

CBSE Class 11 Chemistry
Sample Paper 01 (2019-20)

Maximum Marks: 70

Time Allowed: 3 hours

General Instructions:

- a. All questions are compulsory.
 - b. Section A: Q.no. 1 to 16 are very short answer questions (objective type) and carry 1 mark each.
 - c. Section B: Q.no. 17 to 23 are short answer questions and carry 2 marks each.
 - d. Section C: Q.no. 24 to 30 are long answer questions and carry 3 marks each.
 - e. Section D: Q.no. 31 to 33 are also long answer questions and carry 5 marks each.
 - f. There is no overall choice. However an internal choice has been provided in two questions of two marks, two questions of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
 - g. Use log tables if necessary, use of calculators is not allowed.
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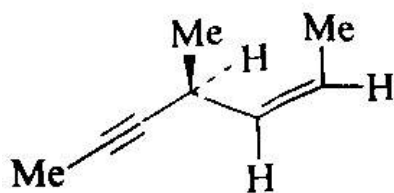
Section A

1. The ionic character of metallic halides tends toward covalent nature as per Fajan's rule. Such covalent halides behave as non-metal in their higher oxidation states. The property to hydrolyse to give oxy-acids of the element and corresponding hydro halogen acid for most non-metallic elements proceeds exceptionally in the way, keeping oxidation number of element and halide same in oxo-acids.
Non-polar halides are immiscible in water, as they do not show hydrolysis, but halides of some elements with empty d-orbital undergo hydrolysis. Stability of halides of the higher state is governed by the inert-pair effect.

Answer the following questions:

- i. How does halide undergo hydrolysis to give oxy-acids of underlined element $\underline{P}Cl_3$?

- ii. Out of $\underline{N}Cl_3$ and $\underline{B}Cl_3$ undergoes hydrolysis to form oxy-acids? Write the chemical reaction for the correct answer.
- iii. Out of $PbCl_4$, PbF_4 , PbI_4 and $PbBr_4$ which one doesn't exist?
- iv. Non-Polar halides are immiscible in water. Why?
- v. Which one is not correct?
- $SiCl_4 + 4H_2O \rightarrow Si(OH)_4 + 4HCl$
 - $SbCl_5 + 4H_2O \rightarrow (OH)_3SbO + 5HCl$
 - $SbCl_3 + 3H_2O \rightarrow Sb(OH)_3 + 3HCl$
 - $XeF_2 + H_2O \rightarrow Xe + 2HF + \frac{1}{2} O_2$
2. What is the experimental evidence in support of the idea that electronic energies in an atom are quantised?
3. Predict the position of the element in the periodic table which satisfies the electronic configuration $(n-1) d^1 ns^2$ for $n=4$.
4. Air contains about 99% of N_2 and O_2 gases. Why they do not combine to form NO under the standard conditions? Standard Gibbs energy of formation of $NO(g)$ is 86.7 kJ mol^{-1} .
5. It is necessary to add gypsum in the final stages of preparation of cement. Explain why?
6. Which of the following gases qualify as greenhouse gases?
CO, NO, NO_2 , Cl_2 , H_2 , Ne.
7. Hydrogenation of the following compound in the presence of poisoned catalyst gives:



- Optically active compound
- A diastereomeric mixture

-
- c. An optically inactive compound
- d. A racemic mixture
8. The strength of a reductant/oxidant in redox systems can be determined
- by taking into consideration the different oxidation states of the atom in the element
 - by taking into consideration only half-reactions involving reduction
 - by the titration method using a redox-sensitive indicator
 - by taking into consideration only half-reactions involving oxidation
9. dipole-dipole forces act between molecules that have
- an electron cloud that causes temporary dipoles
 - an induced electrical dipole moment
 - a permanent magnetic dipole moment
 - a permanent electrical dipole moment.
10. In oxygen difluoride (OF_2) and dioxygen difluoride (O_2F_2), the oxygen is assigned an oxidation number of
- +2
 - +2 and +1
 - +4 and +3
 - +2 and +4
11. Delocalisation of σ electrons of C-H bond of an alkyl group directly attached to an atom of unsaturated system or to an atom with an unshared p orbital is called:
- Electromeric effect

- b. Hyperconjugation
- c. Inductive effect
- d. Resonance effect

12. **Assertion:** TlCl is more stable than TlCl_3 .

Reason: +1 oxidation state of heaviest element is more stable than +3.

- a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
- b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
- c. Assertion is CORRECT but, reason is INCORRECT.
- d. Assertion is INCORRECT but, reason is CORRECT.

13. **Assertion:** 1 g O_2 and 1 g O_3 have an equal number of atoms.

Reason: Mass of 1-mole atom is equal to its gram atomic mass.

- a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
- b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
- c. Assertion is CORRECT but, reason is INCORRECT.
- d. Assertion is INCORRECT but, reason is CORRECT.

14. **Assertion:** $3\text{ClO}^- \rightarrow \text{ClO}_3^- + 2\text{Cl}^-$ is an example of dissociation reaction.

Reason: ClO^- gets oxidised as well as reduced.

