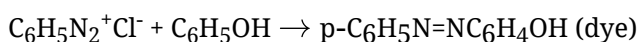


Solution
Class 12 - Chemistry
2020-21 paper 7
Section A

1. i. (a) caustic soda
ii. (a) 200×10^5 Pa
iii. (b) $\text{Al}_2\text{O}_3 + \text{K}_2\text{O}$
iv. (c) three bond pairs and one lone pair
v. (b) Cu^{2+}
2. i. (b) Assertion and reason both are correct statements and reason is not correct explanation for assertion
ii. (d) Assertion is wrong but reason is correct statement
iii. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion
iv. (b) Assertion and reason both are correct statements and reason is not correct explanation for assertion
v. (c) Assertion is correct but reason is wrong statement

3. **(d)** Coupling reaction

Explanation: In Coupling reaction, benzene and phenol get coupled through -N=N- linkage. The compounds containing this type of linkage are called azo compounds.



4. **(b)** D – 2 – deoxy ribose

Explanation: Complete hydrolysis of DNA yields a pentose sugar, phosphoric acid and nitrogen containing heterocyclic compounds (called bases). In DNA molecules, the sugar moiety is β -D-2-deoxyribose.

OR

- (b)** I and II

Explanation: Cyclic structures of monosaccharides which differ in the structure at carbon- 1 position are known as anomers.

Here, I and II are anomer because they differ from each other at carbon- 1 only.

5. **(a)** Helium

Explanation: Size of Helium is small so does not causes “Bents” to divers when the dive back to surface. As it is less soluble.

6. **(b)** 1-Bromo-2,2-dimethylpropane.

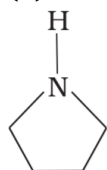
Explanation: neo-Pentyl bromide is $(\text{CH}_3)_3\text{CCH}_2\text{Br}$. C attached to Br is given position 1, so 2 - CH_3 groups are placed on 2nd C of the propane (parent chain). So, its IUPAC name will be 1-Bromo-2,2-dimethylpropane.

OR

- (b)** (C) > (B) > (A)

Explanation: Haloalkanes are prepared from alcohol and halogen acids where the hydroxyl group of the alcohol is replaced by the halogen. Options (A) (B) and (C) are primary, secondary, tertiary alcohols respectively. Tertiary alcohols are more reactive than secondary and primary alcohol, the secondary halide is more reactive than primary halide and they form haloalkanes from haloacids at room temperature without catalysts. The order of reactivity of alcohols is $3^\circ > 2^\circ > 1^\circ$.

7. **(b)**



Explanation: Aniline is a weaker base than NH_3 due to the delocalization of the lone pair of electrons on the N-atom into the benzene ring and less available for protonation. Pyrrole is not at all basic because the

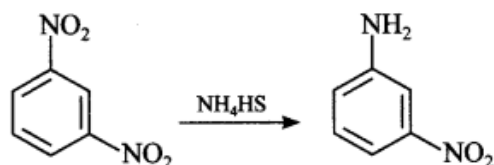
lone pair of electrons on N -atom is donated towards aromatic sextet formation. Therefore, pyrrolidine has a strong tendency to accept a proton and hence the strongest base.

OR

(a) m-nitroaniline

Explanation:

In the presence of NH_4HS , one nitro group of dinitrobenzene gets reduced and gives m- nitroaniline as a major product.



8. (b) It is less readily oxidized in the solid state

Explanation: Mohr's salt is a better volumetric agent than ferrous sulphate because it is less readily oxidized in the solid state. Also, Mohr's salt is more stable than FeSO_4 .

OR

(b) Aluminium potassium sulphate dodecahydrate

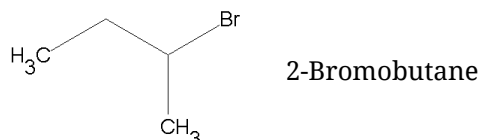
Explanation: This is a double salt so its name is written in alphabetical order and the number of molecules of water of crystallisation is mentioned in the end. So the name is aluminium potassium sulphate dodecahydrate.

9. (a) Lewis acid

Explanation: The central metal atom/ion behaves as a Lewis acid while the ligand acts as a Lewis base. The ligand can be a negatively charged ion or a neutral molecule that donates its electron pair to the central metal atom/ion which acts as an electron pair acceptor (Lewis acid).

10. (c) 2-Bromobutane

Explanation:



It is a chiral molecule since it does not contain plane symmetry and centre of symmetry.

