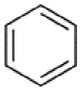
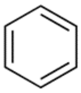
DEPARTMENT OF GOVERNMENT EXAMINATIONS

HIGHER SECONDARY FIRST YEAR EXAMINATION MARCH- 2023

KEY ANSWER FOR CHEMISTRY – ENGLISH MEDIUM

Maximum Marks - 70

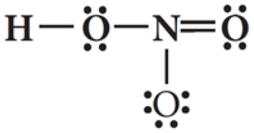
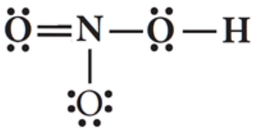
Answer all the Questions **Part -I** **15 x 1 = 15**

Q.NO	Option	A Type	Q.NO	Option	B Type
1	a)	Chloropicrin	1	c)	Both (a) and (b)
2	a)	Kerosene	2	b)	Propene
3	a)	$\pi V = nRT$	3	c)	Increase in pressure
4	b)	Hex – 4 – en – 2- ol	4	a)	5.6
5	c)	Both (a) and (b)	5	d)	374.4 K
6	b)	Propene	6	a)	Assertion is true but reason is false
7	d)	374.4 K	7	a)	Chloropicrin
8	c)	frictional energy	8	a)	
9	a)	5.6	9	b)	112 g mol $^{-1}$
10	a)		10	a)	$\pi V = nRT$
11	b)	9	11	a)	Kerosene
12	a)	Assertion is true but reason is false	12	c)	frictional energy
13	c)	bibibium	13	d)	Hex – 4 – en – 2- ol
14	b)	112 g mol -1	14	c)	bibibium
15	c)	Increase in pressure	15	b)	9

Part – II

Answer any SIX Questions and Questions No.24 is Compulsory. 6 X 2 =12

16	**As per the classical concept,** i) Addition of oxygen (or) removal of hydrogen is called oxidation $C + O_2 \rightarrow CO_2$ **(addition of oxygen)** $H_2S + Cl_2 \rightarrow 2\ HCl + S$ **(removal of hydrogen)** i) Addition of hydrogen (or) removal of oxygen is called reduction $H_2 + Cl_2 \rightarrow 2HCl$ **(addition of hydrogen)** $ZnO + C \rightarrow Zn + CO$ **(removal of oxygen)** (OR) As per the classical concept, addition of oxygen (or) removal of hydrogen is called oxidation and the reverse is called reduction.	1 1	2
17	**Heisenberg's uncertainty principle** 'It is impossible to accurately determine both the position and the momentum of a microscopic particle simultaneously'. **(Correct Statement ………………………………………………………….)** **(or)** $\Delta x.\Delta p \geq h/4\pi$ where, Δx and Δp are uncertainties in determining the position and momentum, h - Planck's constant	2	2
18	***Uses: Plaster of Paris is used as/in,*** 1. The building industry as well as plasters. 2. For immobilising the affected part of organ where there is a bone fracture or sprain. 3.Employed in dentistry, in ornamental work and for making casts of statues and busts. **(any two correct point……………………….)**	1 1	2
19	**Le-Chatelier's Principle** "If a system at equilibrium is disturbed, then the system shifts itself in a direction that nullifies the effect of that disturbance." (Correct Statement ………………………………………………………….)	2	2
20.	Thus, **osmotic pressure** can be defined as "the pressure that must be applied to the solution to stop the influx of the solvent (to stop osmosis) through the semipermeable membrane" Correct definition ………………………………………………………….)	2	2

21	**i) Lewis structure of water**  **ii) Lewis structure of Nitric acid**  OR 	1 1	2
22	**Write short notes on Friedel Craft's reaction:** **a) Friedel Craft's Alkylation: (Methylation)** When benzene is treated with methyl chloride in the presence of anhydrous aluminium chloride, toluene is formed. $C_6H_6 + CH_3Cl \xrightarrow{\text{anhydrous AlCl}_3} C_6H_5CH_3 + HCl$ (or) **c) Friedel Craft's Acylation : (Acetylation)** When benzene is treated with acetyl chloride in the presence of $AlCl_3$, acyl benzene is formed. $C_6H_6 + CH_3COCl \xrightarrow{\text{anhydrous AlCl}_3} C_6H_5COCH_3 + HCl$	2	2
23	**Particulate pollutants** are small solid particles and liquid droplets suspended in air. Many of particulate pollutants are hazardous. **Examples:** dust, pollen, smoke, soot and liquid droplets (aerosols) etc,.	1 1	2
24	$\Delta S_{fusion} = \frac{\Delta H}{T_f}$ $\Delta S_{fusion} = \frac{6008}{0\,^{o}C+273} = 22.007\ JK^{-1}mole^{-1}$	1 1	2

