Solution

Class 12 - Chemistry

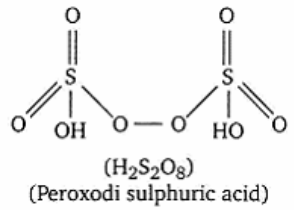
2020-2021 - Paper-2

Section A

1. i. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion
   ii. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion
   iii. (d) Assertion is wrong statement but Reason is correct statement
   iv. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion
   v. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion
2. i. (c) ozonised oxygen
   ii. (d) all of these
   iii. (c) both (a) and (b)
   iv. (a) 128pm
   v. (a) lead sulphate
3. Milk is an emulsion.

   OR

   Due to decrease in (E-H) bond dissociation enthalpy down the group, acidic character increases. Thus, H_2S is more acidic than H_2O.
4. The structure of $H_2S_2O_8$ is given below:



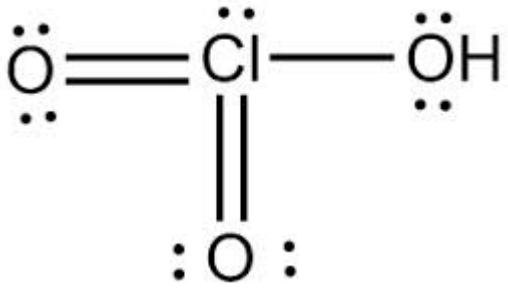
$(H_2S_2O_8)$
(Peroxodi sulphuric acid)

5. Group 6 has Cr element in its 3d series. Like Chromium other elements of this group shows +3 and +6 as their common and stable oxidation state.
   Stability of +3 comes from fully filled t_{2g} configuration and stability of +6 comes from nobel gas configuration.

   OR

   Tetraamminedichlidooroplatinum (IV) ion
6. Pentaqua cyano chromium (III) ion
7. In chemisorption, the increase in $\frac{x}{m}$ initially is due to heat supplied as activation energy and then decrease in $\frac{x}{m}$ is due to exothermic nature of adsorption equilibrium.
8. It can be written as: $HClO_3$ - chloric acid

   The structure is shown below:



   OR

   When a colloid precipitates and floats on the solvent, this phenomenon is called as flocculation.
9. The overall decrease in atomic and ionic radii from lanthanum to lutetium is a unique feature in the chemistry of the lanthanoids. The cumulative effect of the contraction of size of lanthanide elements is known as lanthanoid contraction. It causes the radii of the members of the third transition series to be very similar to those of the corresponding members of the second series. For example radii of Zr (160 pm) and Hf (159 pm) are almost identical.
10. Linkage isomerism.

OR

Because of the compact nature (small size) of oxygen atom, it has less negative electron gain enthalpy than sulphur.

11. Adsorption is exothermic in nature, so ΔH is always negative (ΔH < 0). Here adsorption entropy of adsorbate decrease, so ΔS is also negative.
12. Fluorine ($1s^2$, $2s^2$, $2n^5$) due to small size, hence high electronegativity cannot exhibit any positive oxidation state. Other halogens have the d orbitals and therefore, can expand their octets and can show + 1, + 3, + 5 and + 7 oxidation states also.
13. **(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.
14. **(c)** Assertion is CORRECT but, reason is INCORRECT.
    Explanation: Assertion is CORRECT but, reason is INCORRECT.
15. **(c)** The assertion is correct, but the reason is the wrong statement.
    Explanation: N_2 is less reactive due to high bond dissociation energy. Its electron gain enthalpy is less than phosphorus.

    OR

    (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.
16. **(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.

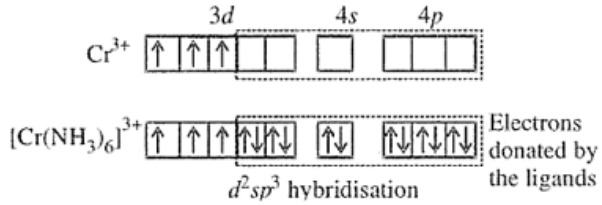
Section B

17. i. It is due to the fact that more force of attraction between dispersed phase and dispersion medium exist in lyophilic colloid than lyophobic colloid.
    ii. $Fe(OH)_3$ sol is positively charged which is coagulated by negatively charged Cl^- ion present in sodium chloride solution.
    iii. Sky appears blue in colour due to scattering of light by colloidal particles. It is called tyndall effect.
18. Thermal decomposition of sodium azide gives dinitrogen gas. $2NaN_3 \rightarrow 2Na + 3N_2$

