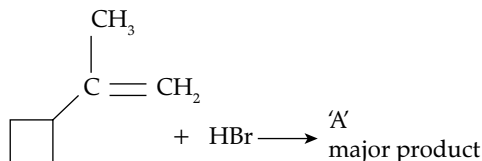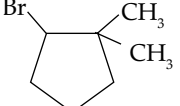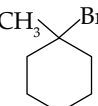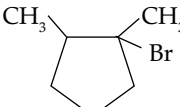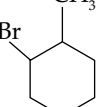|	List I		List II
A.	Chlorophyll	**I.**	Na_2CO_3
B.	Soda ash	**II.**	$CaSO_4$
C.	Dentistry, Ornamental work	**III.**	Mg^{2+}
D.	Used in white washing	**IV.**	$Ca(OH)_4$

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

Q. 10. In the following given reaction, ' A ' is

Q. 11. It is observed that characteristic X-ray spectra of elements show regularity. When frequency to the power v^n " n " i.e. v^n of X-rays emitted is plotted against atomic number " Z ", following graph is obtained.
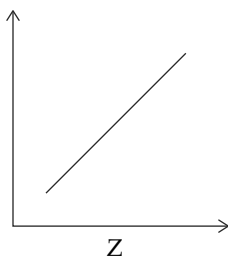
The value of " n " is
(1) 3   **(2)** 2   **(3)** 1   **(4)** $\dfrac{1}{2}$

Q. 12. Given below are two statements:
Statement I: Noradrenaline is a neurotransmitter.
Statement II: Low level of noradrenaline is not the cause of depression in human.
In the light of the above statements, choose the correct answer from the options given below:
(1) Statement I is correct but Statement II is incorrect
(2) Both Statement I and Statement II are correct
(3) Both Statement I and Statement II are incorrect
(4) Statement I is incorrect but Statement II is correct
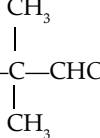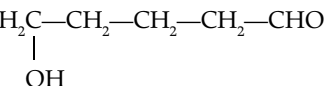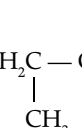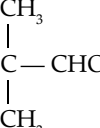
Q. 13. Which of the Phosphorus oxoacid can create silver mirror from $AgNO_3$ solution?
(1) $(HPO_3)_n$ **(2)** $H_4P_2O_6$
(3) $H_4P_2O_5$ **(4)** $H_4P_2O_7$

Q. 14. Compound (X) undergoes following sequence of reactions to give the Lactone (Y).

Compound (X) is

(1) $HOH_2C-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CHO$

(2) $H_2C-CH_2-CH_2-\underset{\underset{OH}{|}}{CH_2}-CHO$

(3) H_2C-CH_2-CHO with CH_3 substituent

(4) $H-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CHO$

Q. 15. Order of Covalent bond;
A. KF > KI; LiF > KF
B. KF < KI; LiF > KF
C. $SnCl_4$ > $SnCl_2$; CuCl > NaCl
D. LiF > KF; CuCl < NaCl
E. KF < KI; CuCl > NaCl

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

Q. 16. Which of the following is true about freons?
(1) These are radicals of chlorine and chlorine monoxide
(2) These are chemicals causing skin cancer
(3) These are chlorofluorocarbon compounds
(4) All radicals are called freons

Q. 17. In the depression of freezing point experiment

    A. Vapour pressure of the solution is less than that of pure solvent

    B. Vapour pressure of the solution is more than that of pure solvent

    C. Only solute molecules solidify at the freezing point

    D. Only solvent molecules solidify at the freezing point

Choose the most appropriate answer from the options given below:

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

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

Q. 18. **Statement I:** For colloidal particles, the values of colligative properties are of small order as compared to values shown by true solutions at same concentration.