11. (d) (A) and (B)

Explanation: AgBr shows both Schottky as well as Frenkel defect. In AgBr , both Ag^+ and Br^- ions are absent from the lattice causing Schottky defect. However, Ag^+ ions are mobile so they have a tendency to move aside the lattice and trapped in interstitial site hence, causing dislocation defect (Frenkel defect).

12. (a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

Explanation: Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

13. (b) Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

Explanation: Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.

14. (d) Both assertion and reason are INCORRECT.

Explanation: Both assertion and reason are INCORRECT.

OR

(c) The assertion is a correct statement but the reason is the wrong statement.

Explanation: Solvent molecules pass through the semipermeable membrane from a region of low concentration solution to the region of high concentration solution.

15. **(b)** Assertion and reason both are wrong statements.
Explanation: Phenol forms 2, 4, 6-tribromophenol on treatment with bromine in water. As in water phenol ionizes and forms phenoxide ion which showed + M effect and its resonating structures are more stable than the resonating structures of phenol that is why in water phenol present in phenoxide ion and its reactivity towards Br₂ increases while with CS₂ phenols could not get ionized and shows ortho and para bromophenol the polarization of bromine takes place even in the absence of Lewis acid.
16. **(a)** The assertion is correct but the reason is the wrong statement.
Explanation: Oxidising agents like HIO₃ oxidise HI to I₂ because, in their absence, the presence of HI makes the aryl iodides go back to being arenes.

Section B

17. i. $2CHCl_3 + O_2 \rightarrow 2COCl_2 + 2HCl$
Chloroform *Phosgene*
- ii. $CHCl_3 + Cl_2 \rightarrow CCl_4 + HCl$
Chloroform *Carbon tetrachloride*

OR

The molecules of organic halogen compounds are generally polar. Due to greater polarity as well as higher molecular mass as compared to the parent hydrocarbon, the intermolecular forces of attraction (dipole-dipole and van der Waals) are stronger in the halogen derivatives. That is why the boiling points of chlorides, bromides and iodides are considerably higher than those of the hydrocarbons of comparable molecular mass

18. **Mole fraction:** It is the ratio of number of moles of a particular component to the total number of moles of all the components in a solution.

Example: Mole fraction of component A

$$x_A = \frac{x_A}{x_A + x_B}$$

Where x_A is the number of moles of component 'A' and x_B is the number of moles of component B.

19. i. **Paramagnetic:** [CoF₆]³⁻
 ii. **More stable:** [Co(en)₃]³⁺
 iii. **Inner orbital complex:** [Co(en)₃]³⁺
 iv. **High spin complex:** [CoF₆]³⁻

OR

In a free transition metal ion the five d-orbitals are degenerate, when it forms a complex, the degeneracy is split. In an octahedral field three d-orbitals having lower energy are called t_{2g} orbitals and the remaining two d-orbitals of higher energy are called e_g orbitals.

20. Initial amount = 5 g

Final amount = 3 g

Rate constant = $1.15 \times 10^{-3} \text{ s}^{-1}$

For a 1st order reaction:

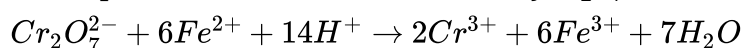
$$t = \frac{2.303}{k} \log \frac{[R]_0}{[R]}$$

$$= \frac{2.303}{1.15 \times 10^{-3}} \log \frac{5}{3} = \frac{2.303}{1.15 \times 10^{-3}} \times 0.2219$$

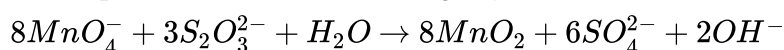
$$= 444.38 \text{ s or } 444 \text{ s (approx).}$$

21. A complex reaction occurs through a sequence of steps. Each step is an elementary step which involves the simultaneous collision of two or three species only.
22. It is because nitro group is electron withdrawing which increases acidic character due to stabilization of o-nitrophenoxide ion whereas -OCH₃ group is electron releasing which decreases acidic character due to destabilization of o-methoxy phenoxide ion.

23. i. Ionic equation for oxidation of Fe²⁺ salts by Cr₂O₇²⁻:



- ii. Ionic equation for oxidation of S₂O₃²⁻ by MnO₄⁻:



Now, total charge on 100 O₂⁻ ions = 100 × (-2) = -200

Let the number of Ni²⁺ ions be x .

So, the number of Ni³⁺ ions is 98 - x .

