HALF YEARLY EXAMINATION-2023

CHEMISTRY ANSWER KEY –DINDIGUL DISTRICT

PART- I

I. CHOOSE THE CORRECT ANSWER:

1. Which of the following compounds used for depressing agents in froth floatation process?
Ans: a) NaCN

2. The compound that is used for nuclear reactors as protective shields and control rod is
Ans: a) metal boride

3. Structure and hybridisationof BrF_3 Ans: c) T-shaped and sp^3d

4 . Assertion: Ce^{4+} is used as an oxidizing agent in volumetric analysis.
Reason : Ce^{4+} has the tendency of attaining +3 oxidation state.
Ans: a) both assertion and reason are true and reason is the correct explanation of assertion

5. Which type isomerism exhibit the following coordination compounds $[Co(NH_3)_4Br_2]Cl$ and $[(Co(NH_3)_4ClBr]Br$
Ans: d) ionization isomerism

6. The number of carbon atoms per unit cell of diamond is Ans: a) 8

7. The half-life period of a radioactive element is 140 days. After 560 days, 1 g element is will be reduce to Ans: d) [1/16]g

8. Solubility product of $BaSO_4$ is Ans: c) s^2

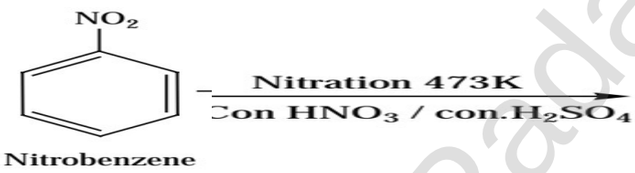
9. Which of the following electrolytic solution has the least specific conductance?
Ans: b) 0.002 N

10. Match the following
A) Pure nitrogen - i) chlorine
B) Haber process - ii) sulphuric acid
C) Contact process - iii) ammonia
D) Deacons process - iv) sodium azide Ans: d) A- iv B-iii C-ii D-i

11. Which of the following compounds used for hypnotic? Ans: A) Acetaldehyde

12. Williamson synthesis of preparing diethyl ether is a/an Ans: b) SN^2 reaction

13.



Nitrobenzene

Ans: C) 1,3,5-trinitrobenzene

14. In a protein, various amino acids linked together by Ans: a) peptide bond

15. Drugs that bind to the receptor site and inhibit its natural function are called
Ans: a) antagonists

PART- II

II. ANSWER ANY SIX QUESTIONS. Q.NO. 24 IS COMPULSORY 6×2=12

16. What are the limitations of Ellingham diagram?
- Ellingham diagram is constructed based only on thermodynamic considerations.
- It givesinformation about the thermodynamic feasibility of a reaction.
- It does not tell anythingabout the rate of the reaction.
- The interpretation of ΔG is based on the assumption that the reactants are in equilibrium with the products which is not always true

17. What are interhalogen compounds ? Give two examples.
Each halogen combines with other halogens to form a series of compounds called interhalogen compounds.
Ex: ClF, BrF_3, IF_5

18. Write the IUPAC ligand name for the following
a) H_2O – aqua b) $C_2O_3^{2-}$ – oxalato c) NH_3 – ammine d) Cl^- – chlorido

19. Define Unit cell.
A basic repeating structural unit of a crystalline solid is called a unit cell.

20. State Ostwald's dilution law.
Ostwald's dilution law relates the dissociation constant of the weak acid (Ka) with its degree of dissociation (α) and the concentration (c). Degree of dissociation (α) is the fraction of the total number of moles of a substance that dissociates at equilibrium.

$$K_a = \frac{\alpha^2 c}{1-\alpha}$$

21. What are catalytic poisions?

Certain substances when added to a catalysed reaction, decreases or completely destroys the activity of catalyst and they are often known as catalytic poisons.

For example, In the reaction, $2SO_2 + O_2 \rightarrow 2SO_3$ with a Pt catalyst, the poison is As_2O_3. i.e., AS_2O_3 destroys the activity of Pt. AS_2O_3 blocks the activity of the catalyst. So, the activity is lost.

