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**CBSE SAMPLE PAPER-01**

**CBSE Class – XI**

**CHEMISTRY**

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Time allowed: 3 hours, Maximum Marks: 70

**General Instructions:**

- a) All the questions are compulsory.
  - b) There are 26 questions in total.
  - c) Questions 1 to 5 are very short answer type questions and carry one mark each.
  - d) Questions 6 to 10 carry two marks each.
  - e) Questions 11 to 22 carry three marks each.
  - f) Questions 23 is value based question carrying four marks.
  - g) Questions 24 to 26 carry five marks each.
  - h) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all three questions in five marks each. You have to attempt only one of the choices in such questions.
  - i) Use of calculators is not permitted. However, you may use log tables if necessary.
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**1. If a metal is higher than a particular metal in electrochemical series, will it be stronger reducing agent or weaker reducing agent? Why?**

**Ans.** It will be a weaker reducing agent if electrochemical series has elements in decreasing order of their reduction potential.

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**2. If the critical temperature for carbon dioxide and methane are  $31.1^{\circ}\text{C}$  and  $-81.9^{\circ}\text{C}$  respectively, then which of these has strong intermolecular forces? Give reason.**

**Ans.** The intermolecular forces in carbon dioxide are more than in methane molecules because of greater polarity.

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**3. Which of these contain the largest number of atoms – 1.0 g Li(s) and 1g Na(s)?**

**Ans.** 1.0 g Li.

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4. Predict the shape of the  $\text{PH}_3$  molecule according to VSEPR theory.

Ans. Trigonal pyramidal.

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5. Give reason: “Metallic hydrides are used for storing hydrogen”.

Ans. Metallic hydrides trap hydrogen in their voids forming interstitial hydrides, thus they can be used for storing hydrogen.

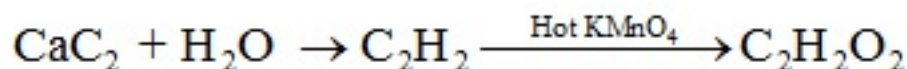
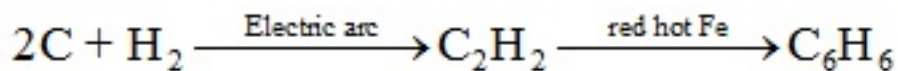
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6. Convert:

a) Carbon to benzene.

b) Calcium carbide to oxalic acid.

Ans.



7. How would you calculate the pH of 0.001M NaOH?

Or

Ramesh forgot to add the reaction mixture to the round bottomed flask at  $27^\circ\text{C}$  but instead he placed the flask on the flame. But after sometime, he realized his mistake and used pyrometer and found the temperature of the flask which was  $477^\circ\text{C}$ . What fraction of air would have been expelled out?

Ans.  $[\text{NaOH}] = [\text{OH}^-] = 0.001\text{M}$

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$$[H_3O^+][OH^-] = 1.0 \times 10^{-14}$$

$$[H_3O^+] = 10^{-11}$$

$$\text{pH} = -\log [H_3O^+] = -\log 10^{-11} = 11$$

**Or**

$$\frac{n_1}{n_2} = \frac{T_2}{T_1}$$

$$\frac{750}{300} = \frac{5}{2}$$

$$\frac{n_2}{n_1} = \frac{2}{5} \quad \text{Thus, the amount of air escaped} = 1 - \frac{2}{5} = 0.6$$

**8. State the difference between classical smog and photochemical smog.**

**Ans.**

Classical smog	Photochemical smog
Occurs in cool humid climate.	Occurs in warm, dry and sunny climate.
It is a mixture of smoke, fog and sulphur dioxide.	Components of photochemical smog result from the action of sunlight on unsaturated hydrocarbons & oxides of nitrogen produced by automobiles & factories.

**9. Given the electrode reduction potentials of four metallic elements A, B, C and D = + 0.79, - 0.74, 1.08 and - 0.31 V. Arrange these in order of decreasing electropositive character and support your answer.**

**Ans.** Higher the electrode potential lower is its tendency to lose electrons and therefore, lower is the electropositive character of the metal. So the metals are arranged as: B, D, A, C.

