MALAPPURAM DISTRICT HIGHER SECONDARY CHEMISTRY TEACHERS ASSOCIATION

FIRST YEAR CHEMISTRY MODEL EXAMINATION -2022

[Redox Reactions,Hydrogen,The s-Block Elements,The p-Block Elements,Organic Chemistry – Some Basic Principles and Techniques,Hydrocarbons and Environmental Chemistry]

ANSWER KEY

Time : 2 Hours,   Cool-off time : 15 Minutes   **Score: 60 Marks**

Answer any 8 questions from 1-11. Each carries 2 scores   **(8x2=16)**

1. Calculate the oxidation number of N in   (i) HNO_3 (ii) NO_2^{--}

   Answer:

   (i)+5   (ii)+3

2. H_2O_2 is stored in wax-lined glass or plastic vessels in dark. Why ?

   Answer:

   H_2O_2 decomposes slowly on exposure to light.

   $2H_2O_2(l) \text{-------}> 2H_2O(l) + O_2(g)$

   In the presence of metal surfaces or traces of alkali (present in glass containers), the above reaction is catalysed. It is, therefore, stored in wax-lined glass or plastic vessels in dark.

3. Discuss the position of hydrogen in the periodic table.

   Answer:

   Hydrogen shows resemblance with both Alkali metals of the first group and halogens of the 17 th group.

   Like alkali metals it has one electron in the outer most shell and forms unipositive ions.

   Like halogens, it requires only one electron to complete the valence shell configuration and form uninegative ion. It exists as diatomic molecule and combines with metals.

   At the same time it shows some differences from alkali metals and halogens. So it is placed separately in the periodic table

4. Write the chemical formula of gypsum. Why gypsum is added during the manufacture of cement?

   Answer:

   $CaSO_4 \cdot 2H_2O$

5. Name the process used for the industrial preparation of sodium carbonate.

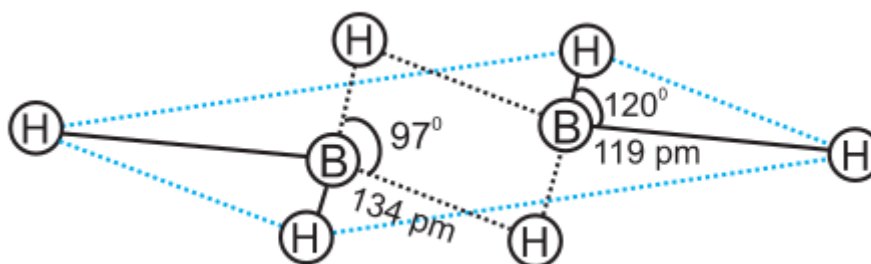**Is this method suitable for the preparation of potassium carbonate? Justify.**

Answer:Solvay process .

Solvay process cannot be used for the preparation of K_2CO_3 because potassium bicarbonate ($KHCO_3$) formed is highly soluble in water.

6. Draw the structure of diborane.

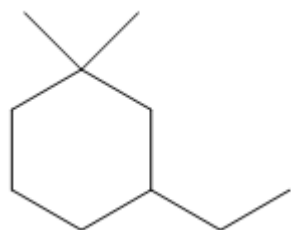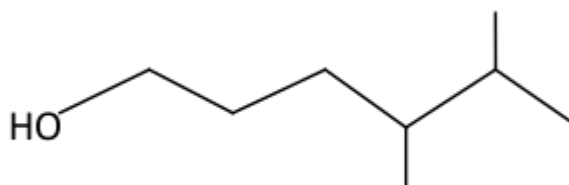**Write the name of special bond present in diborane**

Answer:

3-centre-2-electron bridge bonds or banana bonds

7. Give the IUPAC name of

(I) **(ii)**

Answer: (i)3-Ethyl-1,1-dimethylcyclohexane

(ii) 4,5-Dimethylhexan-1-ol

**8. What is metamerism? Write the metamers of $C_4H_{10}O$.**

Answer:

Isomers which differ in the carbon chain (alkyl groups) around the functional group are called metamers and the phenomenon is called metamerism.