    OR

    Cr has electronic configuration $[Ar]4s^13d^5$

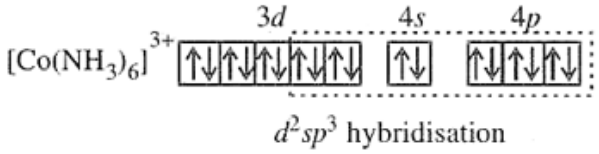
    Cr^{3+} has electronic configuration $[Ar]4s^03d^5$



    d^5 sp^3, hybridisation gives octahedral shape. The complex is paramagnetic due to the presence of unpaired electrons.
19. ns and (n-1) d electrons of transition metal have very little difference in the energies and hence both can participate in bonding, which results in variable oxidation states. When ns electrons take part in bonding, they exhibit lower oxidation states whereas when (n -1)d electrons along with ns electrons participate in bonding, they exhibit higher oxidation states.
20. Electronic configuration of Co : $[Ar]4s^23d^7$

    Electronic configuration of Co^{3+} : $[Ar]^4s^03d^6$

    NH_3 is strong field ligand, it will cause pairing of electrons. Hence,



d^2sp^3 hybridisation

It has octahedral shape and is diamagnetic due to the absence of unpaired electrons.

21. It is an aggregated bulky ion in a soap or detergent which arrange in radial manner. For example, when concentrated solution in a soap say sodium stearate is prepared then stearate ions form micelles.
Micelles differ from a normal colloidal solution. In fact they are aggregate of the bulky ions of soaps and detergents in radial manner.
To the contrary normal colloids are either aggregation of atoms or molecules or even ions or molecules of colloidal size.
However, in the former case, the particles are held together by weak Van der Waals forces. The above are known as multimolecular or macromolecular colloids respectively.
22. Due to the presence of a triple bond between the two nitrogen atoms, the bond dissociation energy of N_2 (941.4 kJ mol^{-1}) is very high. Therefore N_2 is less reactive at room temperature.

OR

Acidified permanganate solution oxidises iron(II) to iron(III). Acidified $KMnO_4$ act as a good oxidising agent.

$$5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}$$

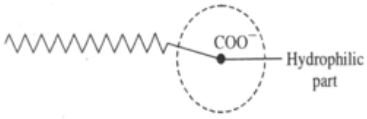
23. Due to an increase in nuclear charge which accompanies the filling of the inner d orbitals, there is a increase in ionisation enthalpy along each series of the transition elements from left to right. However, many small variations occur. The irregular trend in the first ionisation enthalpy of the 3d metals, can be accounted for by considering that the removal of one electron alters the relative energies of 4s and 3d orbitals
24. i. Geometry: Octahedral geometry due to d^2sp^3 -hybridisation.
Magnetic behaviour: Paramagnetic.
ii. The ionisation isomer of $[Ni(NH_3)_3NO_3]Cl$ is $[Ni(NH_3)_3Cl]NO_3$. Its IUPAC name is triammine-chloridonickel (II) nitrate.
25. i. **Alcosol:** A colloidal sol in which dispersion medium is alcohol, known as alcosol. Example: Colloidion.
ii. **Aerosols:** When dispersion medium is gas and dispersed phase is either solid or liquid, the colloidal system is called aerosol. Example: fog, cloud, smoke etc.
Colloidal suspension in the air are also called aerosols.
iii. **Hydrosols:** Colloids in water are called hydrosols. Example: Milk, proteins and nucleic acid are colloidal sized particles dispersed in an aqueous solution for ions.