Part – III

Answer any SIX Questions and Questions No.33 is Compulsory. **6 X 3 =18**

<table>
<tr>
<td>25</td>
<td>
i) KMnO4 + Na2SO3 → MnO2 + Na2SO4 + KOH
$\underset{\substack{\uparrow\\3e^-}}{\mathrm{K\overset{+7}{M}nO_4}} + \underset{\substack{\downarrow\\2e^-}}{\mathrm{Na_2\overset{+4}{S}O_3}} \longrightarrow \mathrm{\overset{+4}{M}nO_2 + Na_2\overset{+6}{S}O_4 + KOH}$
$\Rightarrow \mathbf{2KMnO_4 + 3Na_2SO_3} \longrightarrow \mathrm{MnO_2 + Na_2SO_4 + KOH}$
$\Rightarrow \mathrm{2KMnO_4 + 3Na_2SO_3} \longrightarrow \mathbf{2MnO_2 + 3Na_2SO_4} + \mathrm{KOH}$
$\Rightarrow \mathrm{2KMnO_4 + 3Na_2SO_3} + \mathbf{H_2O} \longrightarrow \mathrm{2MnO_2 + 3Na_2SO_4} + \mathbf{2KOH}$
iii) Cu+ HNO3 → Cu(NO3)2 + NO2+ H2O
$\underset{\substack{\downarrow\\2e^-}}{\mathrm{\overset{0}{C}u}} + \underset{\substack{\uparrow\\1e^-}}{\mathrm{H\overset{+5}{N}O_3}} \longrightarrow \mathrm{\overset{+2}{C}u(NO_3)_2 + \overset{+4}{N}O_2 + H_2O}$
$\mathbf{Cu + 2HNO_3} \longrightarrow \mathrm{Cu(NO_3)_2 + NO_2 + H_2O}$
$\mathrm{Cu + 2HNO_3} + \mathbf{2HNO_3} \longrightarrow \mathrm{Cu(NO_3)_2} + \mathbf{2NO_2} + \mathrm{2H_2O}$
$\mathrm{Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O}$
</td>
<td>½
½
½
½
½
½</td>
<td>3</td>
</tr>
<tr>
<td>26</td>
<td>
1) Principal quantum number (n):
<table>
<tr><th>n value</th><th>Shell (or) orbit (or) energy level</th></tr>
<tr><td>1</td><td>K</td></tr>
<tr><td>2</td><td>L</td></tr>
<tr><td>3</td><td>M</td></tr>
<tr><td>4</td><td>N</td></tr>
</table>
2. $2n^2$
3. Energy of the electron and the distance of the electron from the nucleus
$E_n = \frac{(-1312.8)Z^2}{n^2}$ k jmol^{-1} and $r_n = \frac{(0.529)\,n^2}{Z}\ \mathring{A}$
</td>
<td>1
1
1</td>
<td>3</td>
</tr>
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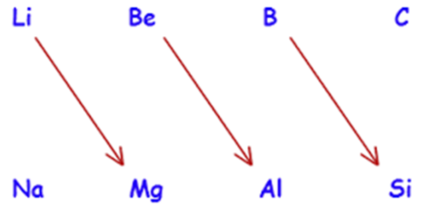
27	**Diagonal Relationship**1. On moving diagonally across the periodic table, the second and third period elements show certain similarities.  2. 3.The similarity in properties existing between the diagonally placed elements is called ‘diagonal relationship’.	1 1 1	3
28	**Conversion of Para hydrogen into ortho hydrogen** 1.The para-form can be catalytically transformed into ortho-form using platinum or iron. 2.Alternatively, it can also be converted by passing an electric discharge, heating above 800°C 3.mixing with paramagnetic molecules such as O_2, NO, NO_2 or with nascent/atomic hydrogen.	1 1 1	3
29	**Ideal gas equation** Boyle’s law $V\alpha\frac{1}{P}$ ……………………..(1) Charles law $V \alpha T$ ……………………..(2) Avogadro’s law $V \alpha n$ ……………………..(3) We can combine these equations we get , $V\alpha\frac{nT}{P}$ $V = \frac{nRT}{P}$ Ideal gas equation : PV = n RT	½ ½ ½ ½ ½ ½	3
30	**State function** A thermodynamic system can be defined by using the variables P, V, T and `n'. A state function is a thermodynamic property of a system, which has a specific value for a given state and does not depend on the path (or manner) by which the particular state is reached. **Example :** Pressure (P), Volume (V), Temperature(T), Internal energy (U), Enthalpy (H), free energy (G) etc. **Path functions:** A path function is a thermodynamic property of the system whose value depends on the path by which the system changes from its initial to final states. **Example:** Work (*w*), Heat (*q*).	1 ½ 1 ½	3