Now, total charge on Ni²⁺ ions = $x(+2) = +2x$

And, total charge on Ni³⁺ ions = $(98 - x)(+3) = 294 - 3x$

hence, total positive charge on Ni ions = $2x + 294 - 3x = 294 - x$

Since, the compound is neutral, we can write:

Total positive charge = total negative charge

$$294 - x = 200$$

$$(294 - x - 200) = 0$$

$$\Rightarrow -x + 94 = 0$$

$$\Rightarrow x = 94$$

Therefore, number of Ni²⁺ ions = 94

And, number of Ni³⁺ ions = 98 - 94 = 4

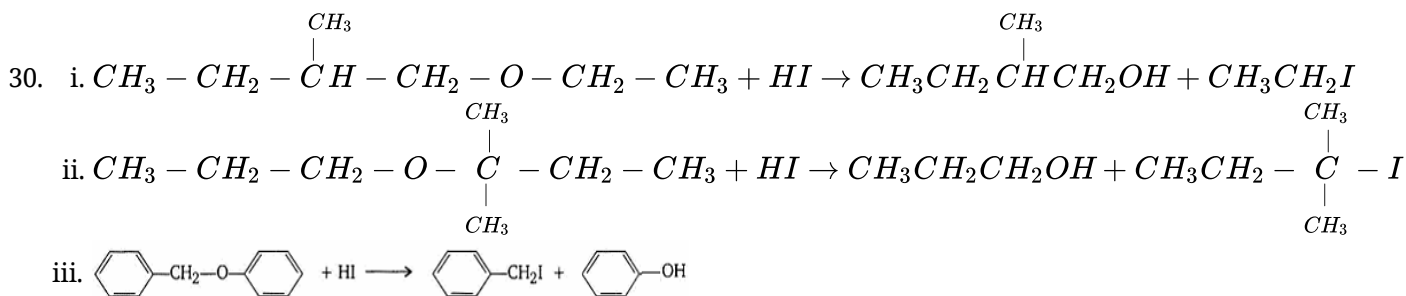
Hence, fraction of nickel that exists as Ni²⁺ = $\frac{94}{98} = 0.959$

And, fraction of nickel that exists as Ni³⁺ = $\frac{4}{98} = 0.041$

Alternatively, fraction of nickel that exists as Ni³⁺ = 1 - 0.959 = 0.041

29. A DNA molecule is double-stranded in which the pairing of bases occurs. Adenine always pairs with thymine, while cytosine always pairs with guanine. Therefore, on hydrolysis of DNA, the quantity of adenine produced is equal to that of thymine and similarly, the quantity of cytosine is equal to that of guanine.

But when RNA is hydrolyzed, there is no relationship among the quantities of the different bases obtained. Hence, RNA is single-stranded.



Section D

31. i. a. The catalytic activities of transition metals and their compounds is due to the ability of adopt variable oxidation states and to form complexes. It can also provide a large surface area for the reactants to be adsorbed.
- b. Separation of lanthanoid elements is difficult because all lanthanoid elements have almost similar physical as well as chemical properties. Due to the lanthanoid contraction, the change in the atomic or ionic radii is very small.
- c. Zn, Cd, and Mg are soft and have a low melting point because they have filled d-orbitals due to which the metallic bond formed is very weak.
- ii. a. The sodium chromate is acidified with H₂SO₄ to give orange sodium dichromate $2Na_2CrO_4 + H_2SO_4 \rightarrow Na_2Cr_2O_7 + Na_2SO_4 + H_2O$
- b. Potassium permanganate is prepared by fusion of MnO₂ with an alkali metal hydroxide $2MnO_2 + 4KOH + O_2 \rightarrow 2K_2MnO_4 + 2H_2O$

OR

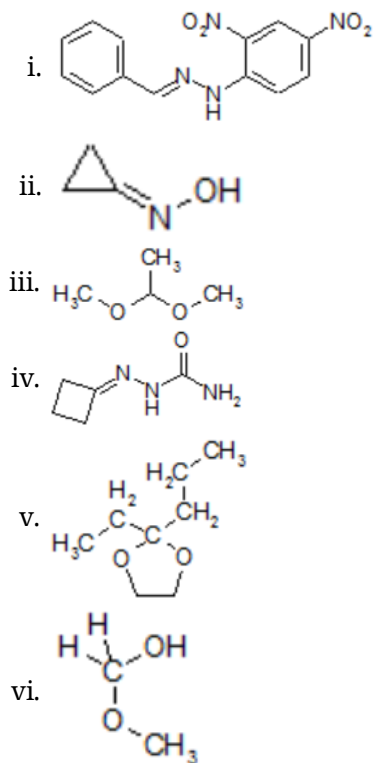
On the basis of lanthanoid contraction:

- Due to lanthanide contraction, the size of the atom decreases with the decrease in size, the covalent character increases. Therefore, La₂O₃ is more ionic while Lu₂O₃ is more covalent in nature.
- As the size decreases from (lanthanum) La to (lutetium) Lu, the stability of the oxo- salts also decreases.
- Stability of complexes from La to Lu, increases as the size of the central atom decreases.
- Radii of the elements of 4d- and 5d-blocks in the same vertical columns are nearly the same.

v. The acidic nature of lanthanoid oxides increases from La to Lu.