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**10. Give any three factors favourable for the formation of ionic bond.**

**Ans.** (a) Low ionization enthalpy of the metal atom.

(b) High electron gain enthalpy of the non-metal atom.

(c) High lattice enthalpy of the compound formed.

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**11. i. Which of the two is more stable  $H_2^+$  or  $H_2^-$  and why?**

**ii. All bonds in  $PCl_5$  are not equal. Explain.**

**iii. Which of the two is more ionic -  $NaCl$  or  $NaI$  and why?**

**Ans.** (i)  $H_2^+$  is more stable than  $H_2^-$  as it contains no electron in antibonding MO while latter contains an electron in antibonding MO making it less stable.

(ii)  $PCl_5$  contains axial and equatorial bonds. Axial bonds are longer than equatorial bonds as they face more repulsion from equatorial bonds. Hence axial bonds are weaker than equatorial bonds.

(iii)  $NaI$  is more covalent due to high polarizability of iodide than chloride ion.

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**12. Explain the following terms with an example each:**

**i) Open system**

**ii) Isolated system**

**iii) Closed system**

**Ans.** (i) In an open system, there is exchange of energy and matter between system and surroundings. The presence of reactants in an open beaker is an example of an open system. Here the boundary is an imaginary surface enclosing the beaker and reactants.

(ii) In a closed system, there is no exchange of matter, but exchange of energy is possible between system and the surroundings. The presence of reactants in a closed vessel made of conducting material e.g. copper or steel is an example of a closed system.

(iii) In an isolated system, there is no exchange of energy or matter between the system and the surroundings. The presence of reactants in a thermos flask or any other closed insulated vessel is an example of an isolated system.

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**13. Draw the structure of the following IUPAC compounds:**

**a) 2,8-Dimethyl-3, 6-decadiene**

**b) 4-Ethyl-2,6-dimethyl-dec-4-ene**

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Mass of carbon dioxide produced = 0.4950 g

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Mass of water produced = 0.2025 g

Percentage of Carbon

$$= \frac{12}{44} \times \frac{\text{Mass of carbon dioxide}}{\text{Mass of compound taken}} \times 100$$
$$= 54.54\%$$

Percentage of Hydrogen

$$= \frac{2}{18} \times \frac{\text{Mass of water}}{\text{Mass of compound taken}} \times 100$$
$$= 9.09\%$$

(ii) Blood red colouration due to  $\text{Fe}(\text{CNS})$  will be produced.

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**15. If water vapour is assumed to be a perfect gas, molar enthalpy change for vapourisation of 1 mol of water at 1 bar and  $100^\circ\text{C}$  is  $41\text{kJmol}^{-1}$ . Calculate the internal energy change, when**

**i) 1 mol of water is vaporised at 1 bar pressure and  $100^\circ\text{C}$**

**ii) 1 mol of water is converted into ice.**

**Ans.** (i) The change  $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{O}(\text{g})$

$$\Delta H = \Delta U + \Delta n_g RT$$

$$\Delta U = 41.00 \text{ kJ/mol}^{-1} \times 8.3 \text{ J/mol/K} \times 373 \text{ K}$$

$$= 41.00 - 3.096 \text{ kJ/mol} = 37.904 \text{ kJ/mol}$$

(ii) The change  $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{O}(\text{s})$

There is negligible change in volume, so  $p = \Delta n_g RT = 0$

In this case,  $\Delta H \cong \Delta U$

Therefore,  $\Delta U = 41.00 \text{ kJ/mol}$

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**16. Explain:**

**i. Boron is unable to form  $\text{BF}_6^{3-}$  ion.**

**ii.  $[\text{SiF}_6]^{2-}$  is known whereas  $[\text{SiCl}_6]^{2-}$  not known.**

**iii. Conc.  $\text{HNO}_3$  can be stored in aluminium container.**

**Ans.** (i) Due to non-availability of d orbitals, boron is unable to expand its octet. Therefore, the maximum covalence of boron cannot exceed 4 and it cannot form ion.

