11 P 19.11.24

Time : 1.30 Hrs.

Tiruppur district

Second Mid-Term Test - 2024

CHEMISTRY

Register No. பா.கவியரசு

Marks : 50

PART - A Answers Key

பா.கவியரசு M.Sc.,B.Ed., முதுகலை வேதியியல் ஆசிரியர் 10 x 1 = 10

I. Answer all the questions

Choose the best answer.

BB (1) In context with Beryllium, which one of the following statement is incorrect?
a) It is rendered passive by nitric acid b) It forms Be_2C (c) Its salts are rarely hydrolysed
d) Its hydride is electron deficient and polymeric

BB (2) Which one of the following gases has the lowest value of Henry's law constant?
a) N_2 b) He (c) CO_2 d) H_2

BB (3) Of the following molecules, which have shape similar to carbondioxide?
a) $SnC\ell_2$ b) NO_2 (c) C_2H_2 d) All of these

BB (4) Consider the nitration of Benzene using mixed conc H_2SO_4 and HNO_3, if a large quantity of $KHSO_4$ is added to the mixture, the rate of nitration will be a) unchanged b) doubled c) faster (d) slower

BB (5) The suspension of slaked lime in water is known as.....
a) lime water b) quick lime (c) milk of lime d) aqueous solution of slaked lime

BB (6) $2C_2H_5Br + 2Na \xrightarrow{\text{dry ether}} C_4H_{10} + 2NaBr$. The above reaction is an example of which of the following?
a) Reimer Tiemann Reaction (b) Wurtz reaction c) Aldol condensation d) Hoffmann reaction

(7) Match Int

A) Solid - Gas	1. Camphor in nitrogen gas
B) Liquid - Gas	2. Humid oxygen
C) Gas - liquid	3. CO_2 dissolved in water
D) Liquid - liquid	4. Ethanol dissolved in water

	A	B	C	D
(a)	1	2	3	4
b)	2	1	3	4
c)	4	1	3	2
d)	4	3	2	1

BB (8) XeF_2 is isostructural with.....
a) $SbC\ell_2$ b) $BaC\ell_2$ c) TeF_2 (d) ICl_2^-

(9) Which of the following statement is false. BB
(a) Ca^{2+} ions are not important in maintaining the regular beating of the heart.
b) Mg^{2+} ions are important in the green parts of the plants.
c) Mg^{2+} ions forms a complex with ATP.
d) Ca^{2+} ions are important in blood clotting.

BB (10) The compound that will react most readily with gaseous bromine has the formula.....
(a) C_3H_6 b) C_2H_2 c) C_4H_{10} d) C_2H_4

1 mark Answers:
1. c
2. c
3. c
4. d
5. c
6. b
7. a
8. d
9. a
10. a

BB-9
Int-1
10

$6Li + N_2 \rightarrow 2Li_3N$

PART - II

Answer any five (question no.18 is compulsory) F-73-1 **5 x 2 = 10**

11. Write the balanced chemical equation for each of the following chemical reaction. F-66-9
    a) Lithium metal with nitrogen gas b) heating calcium carbonate $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$
12. What are the limitations of Henry's law? F-142-4
13. Define Hybridisation. F-155-1-2
14. Write the IUPAC name for the following.
    a) $CH_3 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - \underset{\underset{CH_3}{|}}{CH} - CH_3$ 2,4-Dimethyl Pentane
    b) $CH_2 = CH - \underset{\underset{CH_3}{|}}{CH} - CH_2 - CH_3$ 3-methyl-1-Pentene
15. State Octet rule. F-159-1
16. What is osmosis? F-136-7
17. How will you convert benzene into toluene? F-225-4-c
18. 0.75g of an unknown substance is dissolved in 200g solvent. If the elevation of boiling point is 0.15K and molal elevation constant is 7.5 K kg mol^{-1} then, calculate the molar mass of unknown substance $M_2 = 187.5\ g\ mol^{-1}$ II Volume Page No: 53