Section C

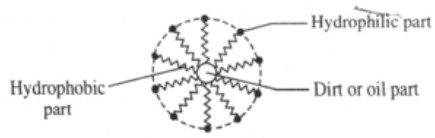
26. Certain substances behave as normal electrolytes, when they are present at low concentration, but they form an aggregates of colloidal dimension, when they are present at high concentration. Such colloids are known as associated colloids and these aggregated particles are known as micelles. Example: Soaps and detergents. They differ from multimolecular and macromolecular colloids as they behave as normal electrolyte at low concentration while become colloids at higher concentration due to the formation of micelles. Multimolecular and macromolecular colloids behave like colloids at lower as well as at higher concentration.
Micelles: The aggregated particles formed by normal electrolytes when they are taken in high concentration are known as micelles. Micelle is formed by the association of small particles. For example, soaps contain sodium salt of higher fatty acids, i.e., sodium stearate or sodium oleate.

$$\underset{Soap}{RCOONa} \rightarrow RCOO^- + Na^+$$

R = long carbon chain of more than 10 carbons.
If soaps are present at low concentration, they will behave like an electrolyte, but if the concentration is higher, then the negative ions (Stearate or oleate ions) make the aggregates through their hydrophobic parts (carbon chain), i.e., COO^- end and the hydrophilic part would be in contact with solvent.



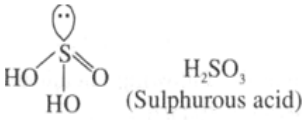
(*a*) Anion of soaps



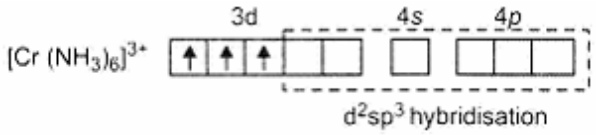
(*b*) Formation of micelle

The formation of micelle requires certain minimum concentration that known as critical micelle concentration (CMC).

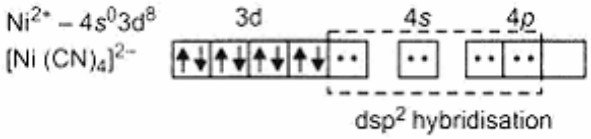
27. The structure of H_2SO_3 is given below:



OR



It is paramagnetic due to the presence of unpaired electrons.



It has square planar structure diamagnetic due to absence of unpaired electrons.

28. i. Transition metal ions have incompletely filled d orbitals. They form strong interatomic metallic bonds due to overlapping of unpaired electrons in d-orbitals. Greater the number of unpaired electrons, greater is the expected enthalpy of atomization.
    ii. Transition metal ions show variable oxidation states and have vacant d-orbitals forming unstable intermediates. The intermediates then decompose into products. Therefore they act as catalyst.
    iii. They act as oxidant both in Lab and industry and they are used for colourisation of oils.

29. A complex having ambident ligand will show linkage isomerism e.g $[Cr(NH_3)_5(NO_2)]Cl_2$ has NO_2^- as ambident Ligand and its Linkage isomer will be $[Cr(NH_3)_5(ONO)]Cl_2$.

OR

Due to small size, six fluorine atoms can be accommodated around sulphur atom while chlorine atoms being larger in size are difficult to accommodate around sulphur.
The other reason is that the fluorine being highly electronegative and oxidising in nature is capable of unpairing the paired orbitals of the values shell of sulphur atom and thereby showing the highest, oxidation state of +6 while chlorine is not able to do this. therefore, SF_6 is known but SCl_6 is not known.

30. **Adsorption:**
    1. Substance is concentrated only at the surface and does not penetrate through the surface to the bulk of the adsorbent
       Example: Chalk dipped in ink is blue at the surface and white in bulk.
    2. It is a surface phenomenon.
       Example: Silica gel adsorbs water vapour on its surface.

    Absorption
    1. In absorption, substance is uniformly distributed throughout the bulk of the solid.
    2. It is a bulk phenomenon
       Example: anhydrous $CaCl_2$ absorbs water vapours.

Section D

31. i. Depending upon the type of the particles of the dispersed phase, colloids are classified as: Multimolecular, macromolecular and associated colloids.
    a. Multimolecular colloids: The colloids in which the colloidal particles consist of aggregates of atoms or small molecules with diameters of cells than 1 nm are called multimolecular colloids.
    For example: A gold sol may contain particles of various sizes having several atoms of gold, a sulphur sol consists of particles containing about a thousand of S_8 molecules. They are held together by Van der Waals forces.
    b. Macromolecular colloids: These are the colloids in which the dispersed particles are themselves large molecules (usually polymers).
    Since these molecules have dimensions comparable to those of colloidal particles, their dispersions are called macromolecular colloids.
    Example: Proteins, starch and cellulose form macromolecular colloids.
    c. Associated colloids (Micelles): Those colloids which behave as normal strong electrolyte at low concentration but show colloidal properties at higher concentrations due to the formation of aggregated particles of colloidal dimensions.
    Such substances are also referred to as associated colloids.