- a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
- b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT

explanation of the assertion.

c. Assertion is CORRECT but, reason is INCORRECT.

d. Assertion is INCORRECT but, reason is CORRECT.

15. **Assertion:** Alkylbenzene is not prepared by Friedel Crafts alkylation of benzene.

Reason: Alkyl halides are less reactive than acyl halides.

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

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

c. Assertion is CORRECT but, reason is INCORRECT.

d. Assertion is INCORRECT but, reason is CORRECT.

16. **Assertion:** At critical point, the densities of gaseous and liquid states become same.

Reason: At critical point, gases behave ideally.

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

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

c. Assertion is CORRECT but, reason is INCORRECT.

d. Assertion is INCORRECT but, reason is CORRECT.

Section B

17. Arrange the following in order of decreasing bond angle, giving a reason NO_2 , NO_2^+ , NO_2^- .

18. Copper dissolves in dilute nitric acid but not in dilute HCl. Explain.

19. What is dead burnt plaster? How is it obtained?

20. What happens when benzene is oxidized at 770K in presence of V_2O_5 ? Give chemical equation.
21. The value of K_c for the reaction $3O_2(g) \rightleftharpoons 2O_3(g)$ is 2.0×10^{-50} at 25°C . If equilibrium concentration of O_2 in air at 25°C is 1.6×10^{-2} , what is the concentration of O_3 ?

OR

Draw diagrams showing the formation of a double bond and a triple bond between carbon atoms in C_2H_4 and C_2H_2 molecules.

22. 0.3780 g of an organic chlorine compound gave 0.5740 g of silver chloride in Carius estimation. Calculate the percentage of chlorine present in the compound.

OR

For an isolated system $\Delta U = 0$ what will be ΔS ?

23. An alkene (molecular weight = 56) on reaction with trioxygen followed by zinc/ CH_3COOH gave only ethanal. Identify the Structure of the alkene.

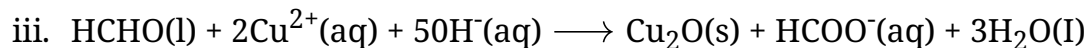
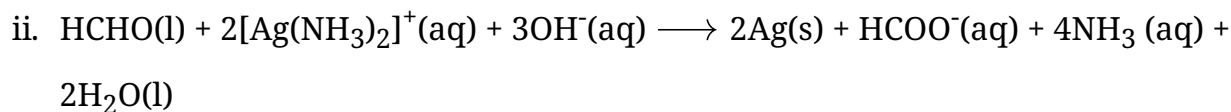
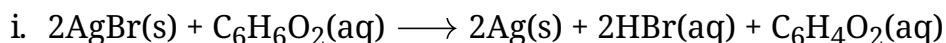
Section C

24. 10 moles of an ideal gas expand isothermally and reversibly from a pressure of 5 atm to 1 atm at 300 K. What is the largest mass that can be lifted through a height of 1 m by this expansion?
25. Explain why o-hydroxybenzaldehyde is a liquid at room temperature while p-hydroxybenzaldehyde is a high melting solid.

OR

The solubility of $AgCl$ in water at 298 K is 1.06×10^{-5} mole per litre. Calculate its solubility product at this temperatures.

26. Identify the substances oxidised reduced oxidizing agent and reducing the agent for each of the following reactions:



27. The compression factor (compressibility factor) for one mole of a van der Waals gas at 0°C and 100 atm pressure is found to be 0.5. Assuming that the Volume of a gas molecule is negligible, calculate the van der Waals' constant a .

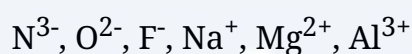
28. How many significant figures are present in

a. 4.01×10^2

b. 8.256

c. 100

29. Consider the following species:



i. What is common in them?

ii. Arrange them in order of increasing radii?

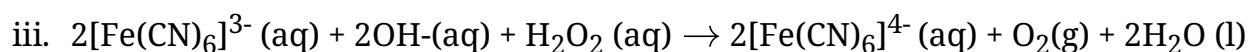
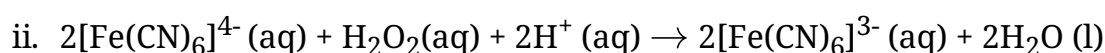
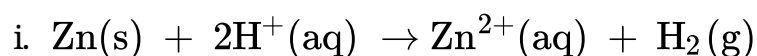
OR

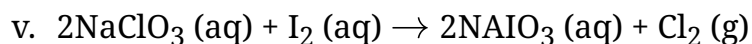
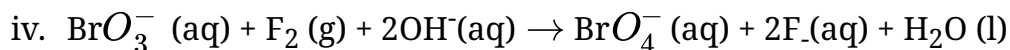
Give the properties of the oxides in a particular period.

30. What would have happened if the greenhouse gases were totally missing in the earth's atmosphere? Discuss.

Section D

31. Using an electron transfer concept, identify the oxidant and reductant in the following redox reactions.





OR

i. Calculate the strength in volumes of a solution containing 30.36 g/litre of H_2O_2 .

ii. What is the mass of hydrogen peroxide present in 1 liter of a 2M solution?

Calculate the volume of oxygen at S.T.P. liberated upon the complete decomposition at 100 cm^3 of the above solution.