PART - III

Answer any five (Q.No.26 is compulsory) **5 x 3 = 15**

19. Define (i) formality (ii) molarity F-136-1, F-141-1-c
20. Explain the bond formation in ethylene. F-166-5
21. Convert the following. a) phenol to benzene b) ethene to ethane - 1, 2 diol F-217-13
22. How is plaster of paris prepared? Give its uses. F-225-4-b F-67-12; F-66-7
23. Distinguish between ideal and non-ideal solution. F-138-13,15
24. (i) Write Markovnikoff's rule (1½) F-217-12
    (ii) Why alkaline earth metals are harder than alkali metals (1½) F-66-10
25. Write the principles of VSEPR theory. F-167-7
26. Alkaline earth metal (A), belong to 3rd period reacts with oxygen and nitrogen to form compound (B) and (C) respectively. It undergoes metal displacement reaction with $AgNO_3$ solution to form compound (D). Identify A, B, C and D. F-76-1 $A \rightarrow Mg$, $B \rightarrow MgO$, $C \rightarrow Mg_3N_2$, $D \rightarrow Mg(NO_3)_2$

PART - IV

Answer all the questions. **3 x 5 = 15**

27. a) (i) Write Huckel's rule of aromaticity. (2) F-215-5
    (ii) Calculate the molality of the solution containing 45g of glucose dissolved in 2 kg of water (3) **(OR)** II Volume Page No: 32
    b) Write the salient features of Molecular orbital theoiry. (5) F-162-9 0.125m
28. a) (i) Which bond is stronger σ (or) π? Why? (2) F-157-8
    (ii) Write a note on reaction of oxygen with alkali metals. (3) **(OR)** I Volume Page No: 130
    b) (i) Compare the properties of lithium with other elements of the same group (any 3 points) (3) F-75-3(b)
    (ii) Write Wurtz - fittig reaction (2). II Volume Page no: 210
29. a) Elucidate the structure of benzene in detail. (5) **(OR)** F-231-7
    b) Draw the MO diagram for N_2 molecule and explain. (5) F-166-4

II mid term Test - 2024 +1 Em Answer Key

19.11.24 — Chemistry (Tiruppur district)

Part - I

1 marks: 10 X 1 = 10

1. c) Its salts are rarely hydrolysed
2. c) CO_2
3. c) C_2H_2
4. d) slower
5. c) milk of lime
6. b) Wurtz reaction
7. a) A 1, B 2, C 3, D 4
8. d) ICl_2^-
9. a) Ca^{2+} ions are not important maintaining the regular beating of the heart
10. a) C_3H_6

Part - II

2 Marks: 5 X 2 = 10

11. a) Lithium metal with Nitrogen gas: (1)

$$6Li + N_2 \longrightarrow 2Li_3N$$

b) heating Calcium carbonate: (1)

$$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$$

12. Limitations of Henry's law:

* It is applicable at moderate temperature and pressure only
* Only the less soluble gases obeys
* The gases reacting with the solvent donot obey Henry's law

eg: NH_3 (or) HCl reacts with H_2O.

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

* The gases obeying Henry's law should not associate (or) dissociate while dissolving in the solvent.

13. Hybridisation:

Hybridisation is the process of mixing of atomic orbitals of the same atom with comparable energy to form equal number of new equivalent orbitals with same energy.

14. a) 2,4-dimethylpentane (1) b) 3-methyl-1-Pentene (1)

15. Octet rule:

The atoms transfer or share electrons so that all atoms involved in Chemical bonding obtain 8 electrons in their outer shell.

16. **Osmosis:**

Osmosis, is a spontaneous process by which the solvent molecules pass through a semipermeable membrane from a solution of lower concentration to a solution of higher concentration.

