JEE (Main) CHEMISTRY SOLVED PAPER

2023
06th April Shift 2

Section A

1. Match List I with List II

List I (Natural Amino acid)	List II (One Letter Code)
A. Arginine	(I) D
B. Aspartic acid	(II) N
C. Asparagine	(III) A
D. Alanine	(IV) R

Choose the correct answer from the options given below:

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

2. Formation of which complex, among the following, is not a confirmatory test of Pb^{2+} ions

(1) lead sulphate **(2)** lead nitrate
(3) lead chromate **(4)** lead iodide

3. The volume of 0.02 M aqueous HBr required to neutralize 10.0 mL of 0.01 M aqueous $Ba(OH)_2$ is (Assume complete neutralization)

(1) 5.0 mL **(2)** 10.0 mL **(3)** 2.5 mL **(4)** 7.5 mL

4. Group-13 elements react with O_2 on amorphous form to form oxides of type M_2O_3(M = element). Which among the following is the most basic oxide?

(1) Al_2O_3 **(2)** Tl_2O_3 **(3)** Ga_2O_3 **(4)** B_2O_3

5. The IUPAC name of $K_3[Co(C_2O_4)_3]$ is-

(1) Potassium tris (oxalate) cobaltate (III)
(2) Potassium trioxalatocobalt (III)
(3) Potassium trioxalatocobaltate (III)
(4) Potassium tris (oxalate) cobalt (III)

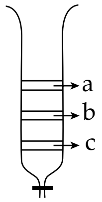
6. If the radius of the first orbit of hydrogen atom is a_0, then de Broglie's wavelength of electron in 3rd orbit is

(1) $\frac{\pi a_0}{6}$ **(2)** $\frac{\pi a_0}{3}$ **(3)** $6\pi a_0$ **(4)** $3\pi a_0$

7. The group of chemical used as pesticide is

(1) Sodium chlorate, DDT, PAN
(2) DDT, Aldrin
(3) Aldrin, Sodium chlorate, Sodium arsinite
(4) Dieldrin, Sodium arsinite, Tetrachlorothene

8. From the figure of column, chromatography given below, identify incorrect statements.



A. Compound 'c' is more polar than 'a' and 'b'
B. Compound 'a' is least polar
C. Compound 'b' comes out of the column before 'c' and after 'a'
D. Compound 'a' spends more time in the column

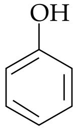
Choose the correct answer from the options given below:

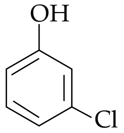
(1) A, B and D only **(2)** A, B and C only
(3) B and D only **(4)** B, C and D only

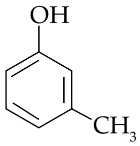
9. Ion having highest hydration enthalpy among the given alkaline earth metal ions is:

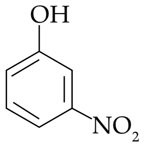
(1) Be^{2+} **(2)** Ba^{2+} **(3)** Ca^{2+} **(4)** Sr^{2+}

10. The strongest acid from the following is

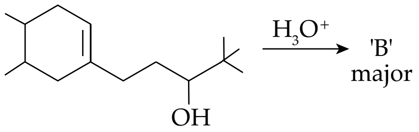
(1) 

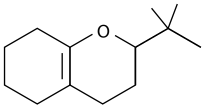
(2) 

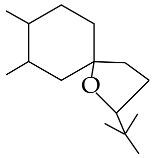
(3) 

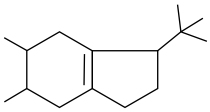
(4) 

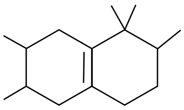
11. In the following reaction 'B' is



(1) 

(2) 

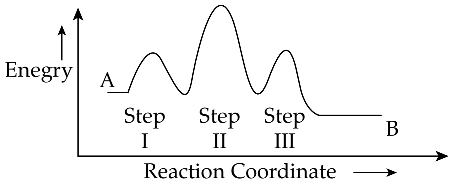
(3) 

(4) 