(ii)  $[\text{SiF}_6]^{2-}$  is known whereas  $[\text{SiCl}_6]^{2-}$  is not known since six large size atoms i.e. six chlorine atoms cannot be accommodated around Si but six small size atoms (F atoms) can be comfortably accommodated.

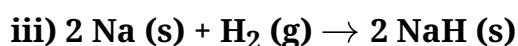
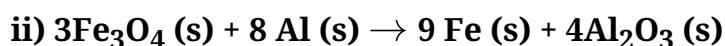
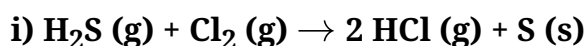
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(iii) Conc.  $\text{HNO}_3$  can be stored in aluminium container because of the formation of protective layer of oxide which prevents subsequent layers from undergoing reaction with nitric acid.

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**17. Identify the species undergoing oxidation and reduction in the reactions given below.**



**Ans.** (i)  $\text{H}_2\text{S}$  is oxidised because a more electronegative element, chlorine is added to hydrogen and so get reduced.

(ii) Aluminium is oxidised because oxygen is added to it. Ferrous ferric oxide ( $\text{Fe}_3\text{O}_4$ ) is reduced because oxygen has been removed from it.

(iii) With the careful application of the concept of electronegativity only we may infer that sodium is oxidised and hydrogen is reduced.

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**18. What are the conclusions made by Rutherford w.r.t the structure of atom?**

**Ans.** (i) Most of the space in the atom is empty as most of the  $\alpha$ -particles passed through the foil undeflected.

(ii) A few positively charged  $\alpha$ - particles were deflected. The deflection must be due to enormous repulsive force showing that the positive charge of the atom is not spread throughout the atom as Thomson had presumed. The positive charge has to be concentrated in a very small volume that repelled and deflected the positively charged  $\alpha$ - particles.

(iii) Calculations by Rutherford showed that the volume occupied by the nucleus is negligibly small as compared to the total volume of the atom. The radius of the atom is about  $10^{-10} \text{ m}$ , while that of nucleus is  $10^{-15} \text{ m}$ .

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**19. Define the following terms:**

i. Functional groups

ii. Homologous series

Or

**Predict about the formation of  $\text{M}^{3+}$  ion in solution and compare the electropositive**

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**character of the two metals given. The standard electrode potential values,  $E^\theta$  for  $\text{Al}^{3+}/\text{Al}$  are  $-1.66\text{ V}$  and that of  $\text{Tl}^{3+}/\text{Tl}$  is  $+1.26\text{ V}$ .**

**Ans.** (i) The functional group may be defined as an atom or group of atoms joined in a specific manner which is responsible for the characteristic chemical properties of the organic compounds. The examples are hydroxyl group ( $-\text{OH}$ ), aldehyde group ( $-\text{CHO}$ ).

(ii) A group or a series of organic compounds each containing a characteristic functional group forms a homologous series and the members of the series are called homologues. The members of a homologous series can be represented by general molecular formula and the successive members differ from each other in molecular formula by a  $-\text{CH}_2$  unit.

**Or**

Standard electrode potential values for two half-cell reactions suggest that aluminium has high tendency to make  $\text{Al}^{3+}(\text{aq})$  ions, whereas  $\text{Tl}^{3+}$  is not only unstable in solution but is a powerful oxidising agent also. Thus  $\text{Tl}^+$  is more stable in solution than  $\text{Tl}^{3+}$ . Aluminium being able to form +3 ions easily is more electropositive than thallium.

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**20. Give reasons:**

**a)  $\text{HCl}$  is predominantly covalent in gaseous state.**

**b)  $\text{KHF}_2$  exists while  $\text{KCl}_2$  does not.**

**c) Sigma bond is stronger than the pi bond.**

**d)  $\text{NaCl}$  gives white precipitate with silver nitrate solution.**

**Ans.** (a) In  $\text{HCl}$ , the electronegativity difference in  $\text{Cl}$  and  $\text{H}$  atoms is 0.9. so it is predominantly covalent in gaseous state.