32. The molecular masses of the given compounds are in the range 44 to 46. $\text{CH}_3\text{CH}_2\text{OH}$ undergoes extensive intermolecular hydrogen-bonding resulting in the association of molecules; therefore, it has the highest boiling point. Whereas, $\text{CH}_3\text{CH}_2\text{CH}_3$ being an alkane will have the weak van der Waals force between its molecules, thus will have the lowest boiling point. CH_3CHO being an aldehyde will be more polar than the ketone CH_3COCH_3 , and its molecule will have more strong dipole-dipole interaction as compared to those between CH_3COCH_3 molecules. As the forces of attraction vary in the order van der Waals < dipole-dipole interactions < hydrogen bonding, the boiling points too varies as $\text{CH}_3\text{CH}_2\text{CH}_3 < \text{CH}_3\text{COCH}_3 < \text{CH}_3\text{CHO} < \text{CH}_3\text{CH}_2\text{OH}$.

OR



33. a. The electrochemical equivalent is the mass of ions deposited or liberated on an electrode during the electrolysis, when 1C of charge is passed through it.

$$\begin{aligned} \text{b. } E_{cell}^{\ominus} &= E_{right}^{\ominus} - E_{left}^{\ominus} \\ &= -0.403 - (-0.763\text{V}) \\ &= 0.36\text{V} \end{aligned}$$

$$E_{cell} = E_{cell}^{\ominus} - \frac{0.059}{n} \log \frac{[\text{Zn}^{2+}]}{[\text{Cu}^{2+}]}$$

$$E_{cell} = 0.36 - \frac{0.059}{n} \log \frac{0.1}{0.01} [\because n = 2]$$

$$E_{cell} = 0.36 - 0.0295 \log 10$$

$$= 0.36 - 0.0295 \times 1$$

$$= 0.3305\text{V}$$

$$\Delta G^{\ominus} = -nFE_{cell}^{\ominus}$$

$$= -2 \times 96500 \times 0.36$$

$$\Delta G^{\ominus} = 69480\text{J mol}^{-1}$$

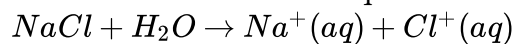
$$= 69.48\text{J mol}^{-1}$$

OR

i. **Weak electrolytes:** An electrolyte that ionizes partially in solution is called a weak electrolyte. The solution formed contains ions which are in equilibrium with un-ionised molecules, e.g., acetic acid dissolves in water to form H_3O^+ and CH_3COO^- ion. The solution contains H_3O^+ (hydronium ion), CH_3COO^- (acetate ion) and unionised CH_3COOH molecule. $\text{CH}_3\text{COOH} + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{COO}^- + \text{H}_3\text{O}^+$

The degree of ionisation of a weak electrolyte is much less than 1. These have low values of molar conductivities at high concentration. Degree of ionisation and molar conductivity both increases with dilution.

- ii. **Strong electrolyte:** An electrolyte which is almost completely ionised in solution is called a strong electrolyte. The degree of ionisation of a strong electrolyte is 1 or 100% (or nearly so). The solution formed contains ions which are in equilibrium with solid form of strong electrolyte.



Strong electrolyte	Weak electrolyte
1. These have higher molar conductivities at all concentrations.	1. These have much lower conductivities at high concentration.
2. λ_m^o values increase very slightly with dilution.	2. λ_m^o values increase sharply with dilution.
3. Degree of ionisation is very high at all concentration i.e., almost fully ionized.	3. Degree of ionisation is very low at high concentration and increases with dilution.
4. Most of the salts like NaCl, KCl, NaNO ₃ , BaCl ₂ and mineral acids like HCl, H ₂ SO ₄ , HNO ₃ and NaOH, KOH etc are common examples of strong electrolytes.	4. Salts like ammonium acetate, acetic acid, aq NH ₄ OH, aqueous CO ₂ and organic acids and bases are common examples of weak electrolytes.