JEE (Main) CHEMISTRY SOLVED PAPER

2023

30th Jan. Shift 2

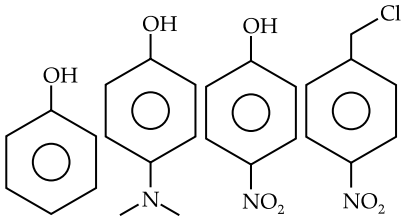
Section A

Q. 1. The Cl–Co–Cl bond angle values in a fac – $[Co(NH_3)_3Cl_3]$ complex is/are:

(1) 90° **(2)** 90° &120°

(3) 180° **(4)** 90° &180°

Q. 2. The correct order of pK_a values for the following compounds is:



(a) (b) (c) (d)

(1) c > a > d > b **(2)** b > a > d > c

(3) b > d > a > c **(4)** a > b > c > d

Q. 3. Given below are two statements:

Statement I : During Electrolytic refining, the pure metal is made to act as anode and its impure metallic form is used as cathode.

Statement II : During the Hall–Heroult electrolysis process, purified Al_2O_3 is mixed with Na_3AlF_6 to lower the melting point of the mixture.

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

(1) Statement I is correct but Statement II is incorrect

(2) Both Statement I and Statement II are incorrect

(3) Both Statement I and Statement II are correct

(4) Statement I is incorrect but Statement II is correct

Q. 4. Match List I with List II:

List I (Mixture)	List II (Separation Technique)
A. $CHCl_3 + C_6H_5NH_2$	I. Steam distillation
B. $C_6H_{14} + C_6H_{12}$	II. Differential extractiom
C. $C_6H_5NH_2 + H_2O$	III. Distillation
D. Organic compound in H_2O	IV. Fraction distillation

(1) A–IV, B–I, C–III, D–II

(2) A–III, B–IV, C–I, D–II

(3) A–III, B–I, C–IV, D–II

(4) A–II, B–I, C–III, D–IV

Q. 5. 1 L, 0.02M solution of $[Co(NH_3)_5SO_4]Br$ is mixed with 1 L, 0.02M solution of $[Co(NH_3)_5Br]SO_4$. The resulting solution is divided into two equal parts (X) and treated with excess of $AgNO_3$ solution and $BaCl_2$ solution respectively as shown below:

1 L solution (X) + $AgNO_3$ solution (excess) → Y

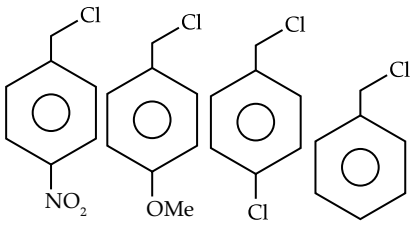
1 L Solution (X) + $BaCl_2$ solution (excess) → Z

The number of moles of Y and Z respectively are

(1) 0.02, 0.01 **(2)** 0.01, 0.01

(3) 0.01, 0.02 **(4)** 0.02, 0.02

Q. 6. Decreasing order towards SN 1 reaction for the following compounds is:



(a) (b) (c) (d)

(1) a > c > d > b **(2)** b > d > c > a

(3) a > b > c > d **(4)** d > b > c > a

Q. 7. Which of the following reaction is correct?

(1) $4LiNO_3 \xrightarrow{\Delta} 2Li_2O + 2N_2O_4 + O_2$

(2) $2LiNO_3 \xrightarrow{\Delta} 2NaNO_2 + O_2$

(3) $2LiNO_3 \rightarrow 2Li + 2NO_2 + O_2$

(4) $4LiNO_3 \xrightarrow{\Delta} 2Li_2O + 4NO_2 + O_2$

Q. 8. Boric acid is solid, whereas BF_3 is gas at room temperature because of

(1) Strong van der Waal's interaction in Boric acid

(2) Strong covalent bond in BF_3

(3) Strong ionic bond in Boric acid

(4) Strong hydrogen bond in Boric acid

Q. 9. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: Antihistamines do not affect the secretion of acid in stomach.