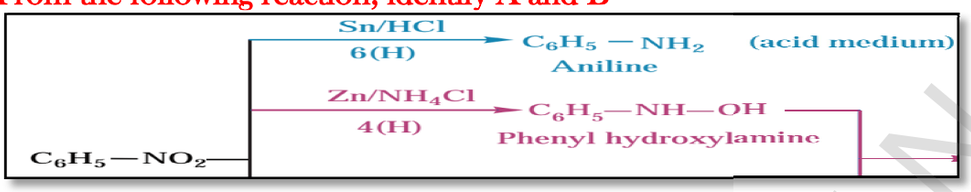
22. Write the test for carboxylic acid group.

- In aqueous solution, carboxylic acid turn blue litmus red.
- Carboxylic acids give brisk effervescence with. sodium bicarbonate due to the evolution of carbon – di – oxide.
- When carboxylic acid is warmed with alcohol and conc H_2SO_4 it forms an ester, which is detected by its fruity odour.

23. What are epimers ? Give example.

- Sugar differing in configuration at an asymmetric centre is known as epimers.
- Epimers are carbohydrates which vary in one position for the placement of the -OH group.
- Examples are for D-glucose and D-galactose.

24. From the following reaction, identify A and B



PART- III

II. ANSWER ANY SIX QUESTIONS. Q.NO. 33 IS COMPULSORY 6×3=18

25. Give the uses of borax.

- Borax is used for the identification of coloured metal ions.
- In the manufacture optical and borosilicate glass, enamels and glazes for pottery.
- It is also used as a flux in metallurgy and also acts as a good preservative.

26. Why d- block elements exhibit variable oxidation state ?

- There is a very small energy difference in between (n-1)d and ns orbitals.
- Electrons of (n-1)d orbitals as well as ns-orbitals take part in bond formation.
- Due to orbitals of two different energy levels taking part in bond formation variable oxidation states are possible.

27. Calculate the magnetic moment and magnetic property of $[CoF_6]^{3-}$

- $[CoF_6]^{3-}$ complex has Co in +3 oxidation state.
- (Co) = [Ar] $3d^7\ 4s^2$ (Co^{+3}) = [Ar] $3d^6$
- No. of Co^{+3} unpaired electrons is 4
- So, spin only magnetic moment = $\sqrt{4\ (4+2)} = \sqrt{24} = 4.8$ BM

28. Distinguish between tetrahedral and octahedral voids.

Tetrahedral void	Octahedral void
Void in a crystal is surrounded by four spheres	Void is surrounded by six spheres
A sphere of second layer is above the void of the first layer	The voids in the first layer are partially covered by the spheres of layer
Three in the lower and one in upper layer .	three in the lower layer and three in the upper layer.
When the centres of these four spheres are joined a tetrahedron is formed	When the centers of these six spheres are joined an octahedron is formed

29. Why is AC current used instead of DC in measuring the electrolytic conductance?

- AC current is used for this to prevent electrolysis of the solution.
- If we apply DC current to the cell the positive ions will be attracted to the negative plate and the negative ions to the positive plate.
- This will cause the composition of the electrolyte to change while measuring the equivalent conductance.
- So DC current through the conductivity cell will lead to the electrolysis of the solution taken in the cell.

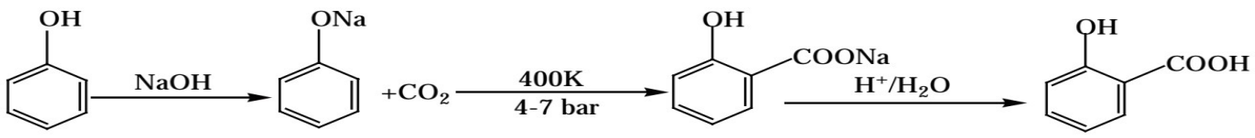
30. Peptizing agent is added to convert precipitate into colloidal solution. Explain with an example.

By addition of suitable electrolytes, precipitated particles can be brought into colloidal state. The process is termed as peptisation and the electrolyte added is called peptising or dispersing agent

$$\underset{\text{Precipitate}}{AgCl} \xrightarrow{HCl} \underset{\text{Colloid}}{AgCl}$$

31. Explain Kolbe's reaction.

Phenol is first converted into sodium phenoxide which is more reactive than phenol towards electrophilic substitution reaction with CO_2. Treatment of sodium phenoxide with CO_2 at 400K, 4 -7 bar pressure followed by acid hydrolysis gives salicylic acid.



phenol sodium phenoxide sodium salicylate Salicyclic acid

32. Write a note on vulcanization of rubber.

- Natural rubber is very soft and brisky.
- Its properties can be improved by a process called vulcanization.
- Natural rubber is mixed with 3 – 5% sulphur and heated at 100 – 150°C causes cross linking of the cis – 1, 4 polyisoprene chains through disuiphide (– S – S –) bonds.
- The physical properties of rubber can be altered by controlling the amount of sulphur that is used for vulcanization.