<table>
<tr>
<td rowspan="3">31</td>
<td>$\underset{(A)}{CH_3\text{–}CH_2\text{–}Cl} + KOH\ (aq) \longrightarrow \underset{(B)}{CH_3\text{–}CH_2\text{–}OH} + KCl$</td>
<td>1</td>
<td rowspan="3">3</td>
</tr>
<tr>
<td>$\underset{(B)}{CH_3\text{–}CH_2\text{–}OH}$ + **Alcoholic KOH** $\longrightarrow \underset{(C)}{CH_2 = CH_2} + H_2O$</td>
<td>½</td>
</tr>
<tr>
<td>
<table>
<tr><th>Compound</th><th>Name</th><th>Formula</th></tr>
<tr><td>A</td><td>Ethyl chloride (or) Chloro ethane</td><td>$CH_3\text{–}CH_2\text{–}Cl$</td></tr>
<tr><td>B</td><td>Ethyl alcohol (or) Ethanol</td><td>$CH_3\text{–}CH_2\text{–}OH$</td></tr>
<tr><td>C</td><td>Ethylene (or) Ethene</td><td>$CH_2 = CH_2$</td></tr>
</table>
</td>
<td>½
½
½</td>
</tr>
<tr>
<td rowspan="2">32</td>
<td>**Inductive effect (I)**
Inductive effect is defined as the change in the polarisation of a covalent bond due to the presence of adjacent bonds, atoms or groups in the molecule. This is a permanent phenomenon.</td>
<td>1</td>
<td rowspan="2">3</td>
</tr>
<tr>
<td>**Example** :
$\overset{\delta\delta^+}{CH_3} \longrightarrow \overset{\delta^+}{CH_2} \longrightarrow \overset{\delta^-}{Cl}$
i) We know that chlorine is more electronegative than carbon
ii) Hence it attracts the shared pair of electron between C-Cl in ethyl chloride towards itself.
iii) This develops a slight negative charge on chlorine and a slight positive charge on carbon to which chlorine is attached.
iv) To compensate it, the **C_1** draws the shared pair of electron between itself and **C_2**. This polarisation effect is called inductive effect.</td>
<td>2</td>
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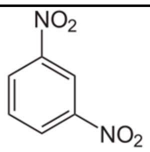
<tr>
<td rowspan="3">33</td>
<td>
<table>
<tr><td>i)</td><td>m – dinitro benzene</td><td></td></tr>
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<td>1</td>
<td rowspan="3">3</td>
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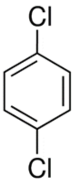
<table>
<tr><td>ii)</td><td>p – dichloro benzene</td><td></td></tr>
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<td>1</td>
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<tr>
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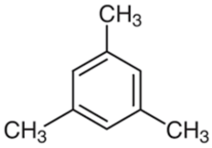
<table>
<tr><td>iii)</td><td>1, 2, 3, trimethyl benzene</td><td></td></tr>
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Part – IV

Answer all the Questions **5 x 5 = 25**

34 a)

Element	%	Relative no. of atoms	Simple ratio
Na	14.31	$\frac{14.31}{23}=0.62$	$\frac{0.62}{0.31}=2$
S	9.97	$\frac{9.97}{32}=0.31$	$\frac{0.31}{0.31}=1$
H	6.22	$\frac{6.22}{1}=6.22$	$\frac{6.22}{0.31}=20$
O	69.5	$\frac{69.5}{16}=4.34$	$\frac{4.34}{0.31}=14$