Reason : Antiallergic and antacid drugs work on different receptors.

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

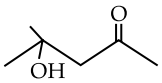
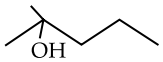
(3) Both A and R are true and R is the correct explanation of A

(4) A is true but R is false

Q. 10. Formulae for Nessler's reagent is:

(1) HgI_2 **(2)** K_2HgI_4 (3) $KHgI_3$ (4) KHg_2I_2

Q. 11. Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A:  can be easily reduced using Zn – Hg/HCl to 

Reason R: Zn − Hg/HCl is used to reduce carbonyl group to − CH_2 − group.

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

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

Q. 12. Maximum number of electrons that can be accommodated in shell with n = 4

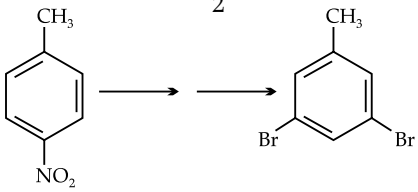
(1) 16 **(2)** 32 **(C)** 72 **(D)** 50

Q. 13. The wave function (Ψ) of 2 s is given by

$$\Psi_{2s} = \frac{1}{2\sqrt{2\pi}}\left(\frac{1}{a_0}\right)^{1/2}\left(2-\frac{r}{a_0}\right)e^{-r/2a_0}$$

At $r = r_0$, radial node is formed. Thus, r_0 in terms of a_0

(1) $r_0 = 4a_0$ **(2)** $r_0 = \frac{a_0}{2}$ **(3)** $r_0 = a_0$ **(4)** $r_0 = 2a_0$

Q. 14. 

In the above conversion of compound (X) to product (Y), the sequence of reagents to be used will be:

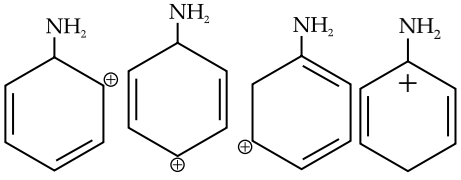
(1) (i) Br_2(aq) (ii) $LiAlH_4$ (iii) H_3O_+
(2) (i) Br_2,Fe (ii) Fe,H^+ (iii) $LiAlH_4$
(3) (i) Fe,H^+ (ii) Br_2 (aq) (iii) HNO_2 (iv) H_3PO_2
(4) (i) Fe,H^+ (ii) Br_2 (aq) (iii) HNO_2 (iv) CuBr

Q. 15. Match List I with List II:

List I (Complexes)	List II (Hybridisation)
A. $[Ni(CO)_4]$	I. sp^3
B. $[Cu(NH_3)_4]^{2+}$	II. dsp^2
C. $[Fe(NH_3)_6]^{2+}$	III. sp^3d^2
D. $[Fe(H_2O)_6]^{2+}$	IV. d^2sp^3

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

Q. 16. The most stable carbocation for the following is:



(a) (b) (c) (d)

(1) a **(2)** c (3) d (4) b

Q. 17. Chlorides of which metal are soluble in organic solvents:

(1) K **(2)** Be (3) Mg (4) Ca

Q. 18. $KMnO_4$ oxidises I^- in acidic and neutral/faintly alkaline solution, respectively, to

(1) IO_3^- & IO_3^- **(2)** I_2 & IO_3^-
(3) I_2 & I_2 **(4)** IO_3^- &I_2

Q. 19. Bond dissociation energy of "E–H" bond of the "H_2E" hydrides of group 16 elements (given below), follows order.

A. O **B.** S C. Se D. Te

Choose the correct from the options given below:

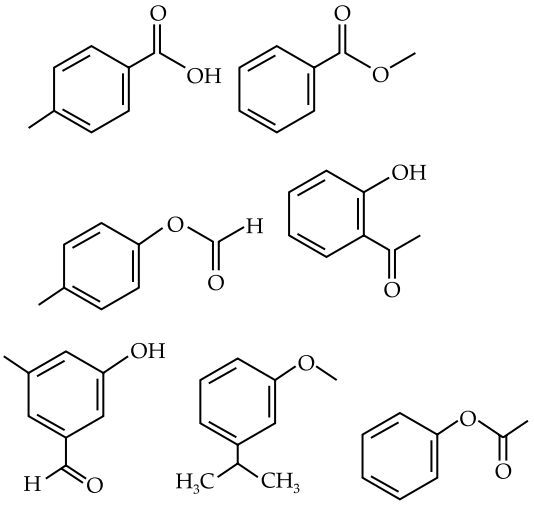
(1) B > A > C > D **(2)** A > B > D > C
(3) A > B > C > D **(4)** D > C > B > A

Q. 20. The water quality of a pond was analysed and its BOD was found to be 4. The pond has

(1) Highly polluted water
(2) Slightly polluted water
(3) Water has high amount of fluoride compounds
(4) Very clean water

Section B

Q. 21. Number of compounds from the following which will not dissolve in cold $NaHCO_3$ and NaOH solutions but will dissolve in hot NaOH solution is



Q. 22. 1 mole of ideal gas is allowed to expand reversibly and adiabatically from a temperature of 27°C. The work done is 3 kJ mol^{-1}. The final temperature of the gas is _____ K (Nearest integer). Given C_V = 20 J mol^{-1} K^{-1}

Q. 23. A short peptide on complete hydrolysis produces 3 moles of glycine (G), two moles of leucine (L) and two moles of valine (V) per mole of peptide. The number of peptide linkages in it are

Q. 24. Lead storage battery contains 38% by weight solution of H_2SO_4. The van't Hoff factor is 2.67 at this concentration. The temperature in Kelvin at which the solution in the battery will freeze is __ (Nearest integer). Given K_f = 1.8 K kg mol^{-1}

Q. 25. The strength of 50 volume solution of hydrogen peroxide is_____ g/L (Nearest integer).
Given: Molar mass of H_2O_2 is 34 g mol^{-1}
Molar volume of gas at STP = 22.7 L.

Q. 26. The electrode potential of the following half cell at 298 K
$X|X^{2+}(0.001M)\|Y^{2+}(0.01M)|Y$ is _____ $\times 10^{-2}$ V (Nearest integer).

Given: $E^0_{X^{2+}|X}$=-2.36 V , $E^0_{Y^{+2}|Y}$

$E^0Y^{2+1Y} = +0.36V$, $\frac{2.303RT}{F}=0.06V$

Q. 27. An organic compound undergoes first order decomposition. If the time taken for the 60% decomposition is 540 s, then the time required for 90% decomposition will be is_____ s. (Nearest integer).
Given: ln 10 = 2.3; log 2 = 0.3

Q. 28. Consider the following equation:

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g), \Delta H = -190$ kJ

The number of factors which will increase the yield of SO_3 at equilibrium from the following is
A. Increasing temperature
B. Increasing pressure
C. Adding more SO_2
D. Adding more O_2
E. Addition of catalyst

Q. 29. Iron oxide FeO, crystallises in a cubic lattice with a unit cell edge length of 5.0Å. If density of the FeO in the crystal is 4.0 g cm^{-3}, then the number of FeO units present per unit cell is_____ (Nearest integer)
Given: Molar mass of Fe and O is 56 and 16 g mol^{-1} respectively. $N_A = 6.0 \times 10^{23}$ mol^{-1}

Q. 30. The graph of $\log \frac{x}{m}$ vs log p for an adsorption process is a straight line inclined at an angle of 45° with intercept equal to 0.6020. The mass of gas adsorbed per unit mass of adsorbent at the pressure of 0.4 atm is _____ $\times 10^{-1}$ (Nearest integer) Given: log 2 = 0.3010