33. Show that in case of first order reaction the time required for 99.9% completion is nearly ten times the time required for half completion of the reaction.

Let $[A_0] = 100$ When $t = t_{99.9\%}$; $[A] = (100 - 99.9) = 0.1$

$$k = \frac{2.303}{t}\log\left(\frac{[A_0]}{[A]}\right)$$

$$t_{99.9\%} = \frac{2.303}{k}\log\left(\frac{100}{0.1}\right)$$

$$t_{99.9\%} = \frac{2.303}{k}\log 1000$$

$$t_{99.9\%} = \frac{2.303}{k}(3)$$

$$t_{99.9\%} = \frac{6.909}{k}$$

$$t_{99.9\%} \simeq 10 \times \frac{0.69}{k}$$

$$t_{99.9\%} \simeq 10\, t_{1/2}$$

PART- IV

IV. ANSWER THE FOLLOWING QUESTIONS:

34. a) i) What is the auto-reduction?

Simple roasting of some of the ores give the crude metal. In such cases, the use of reducing agents is not necessary. For example, mercury is obtained by roasting of its ore cinnabar (HgS)

$$HgS_{(s)} + O_{2(g)} \rightarrow Hg_{(l)} + SO_2 \uparrow$$

ii) Describe a method for refining nickel.

The impure nickel is heated in a stream of carbon monoxide at around 350K. The nickel reacts with the CO to form a highly volatile nickel tetracarbonyl. The solid impurities are left behind.

$$Ni\ (s) + 4\ CO\ (g) \rightarrow Ni(CO)_4(g)$$

On heating the nickel tetracarbonyl around 460 K, the complex decomposes to give pure metal.

$$Ni(CO)_4\ (g) \rightarrow Ni\ (s) + 4\ CO\ (g)$$

[OR]

b) i) Write a note on Fischer tropsch synthesis ?

The reaction of carbon monoxide with hydrogen at a pressure of less than 50 atm using metal catalysts at 500-700 K yields saturated and unsaturated hydrocarbons.

$$nCO + (2n+1)H_2 \longrightarrow C_nH_{(2n+2)} + nH_2O$$

$$nCO + 2nH_2 \longrightarrow C_nH_{2n} + nH_2O$$

ii) How will you identify borate radical?

- When boric acid or borate salt is heated with ethyl alcohol in presence of concentrated H_2SO_4, an ester triethyl borate is formed.

- The Vapour of this ester burns with a green edged flame and this reaction is used to identify the presence of borate.

$$H_3BO_3 + 3C_2H_5OH \xrightarrow[H_2SO_4]{\text{Conc.}} B(OC_2H_5)_3 + 3H_2O$$

35. a) i) How is bleaching powder prepared?

Bleaching powder is synthesized by the action of chlorine gas on dry slaked lime($Ca(OH)_2$)

$$2Ca(OH)_2 + 2Cl_2 \rightarrow Ca(OCl)_2 + CaCl_2 + 2H_2O$$

ii) Sulphuric acid is a dehydrating agent give example.

- Sulphuric acid is highly soluble in water and has strong affinity towards water and hence it can be used as a dehydrating agent.
- When dissolved in water it forms mono ($H_2SO_4.H_2O$) and di ($H_2SO_4.2H_2O$) hydrates and the reaction is exothermic.

$$C_{12}H_{22}O_{11} + H_2SO_4 \rightarrow 12C + H_2SO_4.11H_2O$$

[OR]

b) What is lanthanoid contraction ? Give reason. Explain its consequences.

- As we move across 4f series, the atomic and ionic radii of lanthanoids show gradual decrease with increase in atomic number.
- This decrease in ionic size is called lanthanoid contraction.

Effects (or) Consequences of lanthanoid contraction:

1. Basicity differences: As we move from Ce^{3+} to Lu^{3+} , the basic character of Ln^{3+} ions decrease. Due to the decrease in the size of Ln^{3+} ions, the ionic character of Ln – OH bond which results in the decrease in the basicity.
2. Similarities among lanthanoids – In the complete f-series only 10 pm decrease in atomic radii and 20 pm decrease in ionic radii is observed. Because of this very small change in radii of lanthanoids, their chemical properties are quite similar.