32. i. How will you distinguish 1-pentene from n-pentane?

ii. An alkene on ozonolysis gives 2-butanone and 2-methyl propanal. What products will be obtained when it is treated with hot conc. KMnO_4 ?

OR

Write IUPAC names of the products obtained by the ozonolysis of the following compounds:

i. Pent-2-ene

ii. 3, 4-Dimethylhept-3-ene

iii. 2-Ethylbut-1-ene

iv. 1-Phenylbut-1-ene.

33. I. Find energy of each of the photons which:

i. correspond to light of frequency $3 \times 10^{15} \text{ Hz}$.

ii. have wavelength of 0.50 \AA

II. Calculate the wavelength, frequency and wavenumber of a light wave whose period is $2.0 \times 10^{-10} \text{ s}$.

OR

Commercially available concentrated hydrochloric acid contains 38% HCl by mass.

i. What is the molarity of the solution (density of solution = 1.19 g mL^{-1})?

ii. What volume of concentrated HCl is required to make 1.0 L of an 0.10 M HCl?

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Solution
Section A

1.
 - i. $\text{PCl}_3 + 3\text{H}_2\text{O} \rightarrow \text{H}_3\text{PO}_3 + 3\text{HCl}$
 - ii. BCl_3 undergoes hydrolysis to form oxy-acids. The chemical reaction is as follows:
$$\text{BCl}_3 + 3\text{H}_2\text{O} \rightarrow \text{H}_3\text{BO}_3 + 3\text{HCl}$$
 - iii. PbI_4 doesn't exist because Pb^{4+} is strong oxidant, where as I^- is strong reductant.
 - iv. The non-polar halides are immiscible in water because it doesn't show hydrolysis but halides of some element with empty d-orbital undergo hydrolysis.
 - v. (c) $\text{SbCl}_3 + 3\text{H}_2\text{O} \rightarrow \text{Sb(OH)}_3 + 3\text{HCl}$
2. The line spectrum of an atom has lines corresponding to definite wavelengths. Lines are obtained as a result of electronic transitions between the energy levels of an atom. Hence, electronic energies in an atom are always quantized.
3. The position of element can be predicted as:
Period number = valence shell
Group Number = number of valence electrons
For electronic configuration: $(n-1) d^1 ns^2 = (4-1) d^1 4s^2 = 3d^1 4s^2$
Therefore, It lies in the fourth period and III group.
4. According to the question, Standard Gibbs energy of formation of NO(g) is 86.7 kJ mol^{-1} .
As the standard Gibbs energy of formation is +ve, the reaction is non-spontaneous.
Hence, N_2 and O_2 do not combine to form NO .
5. The purpose of adding gypsum is to slow down the process of setting of the cement so that it gets sufficiently hardened. Hence it is very important.
6. CO , NO , and NO_2 gases are qualified as greenhouse gases.

7. (c) An optically inactive compound

Explanation: An optically inactive compound

8. (c) by the titration method using a redox-sensitive indicator

Explanation: Because a redox indicator (also called an oxidation-reduction indicator) is an indicator which undergoes a definite color change at a specific electrode potential.

9. (d) a permanent electrical dipole moment.

Explanation: dipole forces act between molecules that have a permanent electrical dipole moment, the partial charge of one molecule get attracted to the opposite charge of other molecule

10. (b) +2 and +1

Explanation: Oxidation state of O in OF_2 is +2 and O_2F_2 is +1. Because the number assigned to oxygen will depend upon the bonding state of oxygen.

11. (b) Hyperconjugation

Explanation: Delocalisation of σ electrons of C-H bond of an alkyl group directly attached to an atom of unsaturated system or to an atom with an unshared p orbital is known as Hyperconjugation. It is a general stabilising interaction. The σ electrons of C—H bond of the alkyl group enter into partial conjugation with the attached unsaturated system or with the unshared p orbital. It is a permanent effect

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) Assertion is INCORRECT but, reason is CORRECT.

Explanation: Assertion is INCORRECT but, reason is CORRECT.

15. (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.

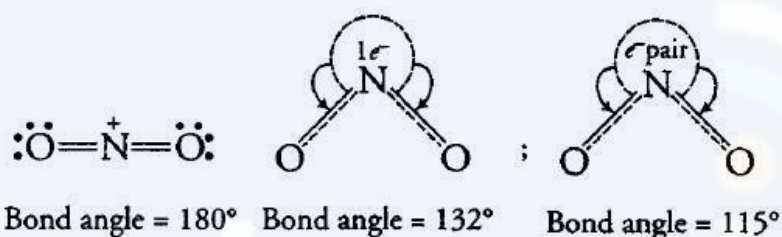
16. (c) Assertion is CORRECT but, reason is INCORRECT.

Explanation: Assertion is CORRECT but, reason is INCORRECT.