17. **Benzene → Toluene :-**

$$C_6H_6 + CH_3Cl \xrightarrow[AlCl_3]{\text{Anhydrous}} \underset{\text{Toluene}}{C_6H_5CH_3} + HCl$$

18. **[Compulsory]:-**

$$\Delta T_b = K_b . m = \frac{K_b \times W_2 \times 1000}{M_2 \times W_1}$$

$$M_2 = \frac{K_b \times W_2 \times 1000}{\Delta T_b \times W_1} = \frac{7.5 \times 0.75 \times 1000}{0.15 \times 200}$$

$$M_2 = 187.5 \text{ g mol}^{-1}$$

Part-III 5×3=15

3 Marks:

19. (i) formality (F) = $\frac{\text{Number of formula weight of solutes}}{\text{Volume of solution (in L)}}$ (1½)

(ii) Molarity (M) = $\frac{\text{Number of moles of solutes}}{\text{Volume of solution (in L)}}$ (1½)

20. **Bond formation in ethylene:-** $CH_2 = CH_2$

The Valence shell Configuration of Carbon is $\Rightarrow 2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^0$

Ground state: $2s^2$ $2p_x^1\ 2p_y^1\ 2p_z^0$

Excited state: $2s^1$ $2p_x^1\ 2p_y^1\ 2p_z^1$

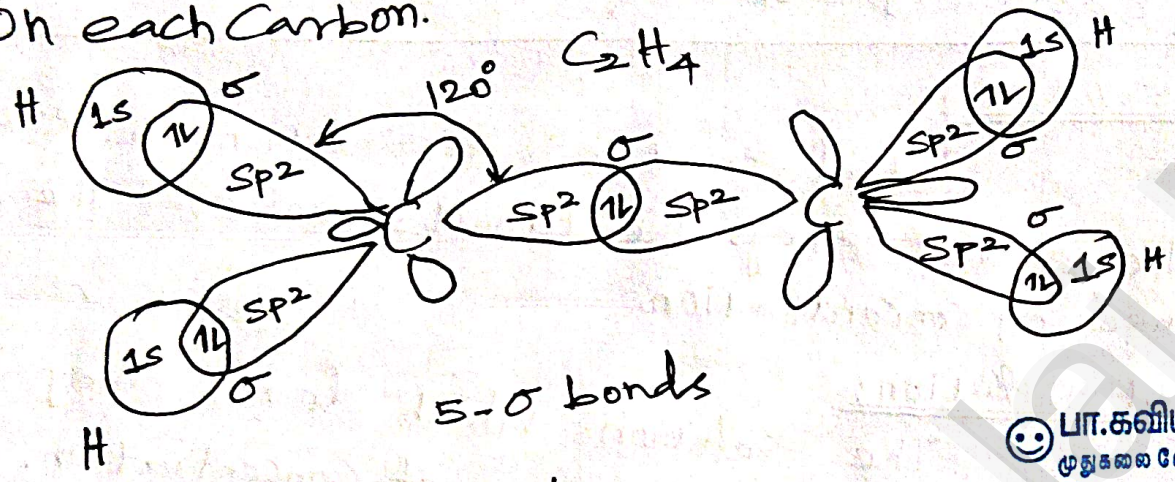
Hybridised state: sp^2 $sp^2 sp^2$ $2p_z^1$

(sp² Hybridisation) σ σ σ π

Formation of σ bond :-

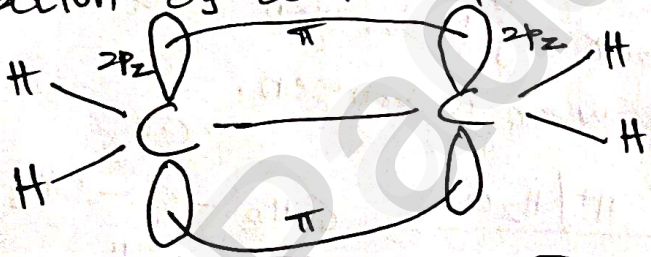
* one of the sp² hybridised orbitals of each Carbon lying on the molecular axis (x axis) linearly overlaps

with each other resulting in the formation of C-C-σ bond
* other 2 sp^2 hybridised orbitals of both Carbons linearly overlap with the 4-1s orbitals of 4 Hydrogen atoms leading to the formation of 2 C-H σ bonds on each Carbon.