    Statement II: For colloidal particles, the potential difference between the fixed layer and the diffused layer of same charges is called the electrokinetic potential or zeta potential.
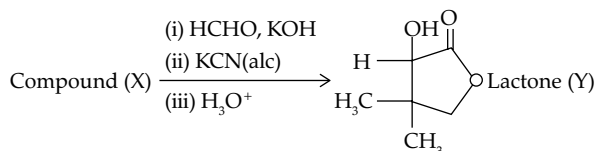
In the light of the above statements, choose the correct answer from the options given below:

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

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

    (3) Both Statement I and Statement II are true

    (4) Both Statement I and Statement II are false

Q. 19. **Assertion A:** Hydrolysis of an alkyl chloride is a slow reaction but in the presence of NaI, the rate of the hydrolysis increases.

    Reason R: I^- is a good nucleophile as well as a good leaving group. 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. 20. The magnetic moment of a transition metal compound has been calculated to be 3.87 B.M. The metal ion is

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

Section B

Q. 21. When $Fe_{0.93}O$ is heated in presence of oxygen, it converts to Fe_2O_3. The number of correct statement/s from the following is

    A. The equivalent weight of $Fe_{0.93}O$ is

$$\frac{\text{Molecular weight}}{0.79}$$

    B. The number of moles of Fe^{2+} and Fe^{3+} in 1 mole of $Fe_{0.93}O$ is 0.79 and 0.14 respectively.

    C. $Fe_{0.93}O$ is metal deficient with lattice comprising of cubic closed packed arrangement of O^{2-} ions

    D. The % composition of Fe^{2+} and Fe^{3+} in $Fe_{0.93}O$ is 85% and 15% respectively

Q. 22. The number of correct statement/s from the following is

    A. Larger the activation energy, smaller is the value of the rate constant.

    B. The higher is the activation energy, higher is the value of the temperature coefficient.

    C. At lower temperatures, increase in temperature causes more change in the value of k than at higher temperature

    D. A plot of ln K VS $\frac{1}{T}$ is a straight line with slope equal to $-\frac{E_a}{R}$

Q. 23. For independent processes at 300 K

Process	$\Delta H/kJ\ mol^{-1}$	$\Delta S/J\ K^{-1}$
A	-25	-80
B	-22	40
C	25	-50
D	22	20

The number of non-spontaneous processes from the following is

Q. 24. 5 g of NaOH was dissolved in deionized water to prepare a 450 mL stock solution. What volume (in mL) of this solution would be required to prepare 500 mL of 0.1M solution?

Given: Molar Mass of Na, O and H is 23,16 and 1 g mol^{-1} respectively

Q. 25. If wavelength of the first line of the Paschen series of hydrogen atom is 720 nm, then the wavelength of the second line of this series is nm. (Nearest integer)

Q. 26. Uracil is a base present in RNA with the following structure. % of N in uracil is
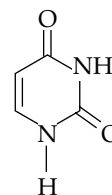
Q. 27. The dissociation constant of acetic acid is $x \times 10^{-5}$. When 25 mL of 0.2M CH_3COONa solution is mixed with 25 mL of 0.02M CH_3COOH solution, the pH of the resultant solution is found to be equal to 5. The value of x is

Q. 28. Number of moles of AgCl formed in the following reaction is
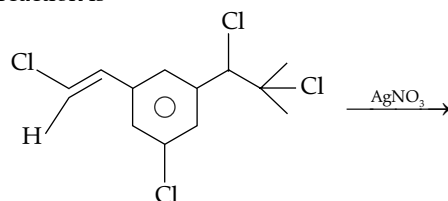
(A)+X AgCl↓

Q. 29. The d-electronic configuration of $[CoCl_4]^{2-}$ in tetrahedral crystal field is $e^m t_2^n$. Sum of "m" and "number of unpaired electrons" is

Q. 30. At 298 K, a 1 litre solution containing 10mmol of $Cr_2O_7^{2-}$ and 100mmol of Cr^{3+} shows a pH of 3.0.

Given: $Cr_2O_7^{2-} \rightarrow Cr^{3+}$; $E^0 = 1.330$ V and $\frac{2.303RT}{F}$

$= 0.059$ V

The potential for the half cell reaction is $x \times 10^{-3}$ V. The value of x i