½ ½ ½ ½ — 5

i) Empirical formula = **$Na_2SH_{20}O_{14}$** ½

ii) Empirical formula mass = (2 x 23) + (1 x 32) + (20 x 1) + (14 x 16) = 322 ½

iii) Molar mass = 322 ½

$$n=\frac{\text{MolarMass}}{\text{calculated empirical formula mass}}=\frac{322}{322}=1$$

n =1 ½

Molecular formula = $(Na_2SH_{20}O_{14})_n$ ½

= $(Na_2SH_{20}O_{14})_1$ ½

Since all the hydrogen in the compound present as water

∴ Molecular formula is **$Na_2SO_4.10H_2O$** ½

(OR)

34 b)

i) Pauli Exclusion Principle

"No two electrons in an atom can have the same set of values of all four quantum numbers." 2½ — 5

ii) Modern periodic law

“the physical and chemical properties of the elements are periodic functions of their atomic numbers.” 2½

35 a)

i) Isotopes are defined as the atoms of the same element, having the same atomic number but different mass number. 1

Hydrogen has three naturally occurring isotopes,

i) Protium (or) ($_1H^1$ or H) ½

ii) Deuterium (or) ($_1H^2$ or D) ½

iii) Tritium (or) ($_1H^3$ or T) ½

	ii) Uses of calcium 1. As a reducing agent in the metallurgy of uranium, zirconium and thorium. 2. As a deoxidiser, desulphuriser or decarboniser for various ferrous and non-ferrous alloys. 3. In making cement and mortar to be used in construction. 4. As a getter in vacuum tubes. 5. In dehydrating oils 6. In fertilisers, concrete and plaster of paris.	1 1 ½	5
	(OR)		
35 b)	**The van der Waals equation for n moles is** $\left(P+\frac{a\,n^2}{V^2}\right)(V-nb)=nRT$ ---------- (1) For 1 mole $\left(P+\frac{a}{V^2}\right)(V-b)=RT$ ---------- (2) On expanding the above equation $PV+\frac{a}{V}-Pb-\frac{ab}{V^2}-RT=0$ ------- (3) Multiply equation (3) by V^2 / P $\frac{V^2}{P}(PV+\frac{a}{V}-Pb-\frac{ab}{V^2}-RT)=0$ $V^3+\frac{aV}{P}+-bV^2-\frac{ab}{P}-\frac{RTV^2}{P}=0$--- (4) When the above equation is rearranged in powers of V $V^3-\left[\frac{RT}{P}+b\right]V^2+\left[\frac{a}{P}\right]V-\left[\frac{ab}{P}\right]=0$ --- (5) The equation (5) is a cubic equation in V. $V = V_C$ $V - V_C = 0$ $(V - V_C)^3 = 0$ $V^3 - 3V_CV^2 + 3V_C^2V - V_C^3 = 0$ --------------- (6)	½ ½ ½ ½ ½	5

As equation (5) is identical with equation (6), we can equate the coefficients of V^2, V and constant terms in (5) and (6).

$$-3V_C V^2 = -\left[\frac{RT_C}{P_C} + b\right] V^2$$

$$3V_C = \frac{RT_C}{P_C} + b \quad ---- \quad (7)$$ ½

$$3V_C^2 = \frac{a}{P_C} \quad ---- \quad (8)$$ ½

$$V_C^3 = \frac{ab}{P_C} \quad ---- \quad (9)$$ ½

Divide equation (9) by equation (8)

$$\frac{V_C^3}{3V_C^2} = \frac{ab / P_C}{a / P_C} \qquad \frac{V_C}{3} = b$$

$$\text{i.e.} \quad V_C = 3b \quad ------- \quad (10)$$

when equation (10) is substituted in (8)

$$3V_C^2 = \frac{a}{P_C}$$

$$P_C = \frac{a}{3V_C^2} = \frac{a}{3(3b^2)} = \frac{a}{3 \times 9b^2} = \frac{a}{27\,b^2}$$

$$P_C = \frac{a}{27b^2} \quad ------ \quad (11)$$ ½

substituting the values of Vc and Pc in equation (7),

$$3V_C = b + \frac{R\,T_C}{P} \qquad 3\,(3\,b) = b + \frac{R\,T_C}{\left(a/27\,b^2\right)}$$

$$9\,b - b = \left(\frac{R\,T_C}{a}\right) 27\,b^2 \qquad 8\,b = \frac{T_C\,R\,27b^2}{a}$$

$$\therefore \quad T_C = \frac{8\,a\,b}{27\,R\,b^2} = \frac{8\,a}{27\,R\,b} \quad ------ \quad (12)$$ ½