Formation of π bond:-

The unhybridised $2p_z$ orbital of both Carbon atoms can overlap only sideways as they are not in the molecular axis. This lateral overlap results in the formation of a π bond between the 2 Carbon atoms.



1-π bond

21. a) **Phenol → Benzene :-**

$$C_6H_5OH + Zn \xrightarrow{\Delta} C_6H_6 + ZnO \quad (1\tfrac{1}{2})$$

b) **ethene → ethane-1,2-diol :**

$$CH_2=CH_2 + H_2O \xrightarrow[\text{Cold dil. } KMnO_4,\ 273K]{[O]} \underset{\underset{OH}{|}}{CH_2}-\underset{\underset{OH}{|}}{CH_2} + MnO_2 \quad (1\tfrac{1}{2})$$

22. **Plaster of Paris Preparation:-**

Hemihydrate of Calcium Sulphate is called plaster of paris. It is obtained when gypsum. $CaSO_4 \cdot 2H_2O$ is heated to 393K.

$$2CaSO_4 \cdot 2H_2O_{(s)} \longrightarrow 2CaSO_4 \cdot \tfrac{1}{2}H_2O + 3H_2O$$

Uses Of Plaster of Paris:-

* It is used in building industry and plasters
* It is used for immobilising agent in bone fracture (or) Sprain.
* It is used in dentistry, in ornamental work and for making casts of statues.

23. **Ideal solution:**

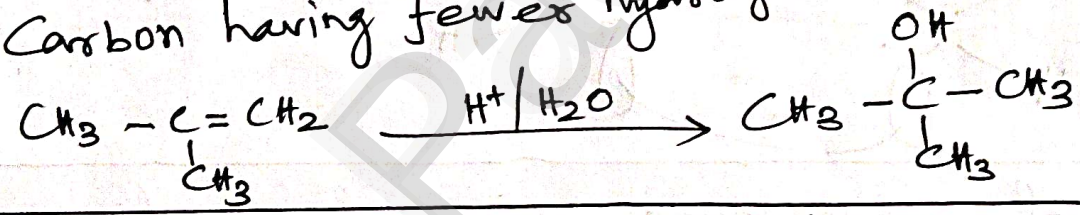
Ideal solution is a solutions the solute as well as the solvent obeys the Raoult's law over the entire range of concentration.

Non-Ideal Solution:

The solutions which do not obey Raoult's law over the entire range of concentration.

24. (i) **Markovnikoff's rule:** (1½)

When an unsymmetrical alkene reacts with hydrogen halide the hydrogen adds to the carbon that has more number of hydrogen and halogen add to the carbon having fewer hydrogen.



24. (ii): * The strength of metallic bond is higher than the alkali metals due to presence of 2 e⁻s into its outer most shell. (1½)

* Due to higher nuclear charge of these atoms which tends to draw the e⁻ inwards and the size of the atom become smaller. Hence this metals becoms much harder.

25. **Principles of VSEPR theory:-**

* The shape of molecules depends on the number of Valence shell e⁻ pair around the central atom.

* There are two types of e⁻ pairs namely bond pair and lonepairs. The bond pair of e⁻s are those shared between two atoms. While the lonepairs are the Valence e⁻ pairs that are not involved in bonding.

* Each pair of Valence e⁻s around the central atom repels each other and hence, they are located as far away as possible in three dimensional space to minimize the repulsion between them.

* The repulsive interaction between the different types of e⁻ pairs is in the following order

$$lp\text{-}lp > lp\text{-}bp > bp\text{-}bp$$

(lp → lonepair, bp → bond pair)

The lonepairs occupy more space and have greater repulsive power than the bond pairs in a molecule.