12. Structures of $BeCl_2$ in solid state, vapour phase and at very high temperature respectively are:

(1) Polymeric, Dimeric, Monomeric
(2) Dimeric, Polymeric, Monomeric
(3) Monomeric, Dimeric, Polymeric
(4) Polymeric, Monomeric, Dimeric

13. Consider the following reaction that goes from A to B in three steps as shown below:



Choose the correct option

Number of intermediates	Number of Activated complex	Rate determining step
(1) 2	3	II
(2) 3	2	II
(3) 2	3	III
(4) 2	3	I

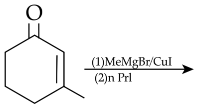
14. The product, which is not obtained during the electrolysis of brine solution is
(1) HCl **(2)** NaOH **(3)** Cl_2 **(4)** H_2

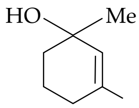
15. Which one of the following elements will remain as liquid inside pure boiling water?
(1) Li **(2)** Ga **(3)** Cs **(4)** Br

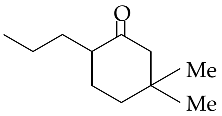
16. Given below are two statements: one is labelled as "Assertion A" and the other is labelled as "Reason R"
Assertion A: In the complex $Ni(CO)_4$ and $Fe(CO)_5$, the metals have zero oxidation state.
Reason R: Low oxidation states are found when a complex has ligands capable of π–donor character in addition to the σ–bonding.
In the light of the above statement, choose the most appropriate answer from the options given below
(1) A is not correct but R is correct.
(2) A is correct but R is not correct
(3) Both A and R are correct and R is the correct explanation of A
(4) Both A and R are correct but R is NOT the correct explanation of A.

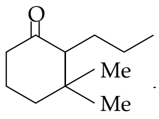
17. Given below are two statements:
Statement I: Morphine is a narcotic analgesic. It helps in reliving pain without producing sleep.
Statement II: Morphine and its derivatives are obtained from opium poppy.
In the light of the above statements, choose the correct answer from the options given below
(1) Statement I is true but statement II is false
(2) Both statement I and statement II are true
(3) Statement I is false but statement II is true
(4) Both Statement I and Statement II are false

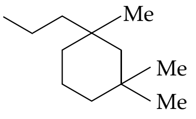
18. Find out the major product from the following reaction.



(1)


(2)


(3)


(4)


19. During the reaction of permanganate with thiosulphate, the change in oxidation of manganese occurs by value of 3. Identify which of the below medium will favour the reaction
(1) aqueous neutral
(2) aqueous acidlic
(3) both aqueous acidic and neutral
(4) both aqueous acidic and faintly alkaline

20. Element not present in Nessler's reagent is
(1) K **(2)** N **(3)** I **(4)** Hg

Section B

21. The standard reduction potentials at 298 K for the following half cells are given below:
$NO_3^- + 4H^+ + 3e^- \rightarrow NO(g) + 2H_2O$ $E^0 = 0.97V$
$V^{2+}(aq) + 2e^- \rightarrow V$ $E^0 = -1.19V$
$Fe^{3+}(aq) + 3e^- \rightarrow Fe$ $E^0 = -0.04V$
$Ag^+(aq) + e^- \rightarrow Ag(s)$ $E^0 = 0.80V$
$Au^{3+}(aq) + 3e^- \rightarrow Au(S)$ $E^0 = 1.40V$
The number of metal(s) which will be oxidized by NO_3^- in aqueous solution is ____________

22. Number of crystal system from the following where body centred unit cell can be found, is__________
Cubic, tetragonal, orthorhombic, hexagonal, rhombohedral, monoclinic, triclinic

23. Among the following the number of compounds which will give positive iodoform reaction is______
(a) 1–Phenylbutan–2–one
(b) 2–Methylbutan–2–ol
(c) 3–Methylbutan–2–ol
(d) 1–Phenylethanol
(e) 3,3–dimethylbutan–2–one
(f) 1–Phenylpropan –2–ol