    ii. Depending upon the nature of interaction between the dispersed phase and the dispersion medium colloidal sols are divided into two types:
    a. Lyophilic colloids: (Solvent attracting) Colloidal sols directly formed by mixing substances like gum, gelatine, starch, rubber etc. with a suitable liquid are called lyophilic sols. They are reversible sols. They are quite stable and cannot be easily coagulated.
    b. Lyophobic colloids: (Solvent repelling) Substances like metals, their sulphides etc. when simply mixed with the dispersion medium do not form the colloidal sols. Their colloidal sols can be prepared only by special methods. These sols are readily precipitated on the addition of small amounts of electrolytes by heating or by shaking and hence are not stable. These sols are also called irreversible sol.

OR

a. i. Transition metal form layer of oxides on their surface due to which they become unreactive. Secondly, reactivity decreases with increase in atomic number due to decrease in size and increase in ionization energy.
    ii. In d-block elements, electrons of s-orbital and d-orbitals both take part in bond formation. In f-block elements due to poor shielding effect of f-electrons effective nuclear charge increases therefore, lesser number of oxidation states are shown.

b. $\underset{'A'}{2Cr_2O_3} + 8\,NaOH + 3O_2 \rightarrow \underset{Yellow\,'B'}{4Na_2CrO_4} + 4H_2O$

$\underset{'B'}{2Na_2CrO_4} + H_2SO_4 \rightarrow \underset{Orange\ \text{'C'}}{Na_2Cr_2O_7} + Na_2SO_4 + H_2O$

$2NH_4Cl + Na_2Cr_2O_7 \rightarrow \underset{(Orange\ \text{'D'})}{(NH_4)_2Cr_2O_7} + 2NaCl$

$\underset{Ammonium\ dichromate}{(NH_4)_2Cr_2O_7} \xrightarrow{heat} N_2 + \underset{Green}{Cr_2O_3} + 4H_2O$

So, Compound A = Cr_2O_3, compound B= Na_2CrO_4, compound C = $Na_2Cr_2O_7$, compound D= $(NH_4)_2Cr_2O_7$

32. i. Oxygen being small in size forms effective and strong P $\pi - P\pi$ bonds with other oxygen atoms. Therefore oxygen molecule is diatomic and discrete whereas Sulphur due to its larger size, its orbitals cannot overlap effectively to form P $\pi - P\pi$ bonds & completes valency by forming σ bonds with many sulphur atom. Therefore sulphur molecule is polyatomic solid.
    ii. Since oxygen is highly electronegative, it has little tendency to give electrons. Therefore its most common oxidation state is -2.
    iii. H_2O is liquid at room temperature due to the presence of intermolecular Hydrogen bonding which is absent in H_2S
    iv. As we move down the group, the size of the atom increases this makes the bond of the element with hydrogen weak. Due to weaker bonds, the bond dissociation enthalpy decreases making the molecule more acidic. Therefore the order of acidic strength is H_2O< H_2S < H_2Te.

v. SF_6 exceptionally stable due to steric reasons. Hydrogen being electropositive or less electronegative than fluorine cannot make the s- electrons of sulphur to participate in bonding. Therefore, SH_6 does not exist.

OR

i. $[Co(H_2O)(CN)(en)_2]^{2+}$ Let the oxidation number of Co be x. The charge on the complex is +2.

$$\left[\underset{\downarrow}{Co} \quad \underset{\downarrow}{(H_2O)} \quad \underset{\downarrow}{(CN)} \quad \underset{\downarrow}{(en)_2}\right]^{2+}$$

$$x + 0 + (-1) + 2(0) = +2$$

x -1 = +2

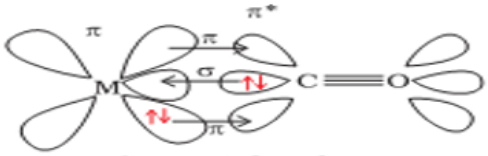
x = +3

ii. $[Pt(Cl)_4]^{2-}$ Let the oxidation number of Pt be x. The charge on the complex is –2.