The critical constants can be calculated using the values of van der waals constant of a gas and vice versa.

$$a = 3\,V_C^2\,P_C \quad \text{and} \quad b = \frac{V_C}{3}$$

36 a)	**Entropy statement:** “the entropy of an isolated system increases during a spontaneous process”. (or) Entropy is a measure of the molecular disorder (randomness) of a system. (or) It is defined as, $dS = dq_{rev} / T$	1	5
	Kelvin-Planck statement: It is impossible to construct a machine that absorbs heat from a hot source and converts it completely into work by a cyclic process without transferring a part of heat to a cold sink.	2	
	Clausius statement: It is impossible to transfer heat from a cold reservoir to a hot reservoir without doing some work.	2	
	(OR)		
36 b)	**i) Law of mass action** “At any instant, the rate of a chemical reaction at a given temperature is directly proportional to the product of the active masses of the reactants at that instant”. Rate α $[Reactant]^x$	2	5
	ii) Limitations of Henry’s law 1 Henry’s law is applicable at moderate temperature and pressure only. 2 Only the less soluble gases obeys Henry’s law	1	
	3 The gases reacting with the solvent do not obey Henry’s law. For example, ammonia or HCl reacts with water and hence does not obey this law. $\mathbf{NH_3^+ H_2O \leftrightarrows NH_4^+ + OH^-}$	1	
	4 The gases obeying Henry’s law should not associate or dissociate while dissolving in the solvent.	1	
37 a)	**The salient features of Molecular orbital** 1. When atoms combines to form molecules, their individual atomic orbitals lose their identity and forms new orbitals called **molecular orbitals**.	1	5
	2. The shapes of molecular orbitals depend upon the shapes of combining atomic orbitals.	1	
	3. The molecular orbital with lower energy is called bonding molecular orbital and the one with higher energy is called **anti-bonding molecular orbital**.	1	

The bonding molecular orbitals are represented as **σ (Sigma), π (pi), δ (delta)** and the corresponding antibonding orbitals are denoted **as σ*, π* and δ*.**

4. The filling of electrons in these orbitals follows **Aufbau's principle, Pauli's exclusion principle** and **Hund's rule** as in the case of filling of electrons in atomic orbitals. 1

5. Bond order gives the number of covalent bonds between the two combining atoms. The bond order of a molecule can be calculated using the following equation 1

$$\text{Bond order} = \frac{\text{Nb} - \text{Na}}{2}$$

Where,
Nb = Total number of electrons present in the bonding molecular orbitals
Na = Total number of electrons present in the antibonding molecular orbitals
and A bond order of zero value indicates that the molecule doesn't exist.

(OR)

37 b) **i) All organic compounds have the following characteristic properties.**

1. They are covalent compounds of carbon and generally insoluble in water and readily soluble in organic solvent such as benzene, toluene, ether, chloroform etc... 1

2. Many of the organic compounds are inflammable (except CCl_4).

3.They possess low boiling and melting points due to their covalent nature

4. Organic compounds are characterised by functional groups. A functional group is an atom or a specific combination of bonded atoms that react in a characteristic way, irrespective of the organic molecule in which it is present. In almost all the cases, the reaction of an organic compound takes place at the functional group. 1 5

5.They exhibit isomerism which is a unique phenomenon. 1

ii) functional group in the following compounds

	Name	Molecular Formula	Functional group	
A	Acetaldehyde	CH_3CHO	- CHO	½
B	Oxalic acid	 $\begin{matrix}COOH \\ \vert \\ COOH\end{matrix}$	- COOH	½
C	Dimethyl ether	CH_3-O-CH_3	-O -	½
D	Methylamine	CH_3NH_2	- NH_2	½

38 a)

Structure of benzene:

1. Molecular formula – C_6H_6 ½

This indicates that benzene is a highly unsaturated compound.

2. Straight chain structure not possible:

It did not decolourise bromine in carbon tetrachloride or acidified $KMnO_4$. It did not react with water in the presence of acid. ½

3. Evidence of cyclic structure:

I) substitution of benzene: ½

$$C_6H_6 + Br_2 \xrightarrow{AlCl_3} C_6H_5Br + HBr$$

Formation of only one mono bromo compound indicates that all the six hydrogen atoms in benzene were identical.