Answer Key

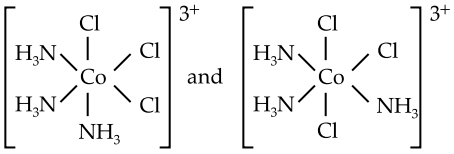
Q. No.	Answer	Topic Name	Chapter Name
1	(1)	Calculation of bond angle	Coordination chemistry
2	(3)	Pka value	Alcohol phenol and ether
3	(4)	Electrolytic refining of metals	Metallurgy
4	(2)	Separation technique	General organic chemistry
5	(2)	Werner coordination theory	Coordination chemistry
6	(2)	Nucleophilic substitution reaction	Halo alkane and Halo arenes
7	(4)	Heating effects	s block
8	(4)	Types of forces	States of matter
9	(3)	Classification of drugs	Chemistry in everyday life
10	(2)	Formula of a compounds	Amines
11	(4)	Clemmensen reduction	Aldehyde and ketones
12	(2)	Number of electron in a shell	Structure of atom
13	(4)	Identification of radial node	Structure of atom
14	(3)	Chemical properties of nitrogen containing compounds	Amines
15	(1)	Hybridization in coordination compounds	Coordination chemistry
16	(2)	Stability of carbocation	General organic chemistry
17	(2)	Solubility of compounds	Qualitative analysis
18	(2)	Identification of radical in acidic and basic medium	Qualitative analysis
19	(3)	Bond dissociation energy	p block
20	(4)	BOD value	Environmental chemistry
21	[3]	Reaction of compounds with sodium bicarbonate	Carboxylic acid
22	[150]	Calculation of temperature in an adiabatic process	Thermodynamics
23	[6]	Number of peptides linkAge	Biomolecules
24	[243]	Depression in freezing point	Liquid solution
25	[150]	Volume strength of hydrogen peroxide	Hydrogen
26	[275]	Standard reduction potential	Electro chemistry
27	[1350]	First order reaction	Chemical kinetics
28	[3]	Le chateliers principle	Chemical equilibrium
29	[4]	Calculation of number of unit cell	Solid state
30	[16]	Frendluich adsorption isotherm	Surface chemistry

Solutions

Section A

1. Option (1) is correct.

Fac-$[Co(NH_3)_3]$ is an isomer where all NH_3 groups and cl groups occupies adjacent positions



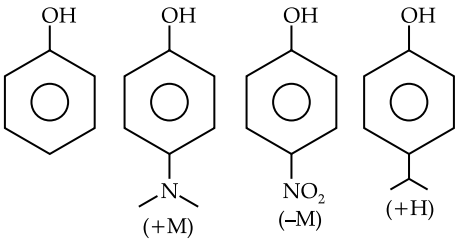
Fac-isomer Mer-isomer

Bond angle = 90° Bond angle = 90° and 180°

2. Option (3) is correct.

Acidic strength is inversely proportional to pka.

Acidic strength depends upon the substituent attached on the phenol .EWG increases the acidic strength by stabilising the phenoxide ion whereas EDG decreases the acidic character by destabilising the phenoxide ion.



(a) (b) (c) (d)

A order of acidic strength: $c > a > d > b$

Order of pK_a: $c < a < d < b$

3. Option (4) is correct.

In Electrolytic refining, the pure metal is used as cathode and impure metal is used as anode. Na_3AlF_6 and CaF_2 is added during electrolysis of Al_2O_3 to lower the melting point and increase conductivity.

4. Option (2) is correct.

List I (Mixture)	List II (Separation Technique)
$CHCl_3 + C_6H_5NH_2$	Distillation
$C_6H_{14} + C_5H_{12}$	Fractional Distillation
$C_6H_5NH_2 + H_2O$	Steam distillation
Organic compound in H_2O	Differential extraction

5. Option (2) is correct.

Mixture *X* contains 0.02 moles of $[Co(NH_3)_5 Br]SO_4$ and 0.02 moles of $[Co(NH_3)_5 Br]SO_4$ was prepared in two litres of solution. So, the concentration of $[Co(NH_3)_5 SO_4]Br$ and $[Co(NH_3)_5 Br] SO_4$ in solution are 0.01 mol L and 0.01 mol L respectively. During the reaction with $AgNO_3$ (excess), AgBr is precipitated as follows:

$$\underset{0.01\ mol/L}{[Co(NH_3)_5SO_4]}Br + \underset{(excess)}{AgNO_3} \rightarrow \underset{Soluble}{[Co(NH_3)_5SO_4]}NO_3 + \underset{\substack{Y\\0.01\ mol/L\ (\gamma)}}{AgBr\downarrow}$$

Hence, number of moles of Y = 0.01

On addition of excess $BaCl_2$, SO_4^{2-} ions of $[Co(NH_3)_5 Br]SO_4$ is precipitated in form of Z.