Answer Key

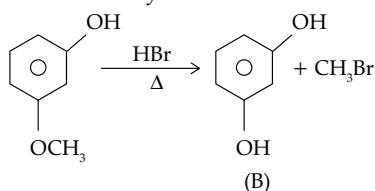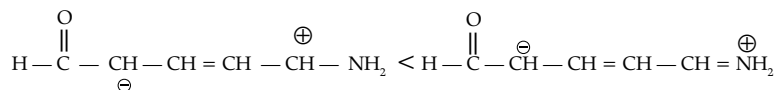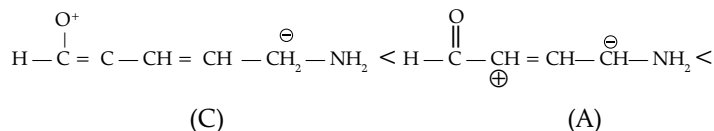| Q. No.	Answer	Topic Name	Chapter Name
1	(2)	Properties of alcohol	Alcohol phenol and ether
2	(1)	Extent of hydrogen bonding	Hydrogen
3	(3)	Stability of resonating structure	General organic chemistry
4	(2)	Properties of carbonyl compounds	Aldehyde and ketone
5	(1)	Werner theory	Coordination compounds
6	(2)	Identification of basic radical	Qualitative analysis
7	(1)	Properties of alkaline earth metals compounds	s-block
8	(1)	Types of purification methods	metallurgy
9	(2)	Uses of S block element	s-block
10	(3)	Electrophillic addition reaction of alkene	Hydrocarbon
11	(4)	Properties of X-ray	Structure of atom
12	(1)	Anti depression drug	Chemistry in everyday life
13	(3)	Oxyacid of phosphorous	p-block
14	(4)	Properties of carbonyl compounds	Aldehyde and ketone
15	(2)	Fajan's rule	Chemical bonding and molecular structure
16	(3)	Freons	Halo Alkane and halo arene
17	(3)	Colligative properties	Liquid solution
18	(2)	Properties of colloidal solution	Surface chemistry
19	(3)	Properties of alkyl halide	Halo Alkane and halo arene
20	(3)	Magnetic moment of transition metals	d and f block
21	[4]	Oxidation number,equivalent weight and percentage composites	Solid state
22	[3]	Arrhenius equation	Chemical kinetics
23	[2]	Spontaneity of reaction	Thermodynamics and thermochemistry
24	[180]	Molarity on dilution	Liquid solution
25	[492]	Hydrogen spectrum	Structure of atom
26	[25]	Percentage composition in uracil	Biomolecules
27	[10]	pH calculation	Ionic equilibrium
28	[2]	Reactivity of halogen containing compounds	Halo Alkane and halo arene
29	[7]	Calculation of number of unpaired electron	Coordination chemistry
30	[917]	Nernst Equation	Electrochemistry

Solutions

Section A

1. Option (2) is correct.
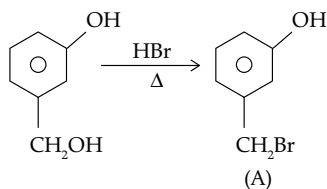
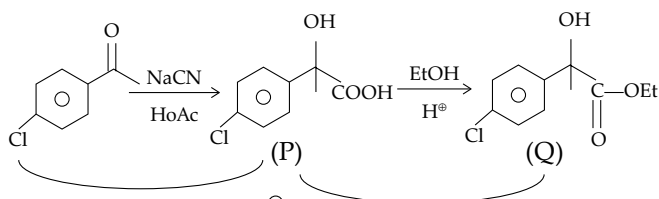In the first step, the -OH of -CH$_2$-OH group is substituted by Br atom.

In this reaction, the reaction of ether takes place with HBr in which the cleavage of ether taken place in such a way that aromatic alcohol is formed.

2. Option (1) is correct.

Among liquid water, ice and impure water, the extent of H-bonding is highly observed in ice. In ice, one water molecule is surrounded by four other water molecule to from a cage like structure while in liquid water the extent of H-bonding is less than ice.