(b)  $\text{HF}$  molecules are hydrogen bonded. Therefore, they can associate to form  $\text{HF}_2^-$  anion which can exist in combination with potassium ion.

(c) The strength of a covalent bond depends on the extent of the overlap. Greater the overlap, stronger is the bond. A sigma bond is formed by the axial overlap of the orbitals which is more effective than the sidewise overlap of pi bond as greater energy will be released in axial overlap.

(d) Both  $\text{NaCl}$  and  $\text{AgNO}_3$  are ionic solids. They readily dissociate to form ions in the solution. Silver ions combine with chlorine ions to give white precipitate of  $\text{AgCl}$ .

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**21. Define:**

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**i. Lattice enthalpy**

**ii. Bond length**

**iii. Bond angle.**

**Ans.** (i) The Lattice Enthalpy of an ionic solid is defined as the energy required to completely separating one mole of a solid ionic compound into gaseous constituent ions.

(ii) Bond length is defined as the equilibrium distance between the nuclei of two bonded atoms in a molecule.

(iii) Bond angle is defined as the angle between the orbitals containing bonding electron pairs around the central atom in a molecule/complex ion.

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**22. i. Name the class of hydrides to which  $\text{H}_2\text{O}$  and  $\text{NaH}$  belong.**

**ii. What do you understand by the term hydride gap?**

**iii. What do you mean by 15 volume  $\text{H}_2\text{O}_2$  solution?**

**Ans.** (i)  $\text{H}_2\text{O}$  is covalent hydride whereas  $\text{NaH}$  is ionic or saline hydride.

(ii) Group 7 to group 9 elements do not form hydrides. This region of periodic table from group 7 to 9 is called as hydride gap.

(iii) 1 L of  $\text{H}_2\text{O}_2$  gives 15 L of  $\text{O}_2$  at NTP.

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**23. Ram uses urea and DAP for his crops whereas Shyam uses compost. Ammonia is prepared by Haber's process. It is used for making fertilizers. If it is used in excess, it is harmful for crops.**

**a) What is DAP?**

**b) What can be done with waste products?**

**c) What is the use of avoiding excess of fertilizers?**

**d) Natural manure is preferred than synthetic fertilizers. Why?**

**Ans.** (a) Diammonium phosphate.

(b) It is used to produce bio gas.

(c) It will make the soil basic which is not suitable for crops.

(d) Manure does not harm the soil whereas fertilizers harm the soil.

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**24. Differentiate valency and oxidation number. [Any five points]**

**Or**

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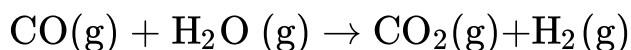
**Calculate equilibrium concentrations of CO<sub>2</sub>, H<sub>2</sub>, CO and H<sub>2</sub>O in**

**CO(g) + H<sub>2</sub>O (g) → CO<sub>2</sub>(g)+H<sub>2</sub>(g) at 800 K, if only CO and H<sub>2</sub>O are present initially at concentrations of 0.1 M each. [K<sub>c</sub> = 4.24] for the reaction:**

**Ans.**

No	Valency	Oxidation Number
1.	It is always a whole number.	It can be even fractional.
2.	It defined as the number of hydrogen atoms which combine with one atom of the element.	It is defined as the charge assigned to an atom of a molecule or ion.
3.	Usually an element has fixed valency in all its compounds.	An element has different valency in different compounds.
4.	It does not have any sign.	It has either positive or negative sign.
5.	Valency of no other element is zero except noble gases.	It can be zero.

**Or**



*Initial concentration*

0.1 M 0.1 M 0 0

Let x mole of each of the product be formed.

At equilibrium:

(0.1 – x) M (0.1 – x) M x M x M

Where x is the amount of carbon dioxide and hydrogen at equilibrium.