The elements of second and third transition series resemble each other more closely than the elements of first and second transition series due to lanthanoid contraction.

36. a) What is meant by term co-ordination number? What is the co-ordination number of atoms in a bec structure ?

Coordination number – The number of nearest neighbours that surrounding a particle in a crystal is called the coordination number of that particle.

Coordination number of atoms in a bcc structure is 8

ii) Write Arrhenius equation and explain the terms involved.

$$k = Ae^{-Ea/RT}$$

A = Arrhenius factor (frequency factor) R = Gas constant k = Rate constant

E_a = Activation energy T = Absolute temperature (in K)

[OR]

B) i) Derive Henderson equation.

1. The concentration of hydronium ion in acidic buffer solution depends on the ratio of concentration of the weak acid to the concentration of its conjugate base present in the solution. i.e., $[H_3O^+] = K_a \frac{[acid]_{eq}}{[base]_{eq}}$

2. The weak acid is dissociated only to a small extent. Moreover due to common ion effect, the dissociation is further suppressed and hence the equilibrium concentration of the acid is nearly equal to the initial concentration of the unionised acid. Similarly the concentration of the conjugate base is nearly equal to the initial concentration of the added salt. $[H_3O^+] = K_a \frac{[acid]}{[salt]}$

3. [Acid] and [Salt] represent the initial concentration of the acid and salt, respectively used to prepare the buffer solution.

4. Taking logarithm on both sides

$$\log [H_3O^+] = \log K_a + \log \frac{[acid]}{[salt]}$$

5. Reverse the sign on both sides

$$-\log [H_3O^+] = -\log K_a - \log \frac{[acid]}{[salt]}$$

We know that

$$pH = -\log [H_3O^+] \text{ and } pK_a = -\log K_a$$

$$\Rightarrow pH = pK_a - \log \frac{[acid]}{[salt]}$$

$$\Rightarrow pH = pK_a + \log \frac{[salt]}{[acid]}$$

37. A) State Kohlraush' law.

It is defined as, at infinite dilution the limiting molar conductivity of an electrolyte is equal to the sum of the limiting molar conductivities of its constituent ions.

ii) Explain intermediate compound formation theory of catalysis with an example.

A catalyst acts by providing a new path with low energy of activation. in homogeneous catalysed reactions a catalyst may combine with one or more reactant to form an intermediate which reacts with other reactant or decompose to give products and the catalyst is regenerated.

Consider the reactions:

A + B → AB .....(1)

A + C → AC (intermediate) .....(2)

C is the catalyst

AC + B → AB + C .....(3)

Activation energies for the reactions (2) and (3) are lowered compared to that of (1). Hence the formation and decomposition of the intermediate accelerate the rate of the reaction.

Example: The mechanism of Fridel crafts reaction is given below

$$C_6H_6 + CH_3Cl \xrightarrow{AlCl_3} C_6H_5CH_3 + HCl$$

The action of catalyst is explained as follows

$$CH_3Cl + AlCl_3 \rightarrow [CH_3]^+[AlCl_4]^-$$ It is an intermediate

$$C_6H_6 + [CH_3^+][AlCl_4]^- \rightarrow C_6H_5CH_3 + AlCl_3 + HCl$$

[OR]

B) i) Explain the reducing action of formic acid with example.

- Formic acid contains both an aldehyde as well as an acid group. Hence, like other aldehydes, formic acid can easily be oxidised and therefore acts as a strong reducing agent.

Aldehyde group Carboxylic acid group

- Formic acid reduces Tollen's reagent (ammonical silver nitrate solution) to metallic silver.

$$HCOO^- + 2Ag^+ + 3OH^- \longrightarrow 2\,Ag + CO_3^{2-} + 2H_2O$$

(Tollens reagent) Silver mirror

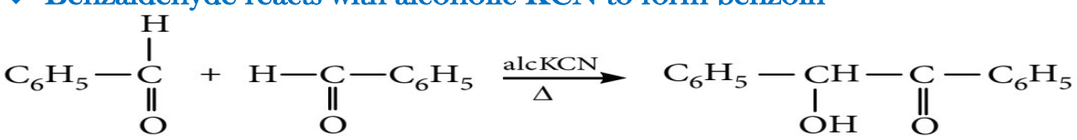
- Formic acid reduces Fehling's solution. It reduces blue coloured cupric ions to red coloured cuprous ions.

$$HCOO^- + 2Cu^{2+} + 5\,OH^- \longrightarrow Cu_2O + CO_3^{2-} + 3\,H_2O$$

(Fehlings solution) red precipitate

ii) Write a note on benzoin condensation.