26. [Compulsory] :

$$A \longrightarrow Mg$$

$$\underset{(A)}{2Mg} + O_2 \longrightarrow \underset{(B)}{2MgO}$$

$$3Mg + O_2 \longrightarrow \underset{(C)}{Mg_3N_2}$$

$$\underset{(A)}{Mg} + 2AgNO_3 \longrightarrow \underset{(D)}{Mg(NO_3)_2} + 2Ag$$

Ans: A → Mg → Magnesium, B → MgO → Magnesium oxide, C → Mg_3N_2 → Magnesium nitride, D → $Mg(NO_3)_2$ → Magnesium nitrate

5 Marks:- Part-IV 3x5=15

27. a) (i) Huckel's rule of aromaticity:- (2)

* The molecule must be coplanar
* Complete delocalization of π e⁻ in the ring
* Presence of $(4n+2)\pi$ e⁻s in the ring. Where n is an integer (n = 0, 1, 2, 3 ....).

27. a) (ii) $\text{Molality (m)} = \frac{\text{Number of moles of solute}}{\text{Mass of Solvent (in kg)}}$ (3)

$= \frac{\left(\frac{45}{180}\right)}{2} = \frac{0.25}{2} = 0.125\text{m}$

(OR)

27. b) Salient features of Molecular orbital theory:- (5)

* When atoms combines to form molecules, their individual atomic orbitals lose their identity and forms new orbitals called molecular orbitals.
* The shapes of molecular orbitals depend upon the Shapes of Combining atomic orbitals.
* The number of molecular orbitals formed is the same as the number of Combining atomic orbitals.
* Two atomic orbitals can combine to form 2 molecular orbitals.
* Lower energy orbital – Bonding molecular orbital
  Higher energy orbital – Antibonding molecular orbital

  Bonding molecular orbitals are represented as σ, π, δ. Antibonding molecular orbitals are represented as $\sigma^*, \pi^*, \delta^*$.
* The filling of e-s in these orbitals follows Aufban's principle, Pauli's exclusion principle and Hund's rule as in the case of filling of e-s in atomic orbitals.
* Bond order gives the number of covalent bonds between the two combining atoms.

  $\text{Bond order} = \frac{N_b - N_a}{2}$

28. a)(i) σ bond is stronger. This is because σ bond is formed by head on overlapping of atomic orbitals and therefore the overlapping is large. But π bond is weak bond. (2)

π bond is formed by sideway overlapping which is small.

28. a) (ii) **Reactions of oxygen with alkalimetals:-** (3)

All the alkali metals on exposure to air (or) O_2 burn vigorously, forming oxides on their surface. Lithium forms only monooxide, sodium forms monooxide and peroxide and the other elements forms monooxide, Peroxide and Superoxides. These are basic in nature.

$4Li + O_2 \longrightarrow 2Li_2O$ (simple oxide), $2Na + O_2 \longrightarrow Na_2O_2$ (peroxide)

$M + O_2 \longrightarrow MO_2$; (M = K, Rb, Cs), $MO_2 \rightarrow$ Super oxide.

(OR) (3)

28. b) (i)

	Lithium	Other elements of the group
1.	Hard, High melting and boiling point	soft and Lower melting and boiling point
2.	Least reactive	More reactive
3.	Reacts with nitrogen to give Li_3N	No Reaction
4.	Reacts with bromine slowly	React Violently
5.	Lithium nitrate decomposes to give an oxide	Decompose to give nitrites.

28. b) (ii) **Wurtz fittig reaction;** (2)

$$C_6H_5Br + 2Na + CH_3I \xrightarrow{\text{ether}} C_6H_5CH_3 + NaBr$$

29. a) **Structure Of Benzene:-** (5)

1. Molecular formula: The molecular formula of Benzene is C_6H_6 This indicates that benzene is a highly unsaturated compound.

2. Straight Chain Structure not possible:

Benzene could be constructed as a straight Chain (or) ring Compound but it not feasible since it does not show the Properties of alkenes (or) alkynes.

Benzene $\xrightarrow[KMnO_4]{\text{acidified}}$ no decolouration, Benzene $\xrightarrow{CCl_4/Br_2}$ no decolouration (Red colour)

(Pink colour)

3. Evidence for Cyclic Structure:

Benzene reacts with Br_2 in the presence of $AlCl_3$ to form monobromobenzene formation of only one monobromo compound indicates that all the 6 Hydrogen atoms in benzene were identical. This is possible only if it has a cyclic structure of 6 Carbons each Containing one hydrogen.