Section B

17. The required order is $\text{NO}_2^+ > \text{NO}_2 > \text{NO}_2^-$.

Reason: NO_2^+ has no lone pair of electrons on central atom i.e. N atom and hence its shape is linear. On the other hand, NO_2 has one lone electron on N atom while NO_2^- has one lone pair of electrons on N. The one lone electron exerts a less repulsion than a lone pair of electrons. So, two bonding oxygen atoms are able to spread out largely in NO_2 than NO_2^- . The structures of the compound are shown below :



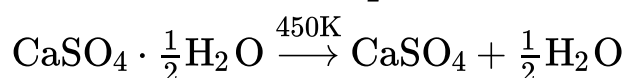
Curved arrows represent repulsion on bond pairs.

18. With the help of the standard reduction potential of element and its ions, we can identify the spontaneity of any reaction.

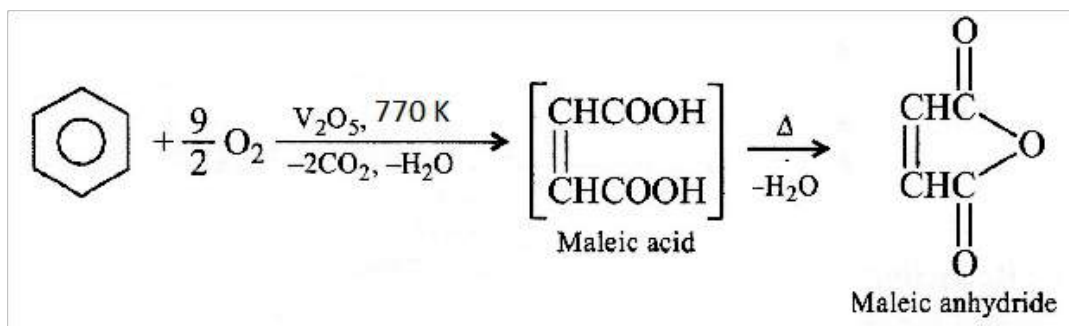
Since E° of Cu^{2+}/Cu electrode (+ 0.34 V) is higher than that of H^+/H_2 electrode (0.0 V), H^+ ions cannot oxidize Cu to Cu^{2+} ions and hence, Cu does not dissolve in dil.

HCl. In contrast, the electrode potential of NO_3^- ion, i.e., NO_3^-/NO electrode (+0.97 V) is higher than that of a Cu electrode and hence, it can oxidize Cu to Cu^{2+} ions and hence Cu dissolves in dil. HNO_3 and not in dil. HCl.

19. Dead burnt plaster is anhydrous calcium sulphate i.e. CaSO_4 . It is obtained by heating plaster of Paris, $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$.



20. Benzene, when undergoes a process of a complete oxidation reaction by V_2O_5 , gives Maleic Anhydride.



21. For the given reaction, $3O_2(g) \rightleftharpoons 2O_3(g)$

Equilibrium concentration: 1.6×10^{-2} ?

$$\text{Now, } K_c = \frac{[O_3]^2}{[O_2]^3} \text{ or } (2.0 \times 10^{-50}) = \frac{[O_3]^2}{(1.6 \times 10^{-2})^3}$$

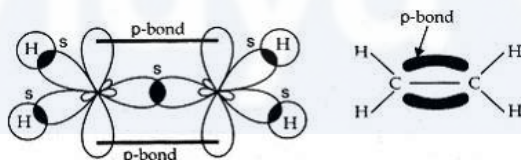
$$\text{or } [O_3]^2 = (2.0 \times 10^{-50}) \times (1.6 \times 10^{-2})^3$$

$$[O_3]^2 = 8.192 \times 10^{-56}$$

$$\text{Or, } [O_3] = 2.86 \times 10^{-28} \text{ mol L}^{-1}$$

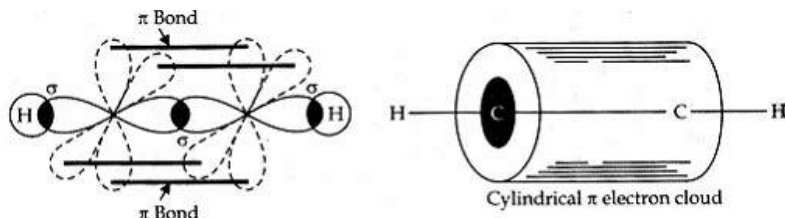
OR

i. Structure of C_2H_4



Orbital picture of ethene molecule

ii. Structure of C_2H_2



Orbitals picture of ethyne

22. According to the question, 0.3780 g of an organic chlorine compound gave 0.5740 g of silver chloride in Carius estimation.

$$\begin{aligned} \text{\% of chlorine} &= \frac{35.5}{143.5} \times \frac{\text{mass of AgCl formed}}{\text{mass of substance taken}} \times 100 \\ &= \frac{35.5}{143.5} \times \frac{0.5740}{0.3780} \times 100 \end{aligned}$$

$$= 37.566\%$$

OR

Change in internal energy (ΔU) for an isolated system is zero for it does not exchange any energy with the surroundings. But entropy tends to increase in case of spontaneous reaction. Therefore, $\Delta S > 0$ or positive.