24. Number of isomeric aromatic amines with molecular formula $C_8H_{11}N$, which can be synthesized by Gabriel Phthalimide synthesis is_________

25. Consider the following pairs of solution which will be isotonic at the same temperature. The number of pairs of solutions is/are______________
A. 1 M aq. NaCl and 2 M aq. Urea
B. 1 M aq. $CaCl_2$ and 1.5 M aq. KCl
C. 1.5 M aq. $AlCl_3$ and 2M aq. Na_2SO_4
D. 2.5 M aq. KCl and 1 M aq. $Al_2(SO_4)_3$

26. The number of colloidal systems from the following, which will have 'liquid' as the dispersion medium, is_________
Gem stones, paints, smoke, cheese, milk, hair cream, insecticide sprays, froth, soap lather

27. In an ice crystal, each water molecule is hydrogen bonded to_____________ neighbouring molecules.

28. Consider the following date
Heat of combustion of H_2 (g) = –241.8 kJ mol^{-1}
Heat of combustion of C(s) = –393.5 kJ mol^{-1}
Heat of combustion of $C_2H_5OH(l)$ = –1234.7 kJ mol^{-1}
The heat of formation of $C_2H_5OH(l)$ is (–) _________________kJ mol^{-1} (Nearest integer).

29. The equilibrium composition for the reaction $PCl_3 + Cl_2 \rightarrow PCl_5$ at 298 K is given below:
$[PCl_3]_{eq} = 0.2 mol\ L^{-1}, [Cl_2]_{eq} = 0.1\ mol\ L^{-1}$,
$[PCl_5]_{eq} = 0.40\ mol\ L^{-1}$
If 0.2 mol of Cl_2 is added at the same temperature, the equibrium concentrations of PCl_5 is _____$\times 10^{-2}$ mol L^{-1}

30. The number of species having a square planar shape from the following is________________
XeF_4, SF_4, SiF_4, BF_4^-, BrF_4^- $[Cu(NH_3)_4]^{2+}$, $[FeCl_4]^{2-}$, $[PtCl_4]^{2-}$

Answer Key

Q. No.	Answer	Topic name	Chapter name
1	(2)	Amino Acid	Biomolecules
2	(2)	Qualitative Analysis of Cations	Principles Related to Practical Chemistry.
3	(2)	Stoichiometry	Basic concepts of Chemistry
4	(2)	Group-13	p-Block
5	(3)	IUPAC Name	Coordination Compounds
6	(3)	De-Broglie Principle	Atomic Structure
7	(2)	Pesticides	Chemistry in Everyday Life
8	(2)	Chromatography	Surface Chemistry
9	(1)	Group 2	S-Block Elements
10	(4)	Acidic Strength	Organic Compounds Containing O
11	(4)	Chemical Reaction of Alcohols	Organic Compounds Containing O
12	(1)	Alkaline Earth Elements	s-block elements
13	(1)	Complex Reaction	Chemical Kinetics
14	(1)	Product of Electrolysis	Electrochemistey
15	(2)	Group-13	p-Block Elements
16	(2)	Metal Carbonyl	Coordination Compounds
17	(2)	Drugs	Chemistry in Everyday Life
18	(3)	Chemical Properties of Ketones	Organic Compounds Containing Oxygen
19	(1)	$KMNO_4$	d and f Block
20	(2)	Detection of Ammonia	Principle Related to Practical Chemistry
21	[3]	Reactivity Series of Metal	Electrochemistry
22	[3]	Solid state	States of Matter
23	[4]	Iodoform Test	Compounds Containing Oxygen
24	[0]	Preparation of Amines	Amines
25	[3]	Osmotic Pressure	Solution
26	[5]	Classification of Colloids	Surface Chemistry
27	[2]	Structure of Water	Hydrogen
28	[278]	Enthalpy	Thermodynamics
29	[48]	Equilibrium Constant	Equilibrium
30	[4]	VBT	Chemical Bonding and Molecular Structure.