In impure water, due to the presence of impurity extent of H-bonding decreases and it has least H-bonding. The decreasing order of H-bonding is as follows.

Ice > Liquid water > Impure water

(B)   (A)   (C)

3. Option (3) is correct.

The correct answer should be C<A<B<D
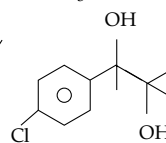

4. Option (2) is correct.

Attacking of nucleophile (⁻CN) along with hydroysis of —CN into — COOH

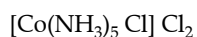Formation of ester takes place when — COOH group reacts with EtOH in presence of acid

Attacking of grignard reagent on ester to form tertiary alcoohal.

(1) 2 MeMgBr
(2) H$_3$O$^+$

5. Option (1) is correct.

[Co(NH$_3$)$_5$ Cl] Cl$_2$

According to Werner's theory, the species which satisfied the coordination numbers are termed as secondary valency while the species which satisfied

the oxidation number are termed as primary valency. Here five NH$_3$ and one Cl⁻ ion

Satisfying the secondary valency while 3 Cl⁻ ion satisfying the primary valency.

The secondary valency are 6 while primary valency are 3.

6. Option (2) is correct.

The metal ion which gives a brilliant red precipitate on addition of dimethyl glyoxime is Ni^{2+} ion.

$$Ni^{2+} + 2\,DMG \longrightarrow [Ni(DMG)_2]$$

Dimethyl glyoxime = (DMG)
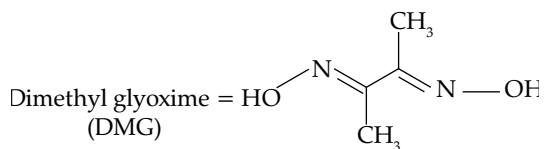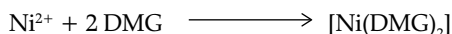
7. Option (1) is correct.

The compound which is formed on reaction of BeO with ammonia and hydrogen fluoride is $(NH_4)\,BeF_4$.

$$Beo + 2NH_3 + 4HF \rightarrow (NH_4)_2\,BeF_4 + H_2O$$

$$\left(NH_4\right)_2 BeF_4 \rightarrow BeF_2 + NH_4F$$
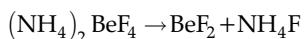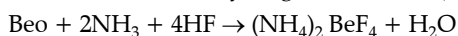
8. Option (1) is correct.

The correct matching of the given process with metal are as follows:

	List –I		List –II
A.	Reverberatory furnace	IV.	Copper
B.	Electrolytic cell	II.	Aluminium
C.	Blast furnace	I.	pig iron
D.	Zone refining furnace	III.	Silicon

9. Option (2) is correct.

The correct matching for the given substance along with the compound are as follows –

	List –I		List-II
A.	Chlorophyll	III.	Mg^{2+}
B.	Soda ash	I.	Na_2CO_3
C.	Dentistry, ornamental work	II.	$CaSO_4$
D.	Used in White washing	IV.	$Ca(OH)_2$

10. Option (3) is correct.

Protonation of alkene, it is an example of electrophillic addition reaction

Ring expansion takes place

1,2 methyl shift

attacking of nucleophile to form stable product
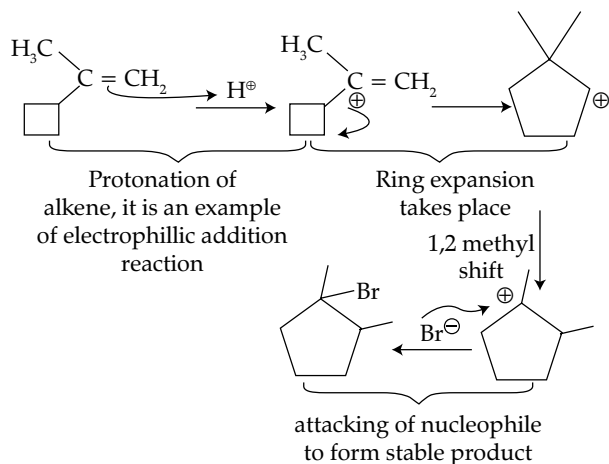
11. Option (4) is correct.