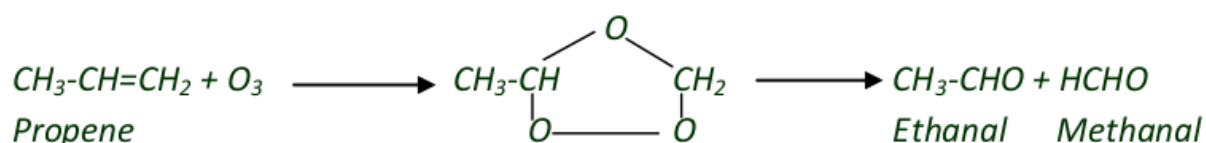CH_3-O-CH_2-CH_2-CH_3 and CH_3-CH_2-O-CH_2-CH_3.

9. Draw the Newman Projections of the eclipsed and staggered conformations of ethane molecule.

Answer:

(i) Eclipsed   (ii) Staggered
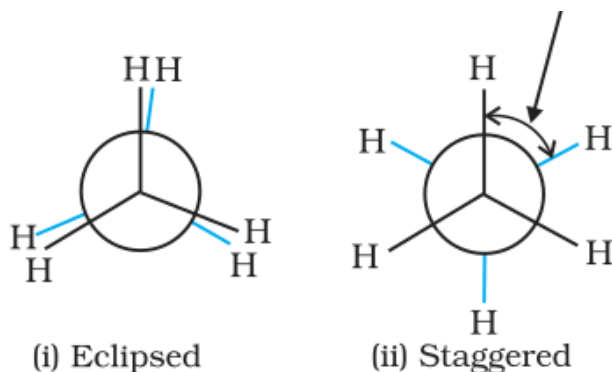
10. **Give the chemical equations for the steps involved in the ozonolysis of propene.**

    Answer:

$CH_3-CH=CH_2 + O_3 \longrightarrow CH_3-CH \overset{O}{\underset{O-O}{\diagup \diagdown}} CH_2 \longrightarrow CH_3-CHO + HCHO$

Propene   Ethanal   Methanal

11. **Write any two applications of green chemistry in day-to-day life.**

    Answer:

    Dry Cleaning of Clothes: Liquefied carbondioxide, with a suitable detergent is used for dry cleaning clothes.

    Bleaching of Paper: Hydrogen peroxide (H_2O_2) with suitable catalyst is used for bleaching paper

Answer any 8 questions from 12-23. Each carries 3 scores   (8x3=24)

12. a) **The oxidation number of an atom in the elementary form is ……….. (1)**

    b) **Using Stock notation, represent the following compounds :**

        (i) FeO,   (ii) $HAuCl_4$ (2)

    Answer:

    a) Zero

    b) (i) Fe(II)O   (ii) HAu(III)Cl$_4$

13. **Balance the following Redox reaction by ion-electron method or oxidation number method (Acid medium)**

    $Cr_2O_7^{2-}(aq) + SO_3^{2-}(aq) \text{ -------> } Cr^{3+}(aq) + SO_4^{2-}(aq)$

    Answer:

    Balanced equation is

    $Cr_2O_7^{2-}(aq) + 3\ SO_3^{2-}(aq) + 8H^+ \text{ -------> } 2\ Cr^{3+}(aq) + 3\ SO_4^{2-}(aq) + 4\ H_2O$

14. a)Why hard water is unsuitable for laundry purpose? (1)

b)Explain the methods used for the removal of temporary hardness of water. (2)

Answer:

a)Hard water does not readily form lather with soap. So it results in wastage of soap and hence unsuitable for laundry purpose.

(b) Boiling: During boiling, the soluble $Mg(HCO_3)_2$ is converted into insoluble $Mg(OH)_2$ and $Ca(HCO_3)_2$ is changed to insoluble $CaCO_3$, which can be removed by filtration.