4. Benzene $\xrightarrow{3H_2/Ni}$ Cyclohexane

This Confirms cyclic structure of Benzene and the presence of 3 C=C bond.

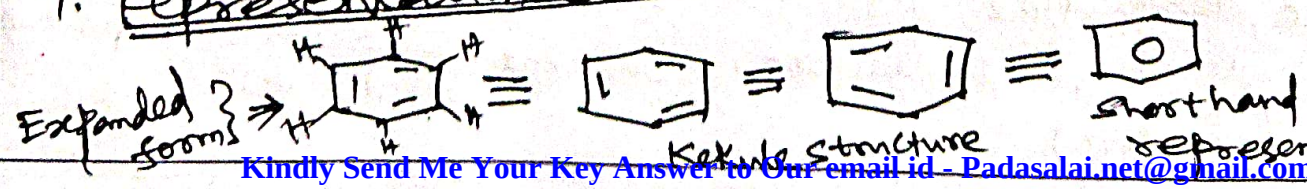
5. Spectroscopic measurements:

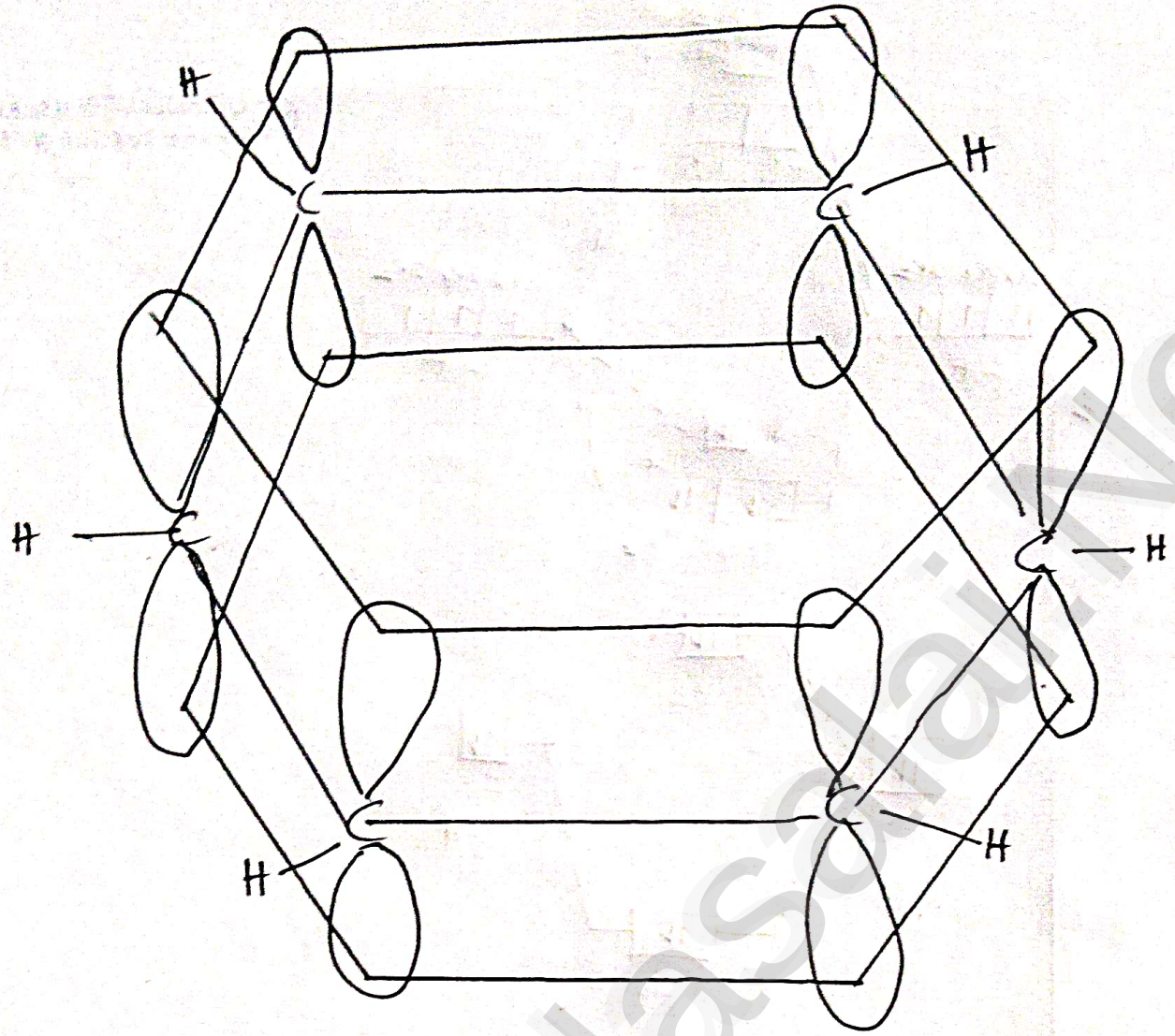
1. Benzene is planar and all of its Carbon-Carbon bonds are of equal length 1.40 Å
2. This value lies between C-C single bond length (1.54 Å) and C=C double bond length (1.34 Å)