According to Henry Moseley $\sqrt{v} \propto Z\text{-b}$
From the formula

$$\sqrt{v} \propto Z \ \text{Or} \ v^n \propto Z \ \text{Or} \ v^{\frac{1}{2}} \propto Z \ \text{So} \quad n = \frac{1}{2}$$

12. Option (1) is correct.

Statement I is correct, noradrenaline is a neurotransmitter,
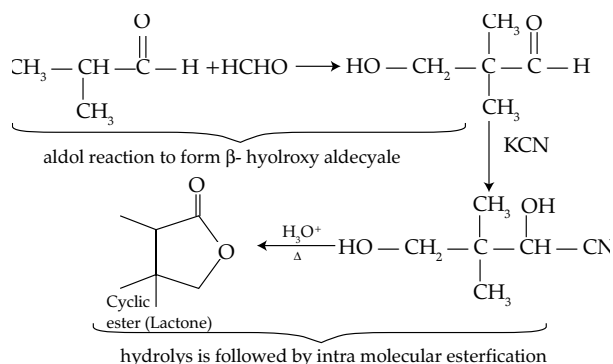
Statement II is incorrect, low level of noradrenaline is not the cause of depression in human, this statement is not correct.

13. Option (3) is correct.

The silver mirror test is given by P^{+1} and P^{3+} because both P^{3+} and P^{+1} can be easily oxidized into P^{5+}

Compound	Oxidation state of P
$(HPO_3)_n$	+5
$H_4P_2O_5$	+3
$H_4P_2O_6$	+4
$H_4P_2O_7$	+5

Here $H_4P_2O_5$ can form silver mirror from $AgNO_3$ solution. Here $H_4P_2O_5$ contain P-H bond which can reduce $AgNO_3$ to Ag.

14. Option (4) is correct.

aldol reaction to form β- hyolroxy aldecyale

Cyclic ester (Lactone)

hydrolys is followed by intra molecular esterfication

15. Option (2) is correct.

According to Fajan's rule, the ionic compound which is formed by small cation and large anion has more covalent character than other ionic comp. according to Fajan's rule

A. KF > KI – False LiF > KF – True

B. KF < KI – True LiF > KF – True

C. $SnCl_4 > SnCl_2$ – True C_4Cl > NaCl –True

D. LiF > KF – True C_4Cl >NaCl – False

E. KF < KI – True C_4Cl > NaCl – True

Order B,C and E is correct. So, option (2) is correct.

16. Option (3) is correct.

The chlorofluorocarbon compound of methane and ethane are collectively called Freon's. They are stable, unreactive, non-toxic gas.

17. Option (3) is correct.

A – On addition of non-volatile solute in the pure solvent the vapour pressure of pure solvent decrease, therefore vapour pressure of solution is less than that of pure solvent.

D – Similarly only addition of solute partide only can affect the depression of freezing point.

T_f^o = freezing point of solvent

T_f = freezing point of solution
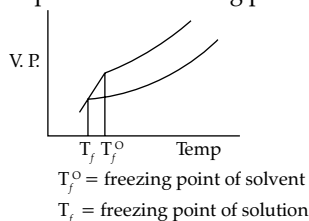
18. Option (2) is correct.

Statement I : In colloidal solution, the size of partides is very big compared to true solution. Therefore, the colloidal particle has lower value of colligative properties.

Statement II : The potential different developed between two layers i.e., fixed and diffused layer of opposite charge is called zeta potential.

Statement I is correct but statement II is not correct.

19. Option (3) is correct.

The rate of hydrolysis of an alkyl chloride is slow because Cl^- is not a better nucleophile and leaving group compared to I^-.

The nucleophilicity of I^- is greater than Cl^- because the basic nature of I^- is less than Cl^-.