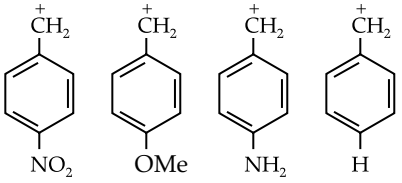
$$\underset{0.01\ mol/L}{[Co(NH_3)_5SO_4]} + \underset{(excess)}{BaCl_2} \rightarrow \underset{\substack{0.01 mol/L\\'Z'}}{BaSO_4\downarrow} + \underset{\substack{Soluble\\Z}}{[Co(NH_3)_5Br]Cl_2}$$

Hence, number of moles of Z = 0.01

Thus, the number of moles of Y and Z are 0.01 and 0.01 respectively.

6. Option (2) is correct.

The reactivity order of the given aryl halides towards S_N1 reaction will be decided by the stability of their corresponding carbocations.



(a) (b) (c) (d)

The benzyl carbocation is stabilised by resonance. The presence of $–NH_2$ group at the p–position promotes the resonance stabilisation due to +R effect. The –OMe group also promotes but to a lesser extent due to higher electronegativity of O–atom than N– atom. The $–NO_2$ group opposes the resonance stabilisation due to its –R effect.

$\therefore$ The correct order is $c > b > d > a$.

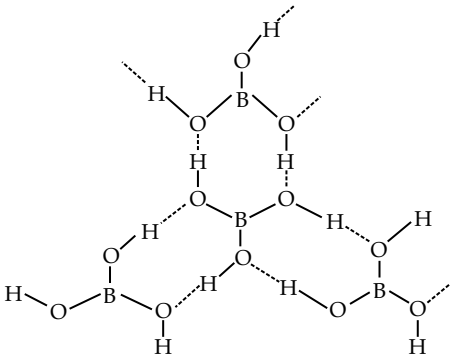
7. Option (4) is correct.

Due to the small size of Li^+, high polarising power and non availability of d orbitals. Lithinum nitrate when heated gives lithium oxide, Li_2O. This property of Li is in diagonal relationship with Mg.

$$4LiNO_3 \rightarrow 2Li_2O + 4NO_2 + O_2$$

8. Option (4) is correct.

Boric acid has strong hydrogen bonding while BF_3 does not. Therefore boric acid is solid.



9. Option (3) is correct.

Antihistamines are the class of drugs which inhibits the physiological effects of histamine, used especially in the treatment of allergies. They do not affect the secretion of acid in the stomach because they act on different receptors. The receptors present in the stomach do not interact with antihistamine.

10. Option (2) is correct.

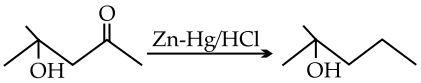
Nessler's reagent is an aqueous solution of potassium iodide, mercuric chloride hydroxide (KOH). It's molecular formula is K_2HgI_4.

Nessler's reagent is used as confirmatory test for ammonium ion NH_4^+.