Solutions

Section A

1. Option (2) is correct.

Natural amino acids	One letter code
Arginine	R
Aspartic acid	D
Asparagine	N
Alanine	A

2. Option (2) is correct.
The formation of complex, lead nitrate $Pb(NO_3)_2$ is not a confirmatory test of Pb^{2+} ions as it is soluble. The other complexes can be used to detect the presence of Pb^{2+} ion due to formation of following precipitate.
$PbSO_4$ – White ppt
$PbCrO_4$ – Yellow ppt
PbI_2 – Yellow ppt

3. Option (2) is correct.

$$\text{M.eq. of HBr} = \text{M.eq. of } Ba(OH)_2$$
$$M \times n_1 \times V_1(\text{mL}) = M_2 \times n_2 \times V_2(\text{mL})$$
$$0.02 \times 1 \times V_1 = 0.02 \times 2 \times 10$$
$$V_1 = 10 \text{ mL}$$

4. Option (2) is correct.
As the metallic character increases basic character of oxide increases. Thus, the basic character increases down the group.
$B_2O_3 < Al_2O_3 < Ga_2O_3 < In_2O_3 < Tl_2O_3$
acidic amphoteric basic

5. Option (3) is correct.
The IUPAC name of $K_3[Co(C_2O_4)_3]$ is potassium trioxalatocobaltate(III). Here coordination utility is anionic complex thus the name of the metal will end with –ate.

6. Option (3) is correct.
Given: Radius of first Orbit of H-atom = a_0
According to De-Broglie principle
$2\pi r = n\lambda$

Also, $r = \dfrac{n^2}{z}a_0$ for H atom $z = 1$ and 1st orbit $n = 1$

$\therefore\ r = a_0$

For 3rd orbit $n = 3$

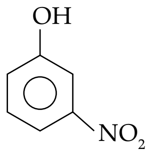
$3 \times \lambda = 2\pi \times \dfrac{(3)^2}{1}a_0 \Rightarrow \lambda = 2\pi \times \dfrac{9}{3}a_0 = 6\pi a_0$

7. **Option (2) is correct.**
DDT (Dichloro Diphenyl trichloroethane) and Aldrin are used as a pesticide.

8. **Option (2) is correct.**
Adsorption of compound is directly proportional to the polarity of a compound. The compound which gets more adsorb will take maximum time in column. From the figure, it is clear that the order of polarity is a>b>c. Since a is maximum polar will spends maximum time in column than b and c.
Thus, incorrect statements are A, B and C only.

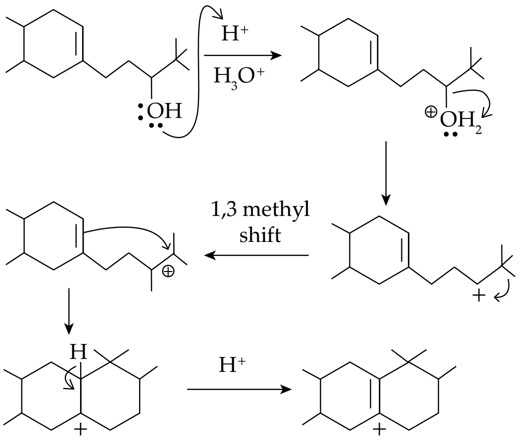
9. **Option (1) is correct.**
Hydration enthalpy is defined as the amount of energy released when 1 mole of gaseous are diluted.
As we know, hydration enthalpy is inversely proportional to the size of an ion. It decreases down the group (as the size is increasing).
Thus, Be^{2+} will have the highest hydration enthalpy.

10. **Option (4) is correct.**
The presence of electron withdrawing groups increases the acidity in a compound whereas the electron donating group decreases it. Thus m-nitrophenol.

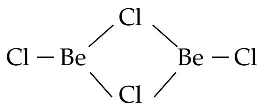


will be the strongest acid.