23. Let the molecular formula of given alkene is C_nH_{2n}

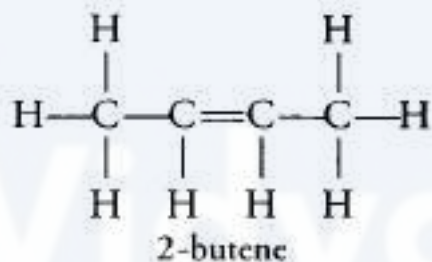
$$12n + 2n = 56$$

$$\text{or } 14n = 56$$

$$\therefore n = 4$$

Thus, the molecular formula of alkene is C_4H_8 .

As, C_4H_8 is giving only ethanal during ozonolysis followed by reduction, Thus, given alkene is symmetrical and its structure is:



Section C

24. Given, $n = 10$, $P_1 = 5 \text{ atm}$, $P_2 = 1 \text{ atm}$, $T = 300 \text{ K}$.

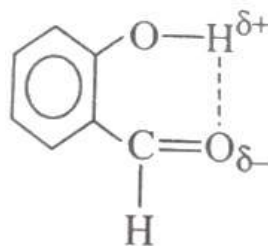
$$\begin{aligned} \text{We know that, } W_{\text{exp}} &= -2.303nRT \log \frac{P_1}{P_2} \\ &= -2.303(10\text{mol}) \times (8.314\text{JK}^{-1}\text{mol}^{-1}) (300\text{K}) \log \frac{5}{1} \\ &= -40.15 \times 10^3 \text{ J} \end{aligned}$$

If M is the mass that can be lifted by this work through a height of 1 m, then work done = Mgh

$$\begin{aligned} 40.15 \times 10^3 &= M \times 9.81 \times 1 \\ \Rightarrow M &= \frac{40.15 \times 10^3}{9.81 \times 1} \\ &= 4092.76 \text{ kg.} \end{aligned}$$

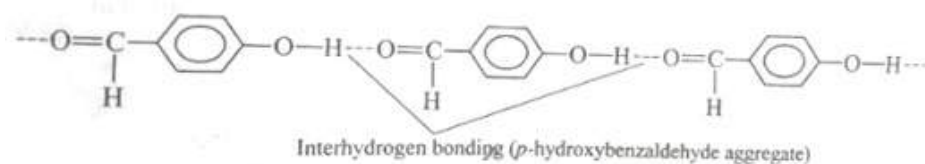
25. *o*-hydroxybenzaldehyde shows intramolecular hydrogen bonding whereas *p*-hydroxybenzaldehyde has intramolecular hydrogen bonding. Thus, *p*-

hydroxybenzaldehyde is an aggregate of a number of molecules and therefore, it is a high melting solid.



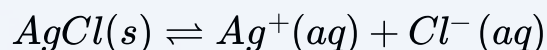
(o-hydroxybenzaldehyde)

Intrahydrogen bonding



OR

The solubility equilibrium in the saturated solution is



The solubility of AgCl is 1.06×10^{-5} mole per litre

$$[Ag^+(aq)] = 1.06 \times 10^{-5} mol L^{-1}$$

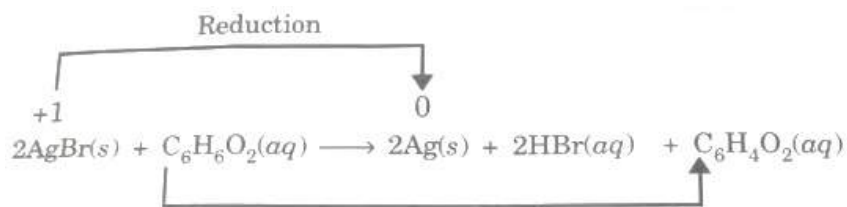
$$[Cl^-(aq)] = 1.06 \times 10^{-5} mol L^{-1}$$

$$K_{sp} = [Ag^+(aq)] [Cl^-(aq)]$$

$$= (1.06 \times 10^{-5} mol L^{-1}) \times (1.06 \times 10^{-5} mol L^{-1})$$

$$= 1.12 \times 10^{-2} mol^2 L^{-2}$$

26. i.