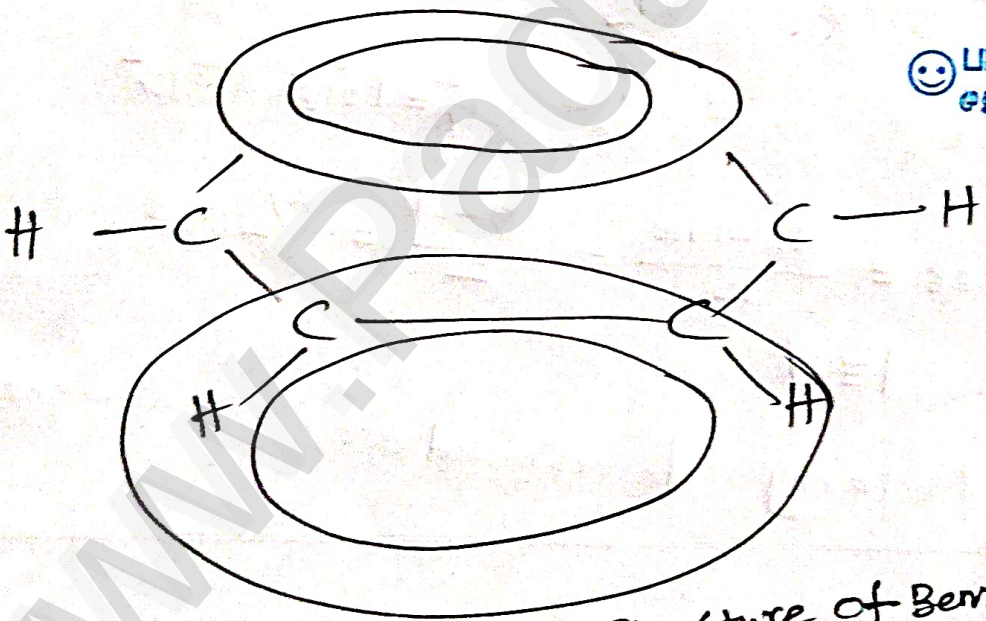
6. Molecular orbital structure:-

* All the six Carbon atoms of benzene are sp^2 hybridised 6 sp^2 hybrid orbitals of Carbon linearly overlap with 6 1s orbitals of hydrogen atoms to form 6 C-H sigma bonds
* Overlap between the remaining sp^2 hybrid orbitals of Carbon forms 6 C-C sigma bonds.
* All the σ bonds in benzene lie in one plane with bond angle 120° Each Carbon atom in benzene possess an unhybridised p-orbital containing one e^-.
* The lateral overlap of their p-orbital produces 3-π bond. The 6 e^-s of the p-orbitals cover all the six Carbon atoms are said to be delocalised. Due to delocalization Strong π-bond is formed which makes the molecule stable.