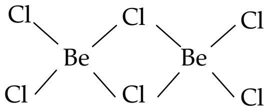
11. **Option (4) is correct.**



12. **Option (1) is correct.**
$BeCl_2$ exist as a polymer in case of solid state, dimeric from in vapour phase and at very high temperature it exhibit its monomeric form



$BeCl_2$ in vapour phase (dimeric)

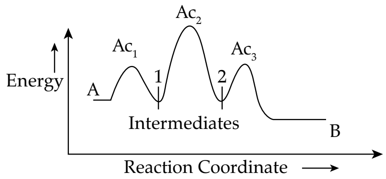


$BeCl_2$ in solid phase (polymeric)

Cl – Be – Cl

temperature > 1200 K (Monomeric form)

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



In the above graph A is the reactant whereas B is the product. The peaks of the curves will give the number of activated complexes whereas the troughs will give the number of intermediate. This is because the activated complex would have higher energy than the intermediate. Also the rate determining step would be one, that is slowest step.
Number of intermediate = 2
Number of Activated Complex = 3
Rate determining step would be II

14. **Option (1) is correct.**
Brine is the aqueous solution of sodium chloride. The reaction which occur during electrolysis of brine solution are as follows.

$$NaCl \rightleftharpoons Na^+ + Cl^-,\quad H_2O \rightleftharpoons OH^- + H^+$$

$$2H^+ + 2e^- \rightarrow H_2\uparrow \quad \text{(at cathode)}$$

$$2Cl^- \rightarrow Cl_2\uparrow + 2e^- \quad \text{(at anode)}$$

$$Na^+ + OH^- \rightarrow NaOH$$

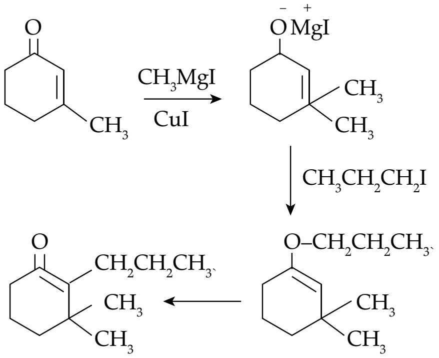
Thus, HCl will not obtained during electrolysis of brine solution.

15. **Option (2) is correct.**
The element which is unreactive with water will remain as liquid inside pure boiling water. Among the given options Ga is an element that will react with water above 100°C (ie., above its boiling point)

16. **Option (2) is correct.**
In complexes $Ni(CO)_4$ and $Fe(CO)_5$, the metals have zero oxidation state as CO is a neutral ligand. Low oxidation states of metals are stabilized by synergic effect.

17. **Option (2) is correct.**
Morphine is a narcotic analgesic. It helps in reliving pain with producing sleep. Morphine and its derivatives are obtained from opium poppy.

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



19. Option (1) is correct.

The reaction of permanganate with thiosulphate is as follows

$$\overset{+7}{KMnO_4} + \overset{+2}{S_2O_3^{2-}} \rightarrow \overset{+6}{SO_4^{2-}} + \overset{+4}{MnO_2}$$

This reaction takes place in neutral or faintly alkaline medium.

20. Option (2) is correct.

The formula for nessler's reagent is $K_2[HgI_4]$

Section B

21. Correct answer is [3].

The metals that has lesser value of reduction potential than that of NO_3^- will get oxidized by it in aqueous solution. Thus V, Fe and Ag can be oxidized by NO_3^- in aqueous solution.

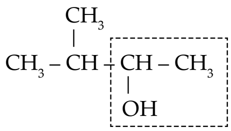
22. Correct answer is [3].

Body centered unit cell can be found in cubic, tetragonal and orthorhombic crystal system.

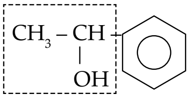
23. Correct answer is [4].

Iodoform test will be given by those compounds which have $CH_3-\underset{\underset{O}{||}}{C}$ or CH_3CHOH groups in them.

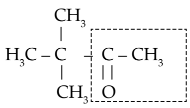
Among the given compounds 3-methylbutane-2butan-2-ol, 1-phenyl ethanol, 3,3-dimethylbutane 2-one and 1- phenyl propane -2ol have such groups present in them. Thus they will show iodoform test.