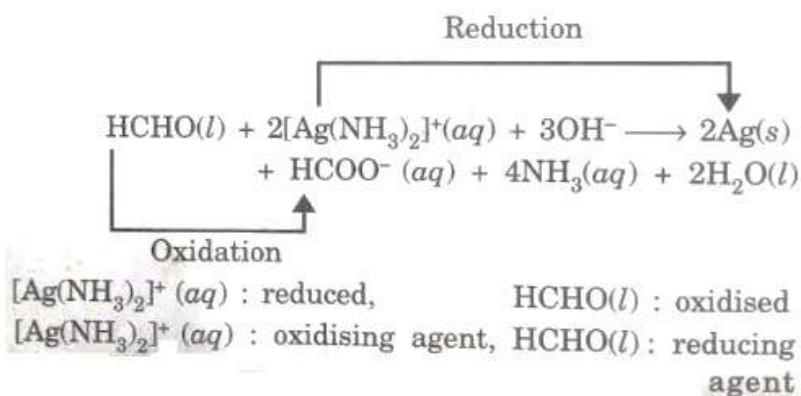
AgBr : reduced,

$C_6H_6O_2(aq)$: oxidised

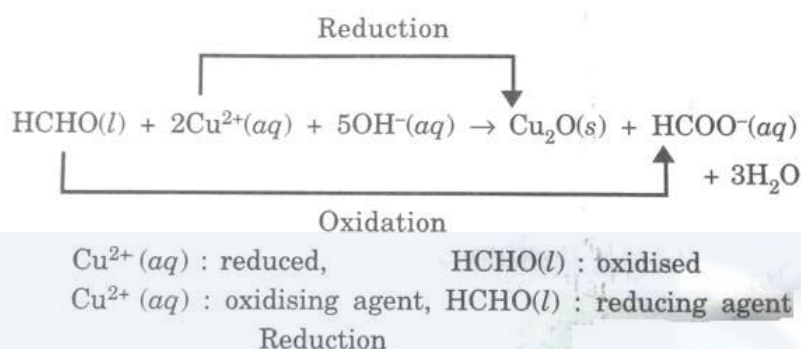
AgBr : Oxidising agent,

$C_6H_6O_2(aq)$: reducing agent

ii.



iii.



27. Given, compression factor = $z = 0.5$, $T = 0^\circ\text{C} = 273\text{ K}$, $p = 100\text{ atm}$.

We know that, $z = \frac{pV}{nRT}$

$$\Rightarrow 0.5 = \frac{100 \times V}{1 \times 0.082 \times 273}$$

$$\Rightarrow V = 0.1119\text{ L}$$

Van der Waals equation:

$$\left(p + \frac{a}{V^2}\right)(V - b) = RT \text{ [for 1 mol]}$$

Neglecting b , $\left(p + \frac{a}{V^2}\right)V = RT$

$$\Rightarrow pV + \frac{a}{V} = RT$$

$$\Rightarrow \frac{pV}{RT} + \frac{a}{VRT} = 1$$

$$\Rightarrow a = \left(1 - \frac{pV}{RT}\right) VRT = (1 - 0.5) \times 0.1119 \times 0.082 \times 273$$

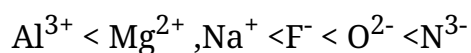
$$\Rightarrow a = 1.252\text{ atm L}^2\text{mol}^{-2}$$

28.

S.No.	Value	Significant figures
1.	4.01×10^2	Three
2.	8.256	Four

3.	100	One
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29. i. They all are iso-electronic with ten electrons each.
 ii. In iso-electronic species, greater the nuclear charge, lesser will be the atomic or ionic radius.



OR

Elements on extremes ends of a period easily combine with oxygen to form oxides. The elements present on the extreme left of a period are metals and formed basic oxides (e.g. Na_2O , MgO , CaO , K_2O etc.) with ionic nature whereas the element present on extreme right are non- metals formed the most acidic oxides (e.g. Cl_2O_7 , CO_2 , SO_2 , N_2O_3 etc.). The non-metallic oxides are covalent in nature. Oxides of middle elements of a period are however amphoteric in nature (eg. Al_2O_3) or neutral (eg. CO).

30. The solar energy radiated back from the earth surface is absorbed by the green house gases.

(CO_2 , CH_4 , O_3 , $\text{CFC}'\text{s}$) are present near the earth's surface.

They heat up the atmosphere near the earth's surface and keep it warm. As a result of these, there is growth of vegetation which supports the life. In the absence of this effect, there will be no life of both plant and animal on the surface of the earth.

Section D

31. The oxidant and reductant in the following reactions are as follows:

i. **Oxidant:** H^+

Reductant: Zn

ii. **Oxidant:** H_2O_2

Reductant: $[\text{Fe}(\text{CN})_6]^{4-}$

iii. **Oxidant:** $[\text{Fe}(\text{CN})_6]^{3-}$

Reductant: H_2O_2

iv. **Oxidant:** F_2

Reductant: BrO_3^-

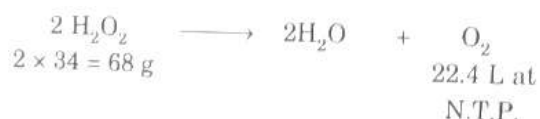
v. **Oxidant:** NaClO_3

Reductant: 2I_2

OR

i. Solution. Let us calculate the volume of O_2 which is liberated by 30.36 g H_2O_2 at N.T.P. This will correspond to volume strength of H_2O_2 .

Hydrogen peroxide decomposes as :



68 g of H_2O_2 produce O_2 at N.T.P, = 22.4 L

30.36 g of H_2O_2 will produce O_2 at N.T.P.

$$= \frac{22.4}{68} \times 30.36 = 10 \text{ L}$$

The given solution of H_2O_2 produces 10 L of O_2 at N.T.P

\therefore Volume strength = 10 volumes

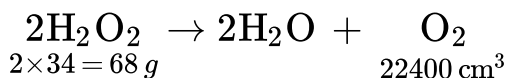
ii. Molecular mass of $\text{H}_2\text{O}_2 = 2 + 32$

$$= 34 \text{ g}$$

Now, 1 litre of 1 M solution contains $\text{H}_2\text{O}_2 = 34 \times 2$

$$= 68 \text{ g}$$

H_2O_2 decomposes as:



Mass of H_2O_2 in 100 cm^3 of the solution

$$= \frac{68}{1000} \times 100 = 6.8$$

Now, according to the equation

68 g H_2O_2 at S.T.P. evolve oxygen = 22400 cm^3

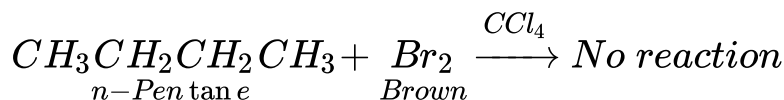
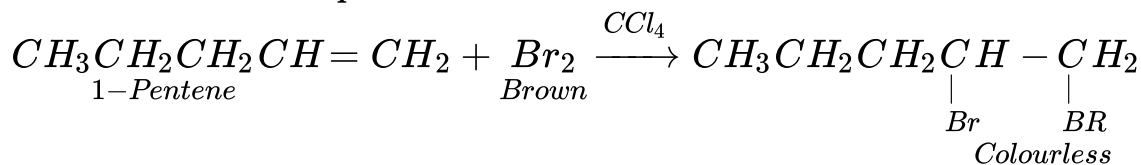
6.8 g of H_2O_2 at S.T.P. evolve oxygen

$$= \frac{22400}{68} \times 6.8 = 2240 \text{ cm}^3$$

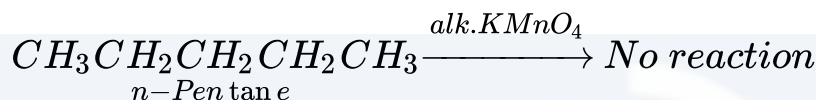
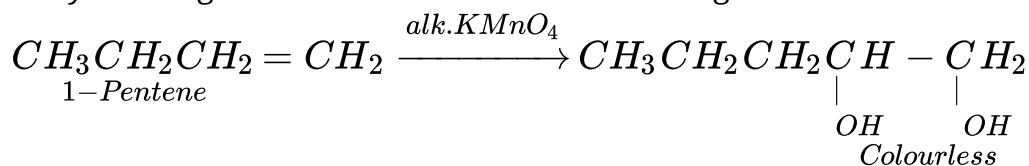
32. i. 1-Pentene and n-pentane can be distinguished by the following tests:

a. **Reaction with Br_2 in CCl_4** - 1-pentene will decolourise the brown colour of the

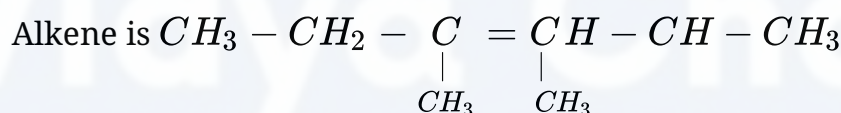
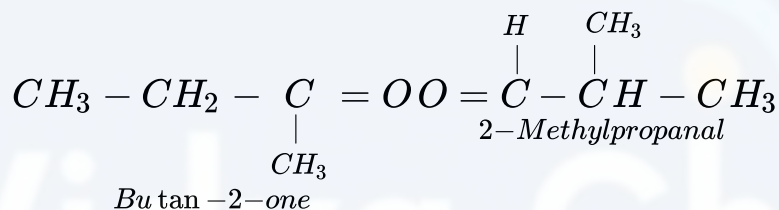
solution of Br₂ in CCl₄. But n-pentane will not decolourise the colour of bromine at room temperature.



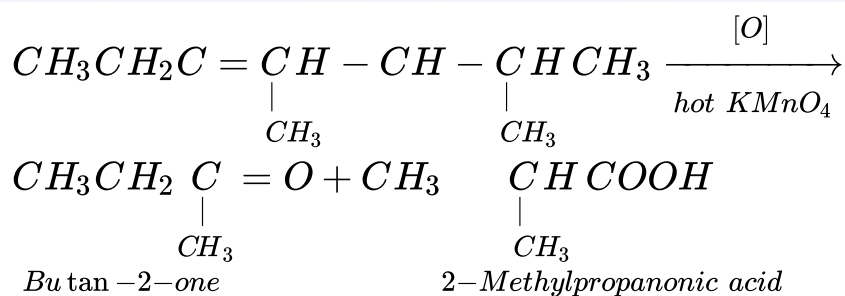
b. Reaction with cold dilute KMnO₄ (Baeyer's test)- 1-Pentene will react with Baeyer's reagent and its colour will be discharged. n-Pentane does not react.