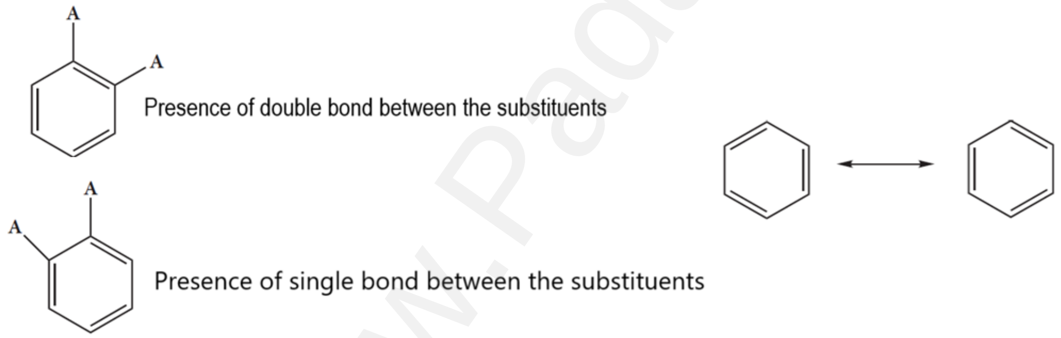
II) addition of hydrogen: ½

$$C_6H_6 + 3H_2 \xrightarrow{\text{Raney Ni}} C_6H_{12}\ \text{cyclohexane}$$

4. Kekule's structure of benzene:

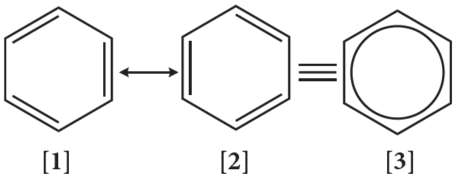
In 1865, August Kekule suggested that benzene consists of a cyclic planar structure of six carbon with alternate single and double bonds. ½

Kekule's structure failed to explain why benzene with three double bonds did not give addition reactions like other alkenes.



5. Resonance description of benzene

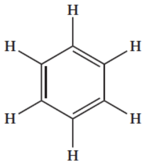
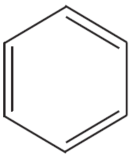
The phenomenon in which two or more structures can be written for a substance which has identical position of atoms is called resonance ½



6. Spectrosscopic measurments ½

Spectroscopic measurements show that benzene is planar and all of its carbon-carbon bonds are of equal length 1.40A°. This value lies between

5

	carbon-carbon single bond length 1.54A° and carbon-carbon double bond length 1.34A°. **7. Molecular orbital structure** All the six carbon atoms of benzene are sp^2 hybridized. Six sp^2 hybrid orbitals of carbon linearly overlap with six 1s orbitals of hydrogen atoms to form six C - H sigma bonds. Overlap between the remaining sp^2 hybrid orbitals of carbon forms six 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 un hybridized p-orbital containing one electron. The lateral overlap of their p-orbital produces 3 π- bond The six electrons of the p-orbitals cover all the six carbon atoms and are said to be delocalised. Due to delocalization, strong π-bond is formed **8. Representation of benzene:**  Expanded form  Kekule structure  Short hand representation	1 ½	
	(OR)		
38) b)	A) H - CHO + $CH_3MgI \longrightarrow CH_3CH_2OMgI \longrightarrow$ **CH_3CH_2OH** + Mg(OH)I B) CH_3 - CHO + $CH_3MgI \rightarrow (CH_3)_2CH$ - OMgI $\longrightarrow$ **$(CH_3)_2CHOH$**+ Mg(OH)I C) $CH_3 – O – CH_2Cl + CH_3MgI \longrightarrow$ **$CH_3 – O – CH_2\ CH_3$** + Mg(Cl)I ii) Eutrophication: Eutrophication is a process by which water bodies receive excess nutrients that stimulates excessive plant growth (algae, other plant weeds). This enhanced plant growth in water bodies is called as algae bloom. **SHANMUGAM S** **ST. JOHN'S MAT.HR.SEC.SCHOOL PORUR, CHENNAI – 600116** **9841945665**	1 1 1 2	5