Clark's method: In this method, calculated amount of lime is added to hard water. Calcium carbonate or magnesium hydroxide gets precipitated and can be filtered out.

15. Give reasons for the anomalous behaviour of Li. Write any two points of similarities between Li and Mg.

Answer:

Li shows some anomalous properties d ue to its small size and high polarizing power.

Similarities between Li and Mg:

Both Li and Mg are harder but lighter than other elements of the respective group.

They do not form superoxides.

Their carbonates decompose easily on heating to form oxides and CO_2.

Their bicarbonates are stable only in solution. Etc...

16. a) The solution of borax is alkaline. Give reason. (1)

b) Boric acid (H_3BO_3) is considered as a weak acid. Why? (1)

c) What is inorganic benzene? How it is prepared (1)

Answer:

a)Borax dissolves in water to give an alkaline solution.

$$Na_2B_4O_7 + 7H_2O \text{ -------> } 2NaOH + 4H_3BO_3$$

Since NaOH is a strong alkali and orthoboric acid is weak acid, the solution is basic in nature.

b)Boric acid is a weak Lewis acid since it accepts electrons from a hydroxyl ion of water molecule.

c)Borazine ($B_3N_3H_6$).

When diborane is heated with ammonia, we get Borazine commonly called inorganic benzene.

17. a) $SiCl_4$ can be hydrolysed but CCl_4 cannot. Why? (1)

    b) What are silicones? (1)

    c) Graphite is used as a lubricant in machines. (1)

    Answer:

    a) This is due to the absence of vacant d-orbitals in carbon.

    b) Silicones are organosilicon polymers, which have (-R_2 SiO-) as a repeating unit.

    c) Because of its layered structure and slippery nature.

18. a) How will you detect the presence of nitrogen in an organic compound by Lassaigne's test? (2)

    (b) Name two method for the estimation of nitrogen in an organic compound. (1)

    Answer:

    a) To a little of the sodium fusion extract, add freshly prepared ferrous sulphate ($FeSO_4$) solution, heated to boiling, cooled and acidified with dil. H_2SO_4. If Nitrogen is present, a Prussian blue or green coloration or precipitate is formed.

    b) Dumas method and Kjeldahl's method

19. Analyze the following reaction:

    $CH_3 - CH = CH_2 + H - Br$ ------> 'A' + 'B'
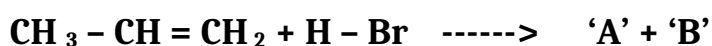
    If 'A' is the major product and 'B' is the minor product, identify 'A' and 'B'.

    Also name and explain the related rule.

    Answer:

    A is CH_3-CHBr-CH_3 (2-Bromopropane) and

    B is CH_3-CH_2-CH_2 Br (1-Bromopropane).

    The rule behind the selection of the major product is Markownikoff's rule.

    The rule states that when an unsymmetrical reagent is added to an unsymmetrical alkene, the negative part of the reagent gets attached to the carbon containing lesser number of hydrogen atoms.

20. Explain

    (i) Wurtz reaction. (1)

    (ii) Huckel rule of aromaticity (1)

    (iii) Baeyer's reagent (1)

21. a)Draw geometrical isomers of but-2-ene   (2)

   b)Give the products formed when benzene reacts with CH_3Cl in presence of anhydrous $AlCl_3$ (1)
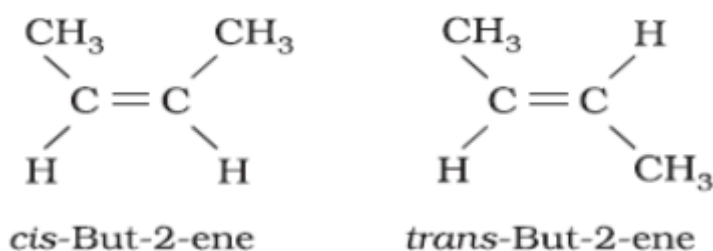
cis-But-2-ene   trans-But-2-ene

22. Explain the following terms:

   (a)Acid rain   (1)