Hence equilibrium constant can be,

$$K_c = K_c = \frac{x^2}{(0.1-x)^2} = 4.24$$

$$x^2 = 4.24 (0.01 + x^2 - 0.2x)$$

$$= 0.0424 + 4.24x^2 - 0.848x$$

$$a = 3.24, b = - 0.848, c = 0.0424$$

for quadratic equation  $ax^2 + bx + c = 0$ ,

$$x = \frac{(-b \pm \sqrt{b^2 - 4ac})}{2a}$$

Substituting the values, we get

$$x = \frac{(0.848 \pm 0.4118)}{6.48}$$

$$x_1 = \frac{(0.848 - 0.4118)}{6.48} = 0.067$$

$$x_2 = \frac{(0.848 + 0.4118)}{6.48} = 0.194$$

The value 0.194 should be neglected because it will give concentration of the reactant which is more than initial concentration.

Hence the equilibrium concentrations are,

$$[\text{CO}_2] = [\text{H}_2] = x = 0.067 \text{ M}$$

$$[\text{CO}] = [\text{H}_2\text{O}] = 0.1 - 0.067 = 0.033 \text{ M}$$

## 25. Explain the rules for calculating oxidation number.

Or

i) Write the chemical reactions when borax solution is acidified.

ii) Explain why  $\text{BF}_3$  exists whereas  $\text{BH}_3$  does not?

iii)  $\text{SiO}_2$  is solid but  $\text{CO}_2$  is a gas at room temperature.

**Ans.** In elements, in the free or the uncombined state, each atom bears an oxidation number of zero. Evidently each atom in  $\text{H}_2$ ,  $\text{O}_2$ ,  $\text{Cl}_2$ ,  $\text{O}_3$ ,  $\text{P}_4$ ,  $\text{S}_8$ , Na, Mg, Al has the oxidation number zero.

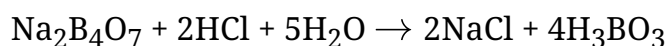
1. For ions composed of only one atom, the oxidation number is equal to the charge on the ion. Thus  $\text{Na}^+$  ion has an oxidation number of +1,  $\text{Mg}^{2+}$  ion, +2,  $\text{Fe}^{3+}$  ion, +3,  $\text{Cl}^-$  ion, -1,  $\text{O}^{2-}$  ion, -2; and so on. In their compounds all alkali metals have oxidation number of +1, and all alkaline earth metals have an oxidation number of +2. Aluminium is regarded to have an oxidation number of +3 in all its compounds.

2. The oxidation number of oxygen in most compounds is -2. However, we come across two kinds of exceptions here. One arises in the case of peroxides and superoxides, the compounds of oxygen in which oxygen atoms are directly linked to each other. While in peroxides (e.g.,  $\text{H}_2\text{O}_2$ ,  $\text{Na}_2\text{O}_2$ ), each oxygen atom is assigned an oxidation number of -1, in superoxides (e.g.,  $\text{KO}_2$ ,  $\text{RbO}_2$ ) each oxygen atom is assigned an oxidation number of  $-(\frac{1}{2})$ . The second exception appears rarely, i.e. when oxygen is bonded to fluorine. In such compounds e.g., oxygen difluoride ( $\text{OF}_2$ ) and dioxygen difluoride ( $\text{O}_2\text{F}_2$ ), the oxygen is assigned an oxidation number of +2 and +1, respectively. The number assigned to oxygen will depend upon the bonding state of oxygen but this number would now be a positive figure only.