20. Option (3) is correct.

1. $Cr^{+2}:[Ar], 3d^4, 4s^0 n=4, \mu=\sqrt{4(4+2)}=\sqrt{24}=4.89 BM$

2. $Mn^{+2}:[Ar],3d^5,4s^0 n=5,\mu=\sqrt{5(5+2)}=\sqrt{35}=5.91 BM$

3. $V^{+2}:[Ar],3d^3,4s^0 n=3,\mu=\sqrt{3(3+2)}=\sqrt{15}=3.87 BM$

4. $Ti^{+2}:[Ar],3d^2,4s^0 n=2,\mu=\sqrt{2(2+2)}=\sqrt{8}=2.82 BM$

Section B

21. The correct answer is [4]

(A) The oxidation state of Fe in $Fe_{0.93}O_{1.0}$ and Fe_2O_3 are $\frac{200}{3}$ & +3 receptively.

First we need to find nf

$$nf = \left(3-\frac{200}{93}\right)\times 0.93$$
$$nf = 0.79$$

So, the equivalent weight of $Fe_{0.93}O_{1.0}$ is

$$\frac{\text{Molecular weight}}{0.79}$$

(B) Let the mole of $Fe^{2+} = x$

The mole of $Fe^{3+} = 0.93-x$

So $+2 \times x + (0.93 - x) \times 3 = 2$

$$x = 0.79$$

So, mole of $Fe^{2+} = 0.79$ mole

Mole of $Fe^{3+} = 0.14$ mole

(C) In the given $Fe_{0.93}O_{1.0}$, the number of metal ion are less than that of O^{2-} ion $\therefore$ it is a metal deficient compound.

(D) % of $Fe^{2+} = \frac{0.79}{0.93}\times 100 = 85\%$

% of $Fe^{3+} = \frac{0.14}{0.93}\times 100 = 15\%$

All the four statement are correct.

22. The correct answer is [3]

A is correct, from $K = Ae^{-Ea/RT}$

If E_a increases the value of K decreases.

B is correct, from $u = \frac{K_T + 10}{K_T}$

If value of activation energy is higher, than the value of u is also high.

as $(u \times E_a)$

C is wrong, from $\log \frac{K_2}{K_1} = \frac{E_a}{2.303R}\left(\frac{T_2-T_1}{T_1 T_2}\right)$

The value of K depends upon temperature so it can be increases as decreases'.

D is correct, $Ln K = L_n A - \frac{E_a}{RT}$

Here the plot of ln K VS $\frac{1}{T}$ is a straight line

With slope equal to $\frac{-E_a}{R}$.

Out of the four statement, there statement are correct.

23. The correct answer is [2]

From $\Delta G = \Delta H - T\Delta S$

A. $\Delta G = -25 \times 10^3 - (300 \times -80)$
$= -25000 + 24000 = -1000$ J/Mol
$\Delta G = -$Ve (spontaneous process)

B. $\Delta G = -22 \times 10^3 - (300\times 40)$
$= -22000 - 12000$
$= -34000$ J/mol
$\Delta G = -$Ve (spontaneous process)

C. $\Delta G = 25 \times 10^3 - (300\times -50)$
$= 25000 + 15000 = 40000$ J/mol
$\Delta G = +$Ve (Non spontaneous)

D. $\Delta G = 22 \times 10^3 - (300\times 20)$
$= 22000 - 6000 = 18000$ J/mol
$\Delta G = +$Ve (Non Spontaneous)

Process C & D are non-spontaneous

24. The correct answer is [180]

$$\text{Molarity} = \frac{\text{mass of NaOH}}{\text{molar mass of NaOH}}\times \frac{1000}{\text{Volume (inmL)}}$$

$$\text{Molarity} = \frac{5\,\text{gm}}{40\,\text{gm/mol}}\times \frac{1000}{450} = 0.278\,\text{M}$$

From $M_1 V_1 = M_2 V_2$ (dilution law)

$0.278 \, M \times V_1 = 0.1 \, M \times 500 \, mL$

$V_1 = 180 \, mL$

25. The correct answer is [492]

For Pascher series (4→3)

First line $\lambda_1 = 720$ nm.