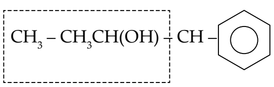
3-methylbutane -2-ol



1-phenylethanol



3,3-dimethylbutane-2-one



1-phenylpropan-2-ol

24. Correct answer is [0].

The aromatic amines cannot be prepared by Gabriel-Phthalimide

25. Correct answer is [3].

Solutions having same osmotic pressure are called isotonic solution. π = iCRT

For osmotic pressure to be same, the value of iC should be same for two solutions. Thus isotonic solutions are as follows:

1 M aq $CaCl_2$ and 1.5 M aq KCl

$$CaCl_2 \rightarrow Ca^{2+} + 2Cl^-$$

$i = 3 \Rightarrow iC = 3 \times 1 = 3$ M

$KCl \rightarrow K^+ + Cl^- \quad \therefore iC = 2 \times 1.5 = 3M$

1.5M aq $AlCl_3$ and 2 M aq. Na_2SO_4

$$AlCl_3 \rightarrow Al^{3+} + 3Cl^-$$

$i=4 \therefore iC = 4 \times 1.5 = 6M$

$Na_2SO_4 \rightarrow 2Na^+ + SO_4^{2-} \quad i=3 \therefore iC=3\times2=6M$

2.5 M aq KCl and 1 M $Al_2(SO_4)_3$

For KCl $iC = 2 \times 2.5 = 5M$`

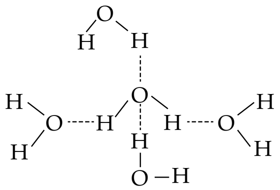
For $Al_2(SO_4)_3$ IC = 5 × 1 = 5M

26. Correct answer is [5].

The colloidal solutions which will have liquid as the dispersion medium are paints, milk, hair cream, froth and soap lather.

27. Correct answer is [2].

In an ice crystal, each water molecule is hydrogen bonded to two neighboring molecules.



28. Correct answer is [278].

Given;

$3H_2 + \frac{3}{2}O_2 \rightarrow 3H_2O \qquad \Delta H_c = -241.8$ KJ/mol

$2\times[C + O_2 \rightarrow CO_2] \qquad \Delta H_c = -393.5$ KJ/mol

$C_2H_5OH + O_2 \rightarrow 2CO_2 + 3H_2O \qquad \Delta H_c = -1234.7$ KJ/mol

The reaction for formation of C_2H_5OH is

$2Cl(s) + 3H_2(g) + \frac{1}{2}O_2(g) \rightarrow C_2H_5OH(l) \quad \Delta H_f = ?$

ΔH_f = 3×(i) + 2 × (ii)—(iii)

= 3 × –244.8 + 2 × –393.5 – (–1234.7)

= –277.7 KJ/mol or 278 KJ/mol

29. Correct answer is [48].

$$PCl_3 + Cl_2 \rightleftharpoons PCl_5$$

Initial conc.	0.2	0.1	0.40
At equb^m	0.2+x	0.1+0.2–x	0.40+x

$$K_c = \frac{[PCl_5]}{[PCl_3][Cl_2]} \Rightarrow K_c = \frac{[0.40]}{[0\text{-}2][0.1]} = 20$$

The value of equilibrium constant remain same even after adding 0.2 mol of Cl_2

$$K_c = 20 = \frac{0.4 + x}{(0.2 - x)(0.3 - x)}, \quad x = 0.084$$

The concentration $[PCl_5]$ = 0.40 + 0.084

= 0.484 = 48.4 × 10^{-2} mol/L

30. Correct answer is [4].

The shapes of molecules given in the question are as follows:

XeF_4	–	square planar
BrF_4	–	square planar
$[Cu(NH_3)_4]^{2+}$	–	square planar
SiF_4	–	tetrahedral
SF_4	–	See Saw
BF_4	–	tetrahedral
$[FeCl_4]^{2-}$	–	tetrahedral
$[PtCl_4]^{2-}$	–	square planar

Thus four species have a square planar shape.

❑❑