Confirmatory test for ammonium ion: Take aqueous solution of salt in test tube and add Nessler's reagent mixture. Appearance of brown or yellow precipitate confirms the presence of NH_4^+ ion.

$$2K_2HgI_4 + NH_4Cl + 4KOH \rightarrow \underset{\text{brown ppt.}}{NH_2HgOHgI\downarrow} + 7KI + KCl + 3H_2O$$

11. Option (4) is correct.



The above conversion is correct and can be easily carried out by using Zn - Hg/HCl. This reaction is known as clemmensen reduction where carbonyl group is reduced methylene group (CH_2) using Zn-Hg/HCl

12. Option (2) is correct.

Maximum number of electrons that can be accommodated in shell = $2n^2$

($n = 4$)

$2(4)^2 = 32$

4*s*	2
4*p*	6
4d	10
4f	14
(Total)	32

13. Option (4) is correct.

$$\Psi_{2s} = \frac{1}{2\sqrt{2\pi}}\left(\frac{1}{a_0}\right)^{1/2}\left(2-\frac{r}{a_0}\right)e^{-r/2a_0}$$

At node, any wave function becomes zero, because at node, probability of finding an electron is zero.

Thus, $\Psi(2s) = 0$, which gives

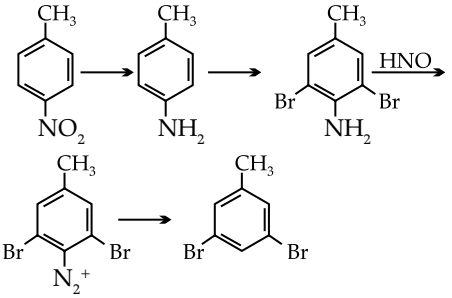
$$\Rightarrow \left(2-\frac{r}{a_0}\right) = 0$$

$$\Rightarrow \frac{r}{a_0} = 2$$

$$\Rightarrow r = 2a_0$$

As $r = r_0$ at node, so $r_0 = 2a_0$

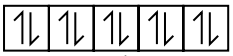
14. Option (3) is correct.

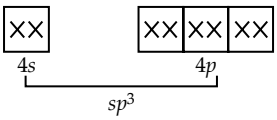


15. Option (1) is correct.

(A) $[Ni(Co)_4]$

The oxidation state of Ni is 0. The electronic configuration of Ni. is $3d^8 4s^2$. As Co is a Strong rigard it with pairup the electrons.

$[Ni(CO)_4]$ 

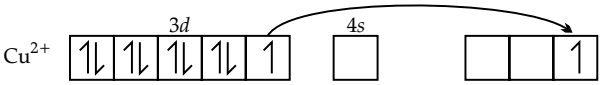


e^-s from ligands.

(B) $[Cu(NH_3)_4]^{2+}$

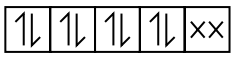
The oxidation state of as is +2. The electronic configuration of Cu^{2+} is $3d^9$.

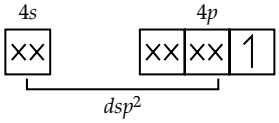
In this case Cu^{2+}



The electron in $3d_{x^2-y^2}$ orbital is promoted if 4*p* orbital

$[Cu(NH_3)_4]$

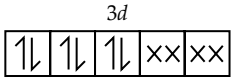
$[Cu(NH_3)_4]^{2+}$ 

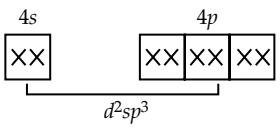


(C) $[Fe(NH_3)_6]^{2+}$

The oxidation state of Fe is Fe^{2+}. The electronic configuration of Fe^{2+} is $3d^6$ since NH_3 is a strong ligand, it will pair up the electrons.

$[Fe(NH_3)_6]^{2+}$

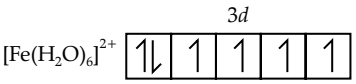
$[Fe(NH_3)_6]^{2+}$ 

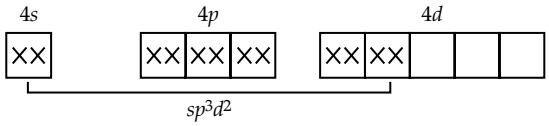


(D) $[Fe(H_2O)_6]^{2+}$

The oxidation state of Fe is 2+. since H_2O is a weak ligand, it will not pair up the electrons.