7. Representation of Benzene:



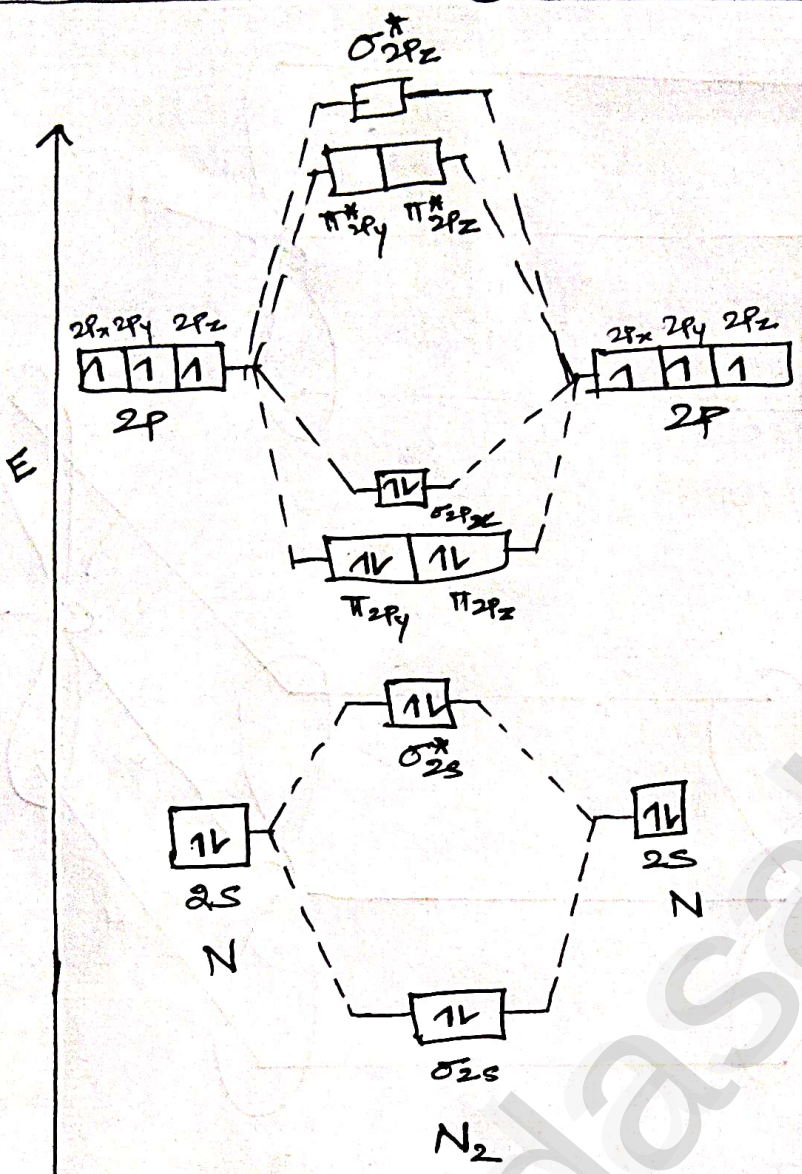




Molecular orbital Structure of Benzene

29. b) **M.O. diagram for N_2 molecule:** (5)

$_7N \rightarrow 1s^2\ 2s^2\ 2p^3$



N_2 : $\sigma_{1s}^2\ \sigma_{1s}^{*2}\ \sigma_{2s}^2\ \sigma_{2s}^{*2}\ \pi_{2py}^2 = \pi_{2pz}^2\ \sigma_{2px}^2$

Bond order $= \frac{N_b - N_a}{2} = \frac{10-4}{2} = 6/2 = 3$

$N \equiv N$

Magnetic property : No unpaired e⁻s Diamagnetic.

Prepared By

பா. கவியரசு

முதுகலை வேதியியல் ஆசிரியர்

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"முயற்சி எனும் (அனைத்து) மயற்சி எனும்"