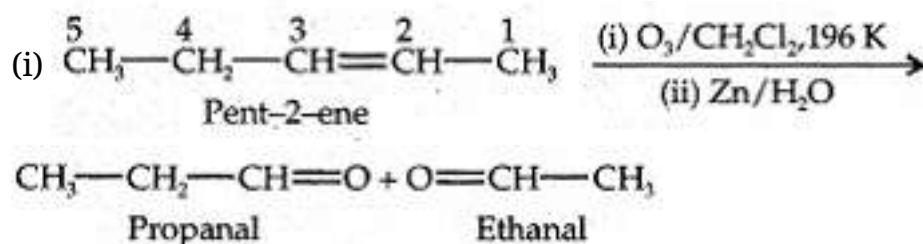
ii. Let us first try to write the structure of alkene. The product of ozonolysis are:

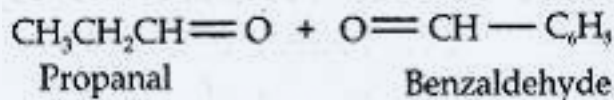
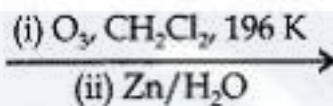
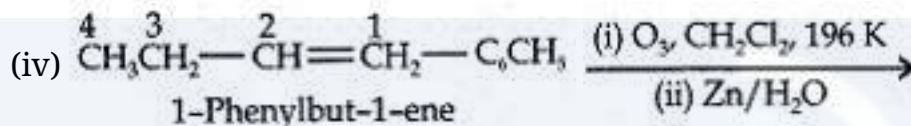
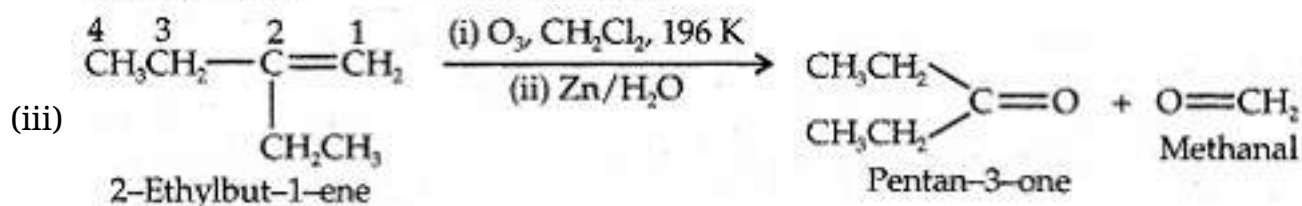
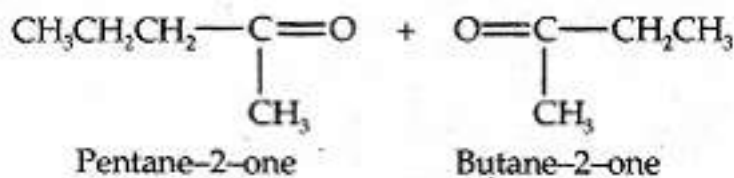
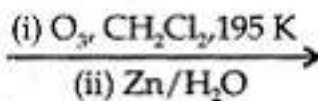
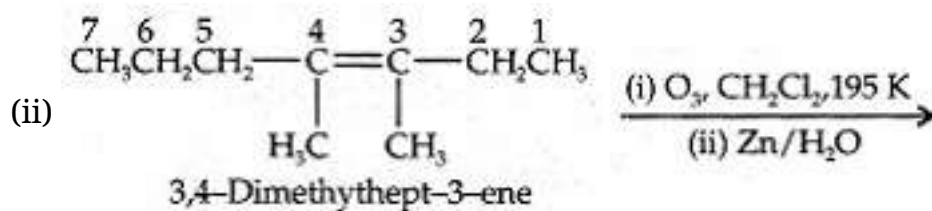


With hot KMnO₄ it will react as:



OR





33. I. i. $E = h\nu$

$= (6.626 \times 10^{-34} \text{ Js}) \times (3 \times 10^{15} \text{ s}^{-1})$

$= 1.988 \times 10^{-18} \text{ J}$

ii. $E = h\nu = \frac{hc}{\lambda}$
 $= \frac{(6.626 \times 10^{-34} \text{ Js}) \times (3 \times 10^8 \text{ ms}^{-1})}{(0.50 \times 10^{-10} \text{ m})}$

$= 3.98 \times 10^{-15} \text{ s}$

II. i. Frequency $= \frac{1}{\text{Period}} = \frac{1}{2.0 \times 10^{-10} \text{ s}} = 5 \times 10^9 \text{ s}^{-1}$

ii. Wavelength, $\lambda = \frac{c}{\nu} = \frac{3 \times 10^8 \text{ ms}^{-1}}{5 \times 10^9 \text{ s}^{-1}} = 6.0 \times 10^{-2} \text{ m}$

iii. Wave number $\bar{\nu} = \frac{1}{\lambda} = \frac{1}{6.0 \times 10^{-2}} = 16.66 \text{ m}^{-1}$

OR

i. 38% HCl by mass means that 38 g of HCl is present in 100 g of solution.

Volume of solution $= \frac{\text{Mass}}{\text{Density}} = \frac{100}{1.19} = 84.03 \text{ mL}$

Molarity $= \frac{1.04 \times 1000}{84.03} = 12.38 \text{ M}$

ii. The volume of this solution required to make 1.0 L of 10 M HCl can be calculated by applying the molarity equation as

$$\underbrace{M_1 V_1}_{\text{acid}_1} = \underbrace{M_2 V_2}_{\text{acid}_2}$$

$$12.38 \times V_1 = 0.10 \text{ M} \times 1.0 \text{ L}$$

$$\therefore V_1 = \frac{0.10 \times 10}{12.38} = 0.00808 \text{ L or } = 8.08 \text{ cm}^3$$



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