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3. The oxidation number of hydrogen is +1, except when it is bonded to metals in binary compounds (that is compounds containing two elements). For example, in LiH, NaH, and  $\text{CaH}_2$ , its oxidation number is -1.
4. In all its compounds, fluorine has an oxidation number of -1. Other halogens (Cl, Br, and I) also have an oxidation number of -1, when they occur as halide ions in their compounds. Chlorine, bromine and iodine when combined with oxygen, for example in oxoacids and oxoanions, have positive oxidation numbers.
5. The algebraic sum of the oxidation number of all the atoms in a compound must be zero. In polyatomic ion, the algebraic sum of all the oxidation numbers of atoms of the ion must equal the charge on the ion. Thus, the sum of oxidation number of three oxygen atoms and one carbon atom in the carbonate ion,  $(\text{CO}_3)^{2-}$  must equal -2.

**Or**

i) Borax solution on acidification forms boric acid.



ii)  $\text{BF}_3$  is trigonal planar molecule. Due to  $p\pi - p\pi$  back bonding lone pair of electrons of F is back donated to B atom. This delocalization reduces the deficiency of electrons of boron thereby increasing the stability of  $\text{BF}_3$  molecule. Thus, due to absence of lone pair of electrons on H atom this compensation does not occur in  $\text{BH}_3$ . In other words electron deficiency of B stays & hence it reduces its electron deficiency as  $\text{BH}_3$  dimerises to form  $\text{B}_2\text{H}_6$ .

iii) Carbon is able to form  $p\pi - p\pi$  bond with O atom and constitute a stable non - polar molecule  $\text{O} = \text{C} = \text{O}$ . Due to weak inter particle force its boiling point is low and it is gas at room temperature. Si on the other hand is not able to form  $p\pi - p\pi$  bond with O atoms because of its relatively large size. In order to complete its octet Si is linked to four O atoms around it by sigma bond & these constitutes network structure, which is responsible for its solidity.

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**26. a) In which C-C bond of  $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$ , the inductive effect is expected to be least?**

**b) Which of the following compound shows geometrical isomerism?**

**i. Pent-1-ene**

**ii. Pent-2-ene**

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iii. 2-Methylbut-2-ene

c) What type of isomerism is present in the following pairs?

Or

a) How will you convert ethanoic acid into benzene?

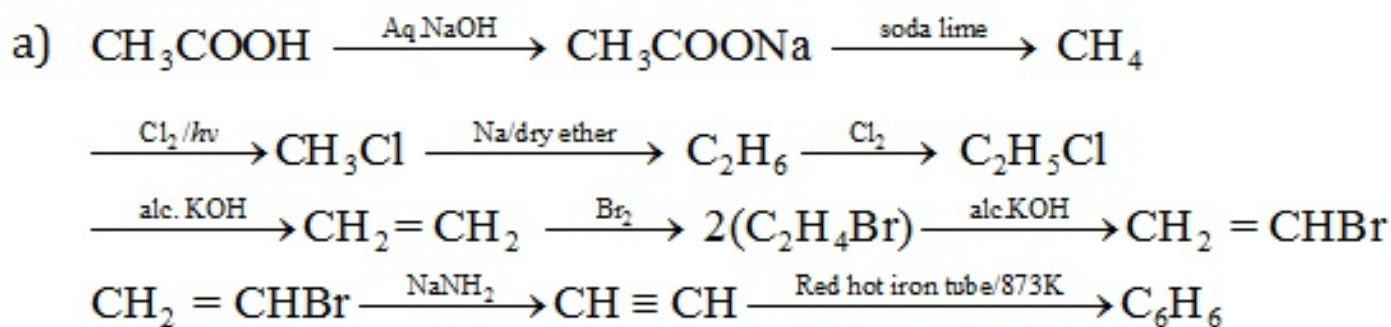
b) “Branched chain hydrocarbons have lower boiling point than straight chain hydrocarbon”. Why?

**Ans.** (a) The inductive effect is least in C<sub>2</sub>-C<sub>3</sub> bond because the magnitude of inductive effect decreases as the number of intervening bonds increases.

(b) Pent-2-ene will show geometrical isomerism.

(c) Position isomerism, Metamerism, Functional isomerism.

**Or**



b) Branched chain hydrocarbons try to acquire spherical shape which has minimum surface area, therefore minimum van der Waals' forces of attraction and hence they have lower boiling point.

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