For second line 5→3

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

For 1st line $\dfrac{1}{(\lambda_1)_p} = R_H Z^2 \left(\dfrac{1}{9} - \dfrac{1}{16} \right)$

$n_1 = 3 \quad n_2 = 4$

For 2nd line

$$\frac{1}{(\lambda_2)_p} = R_H Z^2 \left(\frac{1}{9} - \frac{1}{25} \right)$$

$n_1 = 3 \quad n_2 = 4$

$$\frac{(\lambda_2)_p}{(\lambda_1)_p} = \frac{\frac{7}{16 \times 9}}{\frac{16}{25 \times 9}} = \frac{25 \times 7}{16 \times 16}$$

$$(\lambda_2)_p = \frac{175}{256} \times (\lambda_1)_p$$

$$= \frac{175}{256} \times 720 \, nm = 492.2 \, nm$$

≈ 492 nm (nearest integer)

26. The correct answer is [25]

Molar mass of uracil ($C_4 H_4 N_4 O_2$)

$= 4(C) \times 12 + 4(H) \times 1 + 2(N) \times 14 + 2(O) \times 16$

$= 48 + 4 + 28 + 32 = 112 \, gm$

% of N-atom $= \dfrac{\text{mass of N}}{\text{Total mass}} \times 100$

$= \dfrac{28}{112} \times 100 = (25\%)$

27. The correct answer is [10]

From Hendersen Hassel Bach equation

$$pH = pK_q + \log \left[\frac{salt}{acid} \right]$$

Given : $pH = 5$

[Salt] = 0.2 M [acid] = 0.02 M

By putting the value

$5 = pk_a + \log \dfrac{0.2}{0.02}$

$5 = pk_a + \log 10$

$5 = pk_a + 1$

$pk_a = 4$

Or $\quad ka = $ (antilog) 4

$ka = 10^{-4}$

Or $\quad ka = 10 \times 10^{-5}$

So $\quad x = 10$

28. The correct answer is [2]
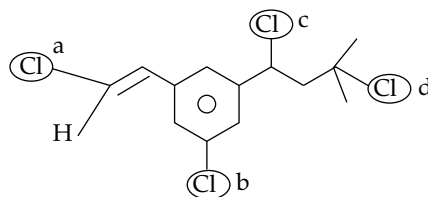
Tow of four chlorine atoms give AgCl on reaction with $AgNO_3$. (c) and (d) will give reaction with $AgNO_3$ while (a) and (b) do not give reaction with $AgNO_3$ because they are highly stable and do not undergo substitution reaction.
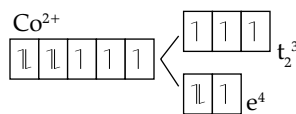
29. The correct answer is [7]

In $[CoCl_4]^{2-}$ Let oxidation state of Co = x

Oxidation state of Co $\Rightarrow x - 4 = -2$
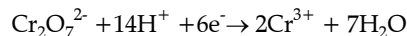
$\Rightarrow x = +2$

Configuration of Co = $3d^7 4s^2$

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

The value of m = 4 and n = 3 so the sum of m + n $\Rightarrow 4 + 3 = (7)$

30. The correct answer is [917]

The balanced chemical ionic equation.

$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$

From $E = E^\circ - \dfrac{0.059}{n} \log \dfrac{\left[Cr^{3+} \right]^2}{\left[Cr_2O_7^{2-} \right] \left[H^+ \right]^{14}}$

Given $\quad E^\circ = 1.330 V$

$n = 6$

$pH = 3, [H^+] = 10^{-3}$

mmol of $Cr_2O_7^{2-} = 10$ mmol

$= 10 \times 10^{-3}$ mol $= 10^{-2}$ mol

mmol of $Cr^{3+} = 100$ mmol

$= 100 \times 10^{-3}$ mol $= 10^{-1}$ mol.

By putting the values.

$$E = 1.33 - \frac{0.059}{6} \log \frac{(0.1)^2}{(10^{-2})(10^{-3})^{14}}$$

$E = 0.917 \times 10^{-3}$

$x = 917$

❑❑