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



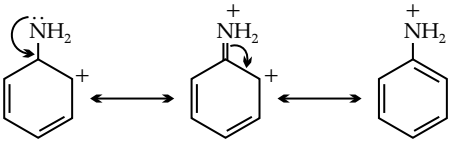


∴ A--I, B-II, c-IV, D-III

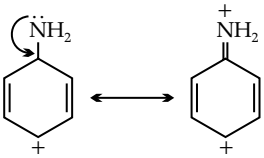
List (Complexes)	List II (Hybridisation)
$[Ni(CO)_4]$	sp^3
$[Cu(NH_3)_4]^{2+}$	dsp^2
$[Fe(NH_3)_6]^{2+}$	d^2sp^3
$[Fe(H_2O)_6]^{2+}$	sp^3d^2

16. Option (2) is correct.

The mock stable carbocation from the given carbocations, will be one whose the lone pair of N stabilises the positive sharge of the carbocation.

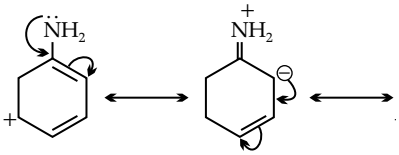


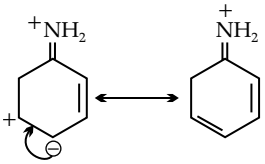
(A)



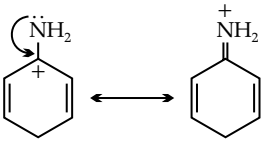
(B)

(No further congation to stabilise the carbocation)





(C)



(D)

Thus carbocation (C) would be most stable.

17. Option (2) is correct.

Out of the given elements, the chlorides of K and Ca are largely ionic. So, they will be more soluble in water and less soluble in organic solvents. Due to smaller size, Be^{+2}. will show more polarising power, hence, Be will have maximum covalent character & most soluble in organic solvent.

18. Option (2) is correct.

In acidic medium

$$2MnO_4^- + 10I^- + 16H^- \rightarrow 2Mn^{2+} + 5I_2 + 8H_2O$$

In neutral/faintly alkaline solution

$$2MnO_4^- + I^- + H_2O \rightarrow 2MnO_2 + 2OH^- + IO_3^-$$

19. Option (3) is correct.

Bond dissociation energy of E – H bond in hydrides of group 16 follows the order

$H_2O > H_2S > H_2Se > H_2Te$

This is because as we go down the group the bond length increases.

20. Option (4) is correct.

BOD– Biochemical Oxygen Demand is the amount of dissolved oxygen in a water body, required by microorganisms for the aerobic breakdown of organic matter in the water. Higher the value of BOD more is the amount of organic matter available for aerobic bacteria. this corresponds to the greater degree of pollution. Clean water have BOD value less than 5 ppm while highly polluted water have BOD value of 17 ppm or more. Thus the pond has very clean water.

Section B

21. The correct answer is [3].

The Given functional groups in these compounds are carboxylic acid asters, ethers and alcohols, Now we will check their solubilities;

	Carboxylic acid	Ester	Etarer	alcohols
cold $NaHCO_3$	✓	×	×	✓
cold NaOH	✓	×	×	✓
hot NaOH	✓	✓	×	✓

22. The correct answer is [150].

From first law of thermodynamics,

$$\Delta U = q + W$$

As we know that, for adiabatic condition, $q = 0$

$$\therefore \quad \Delta U = W$$

At constant volume,

$$\Delta U = nC_v\Delta T \qquad \ldots\ldots (2)$$

From eq (1) & (2), we have

$$W = nC_v\Delta T$$

Given:

$$T_i = 27^0C = (27 + 273)K = 300K$$

$$\Delta T = T_f - T_i = (T_f - 300)$$

$$C_v = 20J/K/mol$$

$$W = -3kJ = -3\times 10^3\ J$$

[∵ Work done by the gas is negative as it is expanding.]

Substituting all these values in eq^n (3), we have

$$-3000 = 1 \times 20 \times (T_f - 300)$$
$$T_f - 300 = -150$$
$$\Rightarrow \quad T_f = 300 - 150 = 150K$$

Hence the final temperature is 150K.