$$[\underset{\downarrow}{Pt} \quad \underset{\downarrow}{(Cl)_4}]^{2-}$$

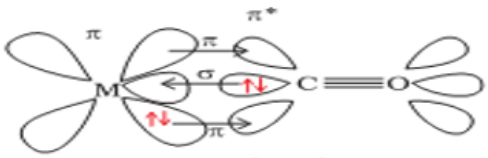
$$x + 4(-1) = -2$$

x = +2



Synergic bonding

iii. $K_3[Fe(CN)_6]$



Synergic bonding

iv.

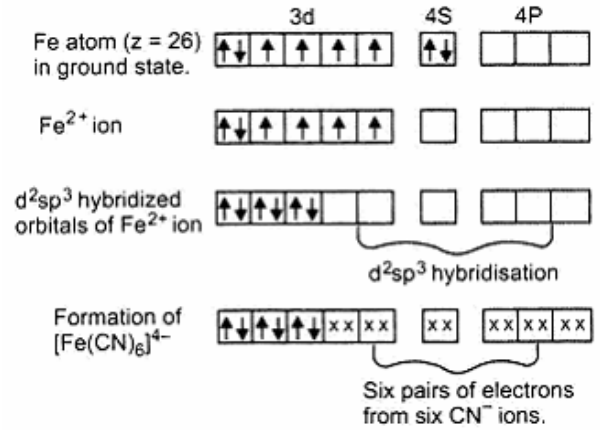
$$\left[\underset{\downarrow}{Cr} \quad \underset{\downarrow}{(NH_3)_3} \quad \underset{\downarrow}{Cl_3}\right]$$

$$x + 3(0) + 3(-1) = 0$$

x - 3 = 0

x = +3

33. i. In $[Fe(CN)_6]^{4-}$



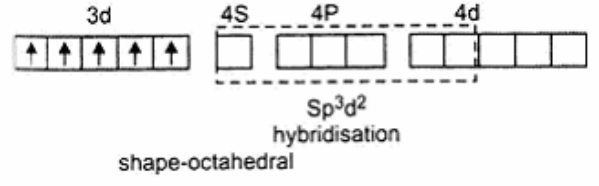
It has octahedral shape diamagnetic.

ii. In $[FeF_6]^{3-}$: [Ar] $4S^2$ $3d^6$

Fe^{3+} : [Ar] $4S^0$ $3d^5$

F^- is a weak ligand, does not cause pairing of electrons.

$FeF_6]^{3-}$

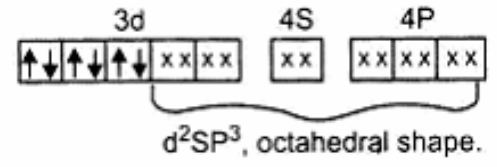


iii. $[Co(C_2O_4)]^{3-}$

Co (27) : [Ar] AS^2 $3d^7$

Co^{3+} : [Ar] $4S^0$ $3d^6$

$C_2O_4^{2-}$ is strong field ligand causes pairing of electrons.



iv. $[CoF_6]^{3-}$

Co (27) - [Ar] $4S^2$ $3d^7$

Co^{3+} - [Ar] $4S^0$ $3d^6$

F^- is a weak ligand, does not cause pairing of electrons.

OR

Lyophilic sols: Colloidal sols directly formed by mixing substances like gums gelatine, starch, rubber etc. with a suitable liquid (the dispersion medium) are lyophilic sols.

An important characteristic of these sols is that if the dispersion medium is separated from the dispersed phase (say by evaporation the sol can be reconstituted by simply from the remixing with the dispersion medium. That is why these sols are also called reversible sols. These sols are quite stable and cannot be easily coagulated.

Lyophobic sols: Their colloidal sol can be prepared by only special methods. These sols are readily precipitated on the addition of small amounts of electrolysis, by heating or by shaking and hence are not stable.

Hydrophobic sols are formed by indirect method. These sols are irreversible sols. These sols are readily precipitated on the addition of small amounts of electrolyte by heating or by shaking and hence are not stable. They need stabilizing agents for the preservation.