   (b) BOD   (1)

   (c) Green house effect   (1)

23. a)Give the chemical name of perhydrol.   (1)

   b)Why is KO_2 paramagnetic ?   (1)

   c)Liquids having large difference in boiling points are separated by……………
      method   (1)

a)Hydrogen peroxide (H_2O_2)

b)The superoxide O_2^- is paramagneticbecause of one unpaired electron in π^*2p molecular orbital.

c)Distillation

Answer any 5 questions from 24-31. Each carries 4 scores each.   (5x4=20)

24. a)What is disproportionation reaction.Write one example to it   (2)

b)Write the reaction involved when metallic zinc is placed in a copper sulphate solution.Justify the above reaction as a redox reaction   (2)

Answer:

a)In a disproportionation reaction, an element in one oxidation state is simultaneously oxidised and reduced.

$2H_2O_2$ (aq) --------> $2H_2O$(l) + O_2(g) or suitable reaction

(b) Zn(s) + Cu^{2+} (aq) --------> Zn^{2+} (aq) + Cu(s)

Change in oxidation number or electron transfer occures in reaction

25. a)What is heavy water? Mention one of its uses?   (1)

b) Explain the different types of covalent hydrides with suitable examples.   (3)

Answer:

a)D_2O is called heavy water. It is used as moderator in Nuclear reactors.

b)

(i)Electron-deficient hydride has very few electrons for writing its Lewis structure. E.g.Diborane (B_2H_6). All elements of group 13 will form electron-deficient compounds. They act as Lewis acids (i.e. they accept electron pairs).

(ii)Electron-precise hydrides have the required number of electrons to write their Lewis structures. All elements of group 14 form such compounds

(e.g., CH_4 ,SiH_4 etc.)

(iii)Electron-rich hydrides have excess electrons which are present as lone pairs.   Elements of group 15 to 17 form such compounds. They behave as Lewis bases (i.e., electron donors).(e.g., NH_3)

26. Give reasons.

(i) Solutions of alkali metals in liquid ammonia are blue in colour.   (1)

(ii) When CO_2 is passed through lime water it turns milky   (1)

(iii) Alkali metals are normally kept in kerosene (1)

(iv) Be and Mg do not impart any colour to the flame. Give reason (1)

Answer:

(I) It is due to the formation of ammoniated electrons.

(ii) It is due to the formation of $CaCO_3$

$$Ca(OH)_2 + CO_2 ------> CaCO_3 + H_2O$$

(iii) Because of their high reactivity towards air and water, alkali metals are normally kept in kerosene oil.

(iv) The electrons in Be and Mg are very strongly bound to the nucleus. So they do not get excited by the flame. Hence they do not give flame colouration.

27. What is water gas and producer gas. Write its preparation and uses

Answer:

The mixture of CO and H_2 is known as water gas .

On commercial scale it is prepared by the passage of steam over hot coke

A mixture of CO and N_2 is called producer gas.

When air is used instead of steam, a mixture of CO and N_2 is produced, which is called producer gas.

Water gas and producer gas are very important industrial fuels.

28. a) What are nucleophiles? Give one example. (1)

b) Arrange the following carbocation in the increasing order of their stability.

$CH_3 - CH_2^+$, CH_3^+, $(CH_3)_3 C^+$, $(CH_3)_2 CH^+$ (1)
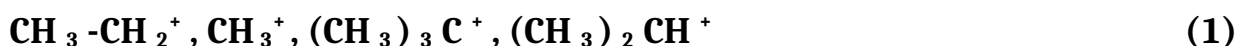
c) Name the type of the fission of a covalent bond which gives free radicals. (1)

d) Explain electromeric effect (1)

Answer:

a) A reagent that brings an electron pair is called a nucleophile. Or, they are electron rich species attack at electron deficient centre. E.g.: OH^-, CN^-, NH_3 etc

b) $CH_3^+ < CH_3 - CH_2^+ < (CH_3)_2 CH^+ < (CH_3)_3 C^+$

c) Homolytic fission

d) Electromeric effect is defined as the complete transfer of a shared pair of

π-electrons to one of the atoms joined by a multiple bond in presence of an attacking reagent. It is a temporary effect.