23. The correct answer is [6].

Number of peptide linkage = (amino acid – 1)
= 7 – 1 = 6

24. The correct answer is [243].

Given, $W_{H_2SO_4} = 38$ g; $W_{H_2O} = 62$g

$$\Delta T_f = i.\, kf.\, m$$
$$m = \frac{38}{98} \times \frac{1000}{62}$$
$$\Delta T_f = 2.67 \times 1.8 \times \frac{38}{98} \times \frac{1000}{62}$$
$$\Delta T_f = 30.05$$
$$F.P = 273 - 30 = 243\ K$$

25. The correct answer is [150].

$$H_2O_2 \rightarrow H_2O + \frac{1}{2}O_2$$

$$\therefore \text{ Moles of } H_2O_2 \text{ in solution} = \frac{50}{22.7} \times 2$$

$$\therefore \quad \text{Strength} = \frac{\frac{50}{22.7} \times 2}{1} \times 34$$
$$= 149.78$$
$$\approx 150$$

26. The correct answer is [275].

$x + y^{+2} \rightarrow y + x^{2+}$

E^0 Cell = E^0 Cathode – E^0 Anode

E^0 Cell = 0.36 – (–2.36) = 2.72 V

According to Nernst Equation,

$$E_{cell} = E^0 - \frac{2.303RT}{nF} \log \frac{\left[x^{+2}\right]}{\left[y^{+2}\right]}$$

$$E_{cell} = 2.72 - \frac{0.06}{2} \log \frac{\left[x^{+2}\right]}{\left[y^{+2}\right]}$$

$$E_{cell} = 2.72 - \frac{0.06}{2} \log \frac{0.001}{0.01}$$
$$= 2.72 + 0.03 = 2.75\ V$$
$$= 275 \times 10^{-2}\ V$$

27. The correct answer is [1350].

$$\frac{t_1}{t_2} = \frac{\frac{1}{K} \ln \frac{a_0}{0.4a_0}}{\frac{1}{K} \ln \frac{a_0}{0.a_0}} \Rightarrow \quad \frac{540}{t_2} = \frac{\ln \frac{10}{4}}{\ln 10}$$

$$\frac{540}{t_2} = \frac{1 - 0.6}{1}$$

$$\Rightarrow \frac{540}{t_2} = 0.4 \Rightarrow t_2 = \frac{540}{0.4} = 1350 \text{ sec}$$

28. The correct answer is [3].

The given reaction is exothermic.

For an exothermic reaction, on decreasing the temperature equilibrium will shift in forward direction. Hence, low temperature will be favoured for formation of SO_3. According to the Le Chatelier's principle, on increasing pressure, equilibrium will shift in the direction where lesser number of gaseous moles are present. Hence, on increasing pressure equilibrium will shift in forward direction for the given system. Hence, high pressure is favourable for greater yield of SO_3.

The increased yield of SO_3 at equilibrium will be due to:

B. Increasing pressure

C. Adding more SO_2

D. Adding more O_2

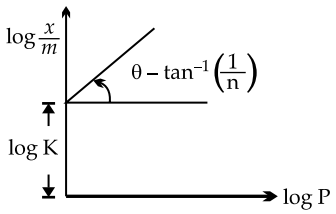
29. The correct answer is [4].

$$d = \frac{z \times m}{a^3}$$

$$4 = \frac{z \times 72}{6 \times 10^{23} (5 \times 10^{-8})^3}$$

$$4 = \frac{z \times 72}{6 \times 125 \times 10^{-1}}$$
$$= z \approx 4$$

30. The correct answer is [16].



From the graph,

$$\text{Slope} = \frac{1}{n} = \tan 45^0 = 1$$

intercept = Log k = 0.6020 = log 4 K = 4

Accoding to freundlich adsorption isotherm

$$\therefore \quad \frac{x}{m} = K.\, P^{1/n} \text{ or } \frac{x}{m} = 4(0.4) = 1.6$$

$$\frac{x}{m} = 1.6 = 16 \times 10^{-1}$$

❐❐