- The Benzoin condensation involves the treatment of an aromatic aldehyde with aqueous alcoholic KCN. The products are a hydroxy ketone.
- Benzaldehyde reacts with alcoholic KCN to form benzoin



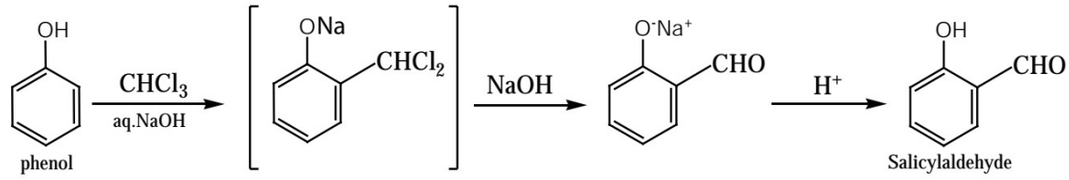
Benzaldehyde Benzoin

2-hydroxy – 1, 2 – diphenyl ethanone

38, a) Compound (A) molecular formula C_6H_6O gives purple colouration with neutral $FeCl_3$. Compound (A) reacts with $CHCl_3$/NaOH gives compound (B) and compound (A)also reacts with benzene diazonium chloride in presence of NaOH at 273-278 K gives compound (C). Identify the compounds (A), (B) and (C). Explain the reactions.

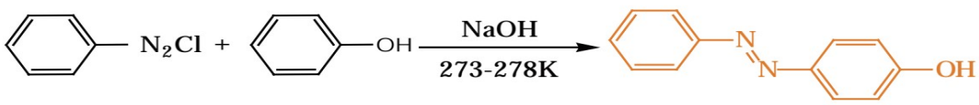
1. (A) of molecular formula C_6H_6O gives violet colour with neutral $FeCl_3$ means it must be Phenol – C_6H_5OH.

2. On treating phenol with $CHCl_3$/NaOH, a -CHO group is introduced at ortho position. This reaction proceeds through the formation of substituted benzal chloride intermediate.



phenol Salicylaldehyde

3. Phenol couples with benzene diazonium chloride in an alkaline solution to form p-hydroxy azobenzene(a red orange dye)

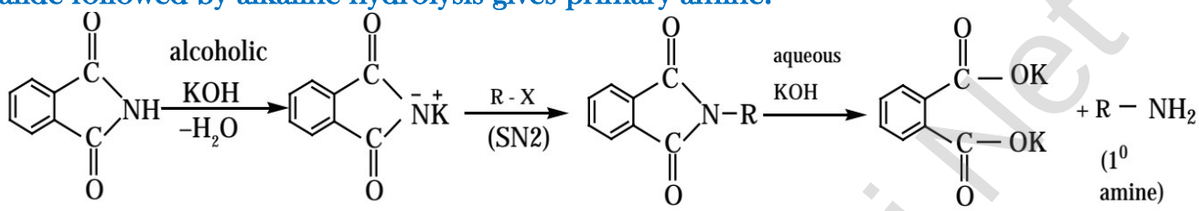


Benzene diazonium chloride Phenol p-hydroxy azobenzene

[OR]

b) i) Give short note on Gabriel phthalimide synthesis.

Gabriel synthesis is used for the preparation of Aliphatic primary amines. Phthalimide on treatment with ethanolic KOH forms potassium salt of phthalimide which on heating with alkyl halide followed by alkaline hydrolysis gives primary amine.



Phthalimide Potassium phthalimide N - alkyl phthalimide Potassium pthalati

ii) Write any four difference between RNA and DNA.

DNA	RNA
It is mainly present in nucleus, mitochondria and chloroplast .	It is mainly present in cytoplasm, nucleolus and ribosomes
It contains deoxyribose sugar	It contains ribose sugar
Base pair A = T. G = C	Base pair A = U. C = G
Double stranded molecules	Single stranded molecules
Its life time is high	It is Short lived
It can replicate itself	It cannot replicate itself. It is formed from DNA.

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