29. a) How many 'σ' and 'π' bonds are present in the following compounds?
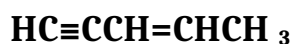
$HC≡CCH=CHCH_3$ (1)

b) On complete combustion, 0.246g of an organic compound gave 0.198g of CO_2 and 0.1014g of H_2O. Determine the percentage composition of carbon and hydrogen in the compound. **(3)**

Answer:

a) sigma bond = 10   Pi bond = 3

b)

$$\text{Percentage of carbon} = \frac{12 \times m_1 \times 100}{44 \times m} = \frac{12 \times 0.198 \times 100}{44 \times 0.246} = 21.95\%$$

Mass of water formed $(m_2) = 0.1014$ g

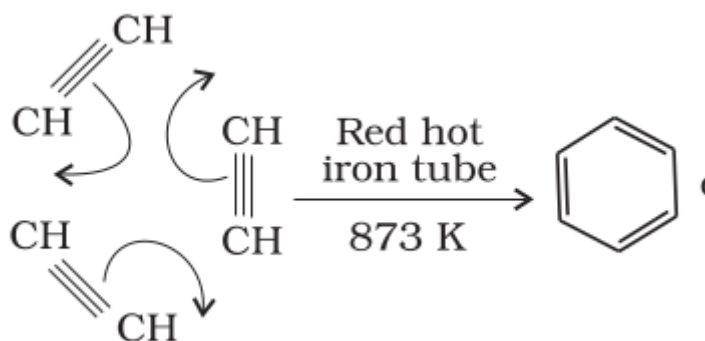$$\text{Percentage of hydrogen} = \frac{2 \times m_2 \times 100}{18 \times m} = \frac{2 \times 0.1014 \times 100}{18 \times 0.246} = 4.58\%$$

30. How wiil you convert
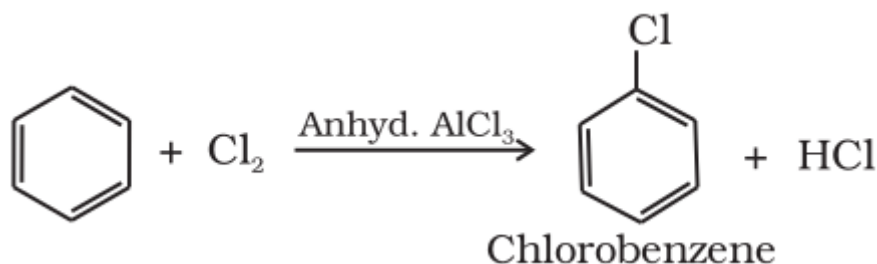
(i) Ethyne to benzene.

(ii) Benzene to chloro benzene

(iii) Phenol to benzene

(iv) Bromo ethane to ethene

Answer:

(i) Ethyne on passing through red hot iron tube at 873K undergoes cyclic polymerization to form benzene

(ii)

Chlorobenzene

(iii)

(iv) byheating with alcoholic potassium hydroxide

31. a)The smog that occurs in cool humid climate is called .... **(1)**

b) Suggest any one method to control photochemical smog. **(1)**

c) The disease caused by excess nitrate in drinking water is........................ **(1)**

d) Carbon monoxide gas is more dangerous than carbon dioxide gas. Why? **(1)**

Answer:

a)Classical smog

b)Use catalytic converters in automobiles, which prevent the release of nitrogen   oxide and hydrocarbons to the atmosphere.

Certain plants like Pinus, can metabolise nitrogen oxide. So their plantation helps to reduce   these oxides.

c) methemoglobinemia ('blue baby' syndrome).

d) CO can easily form a stable complex with haemoglobin (carboxy haemoglobin).   This prevents haemoglobin in RBC from carrying oxygen round the body. Hence it is   poisonous.

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