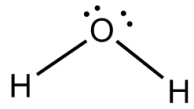
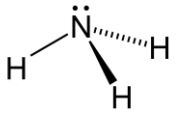
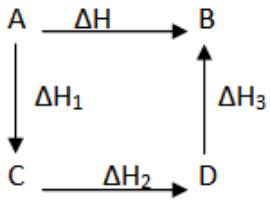
FIRST YEAR HIGHER SECONDARY MODEL EXAMINATION – 2021

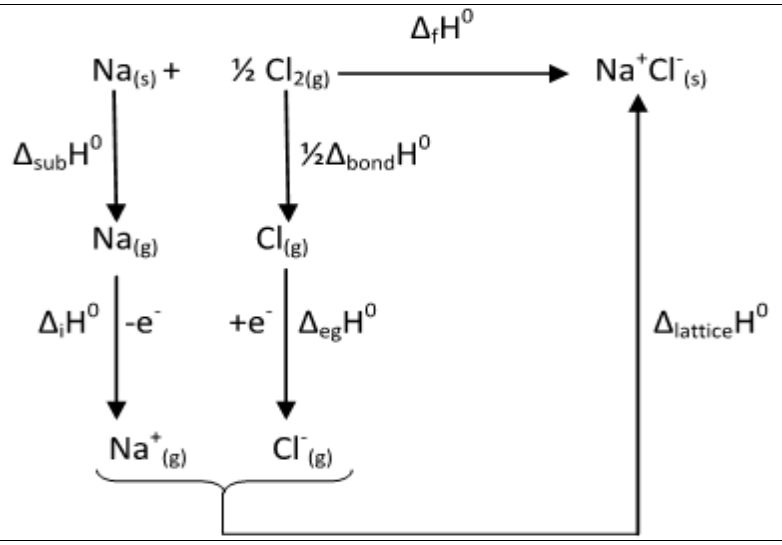
SUBJECT: CHEMISTRY Qn. Code: FY 325

Qn. No.	Sub qns.	Answer Key/Value Points	Score	Total
		Answer any 6 questions from 1 to 12. Each carries 2 scores. (6 x 2 = 12)		
1.		Hund's rule states that pairing of electrons in the orbitals belonging to the same subshell does not take place until each orbital belonging to that subshell has got one electron each. Or, ***electron pairing in degenerate orbitals takes place only after partially filling (singly filling) all the degenerate orbitals***.	2	2
2.		De Broglie wavelength (λ) = $\frac{h}{mv}$ = $\frac{6.626 \times 10^{-34}}{9.1 \times 10^{-31} \times 2.05 \times 10^{7}}$ = **3.55×10^{-11} m** = **35.5 pm**	1 1	2
3.		H_2O – Bent structure or, angular shape or, inverted 'V' shape or,  NH_3 – Trigonal pyramidal or pyramidal shape or, 	1 1	2
4.		This is due to two wrong assumptions of kinetic molecular theory of gases at certain conditions. They are: (i) The actual volume of the molecules is negligible compared to the volume of the gas. (ii) There is no force of attraction between the gas particles.	2	2
5.		It states that energy can neither be created nor be destroyed. Or, the total energy in the universe is always a constant. Or, the total energy of an isolated system is always a constant. Or, the mathematical equation $\Delta U = q + w$	2	2
6.		$K_p > K_c$ or, $K_p = K_c.RT$	2	2
7.		Lewis Acids: BCl_3, H^+ Lewis Bases: H_2O, NH_3	1 1	2
8.		1. Li is much harder and has high melting point and boiling point. 2. Li is the least reactive but the strongest reducing agent among all the alkali metals. 3. It forms only monoxide with oxygen. 4. LiCl is deliquescent and crystallizes as a hydrate ($LiCl.2H_2O$). But the other alkali metal chlorides do not form hydrates. ***[Any 2 required]***	2	2

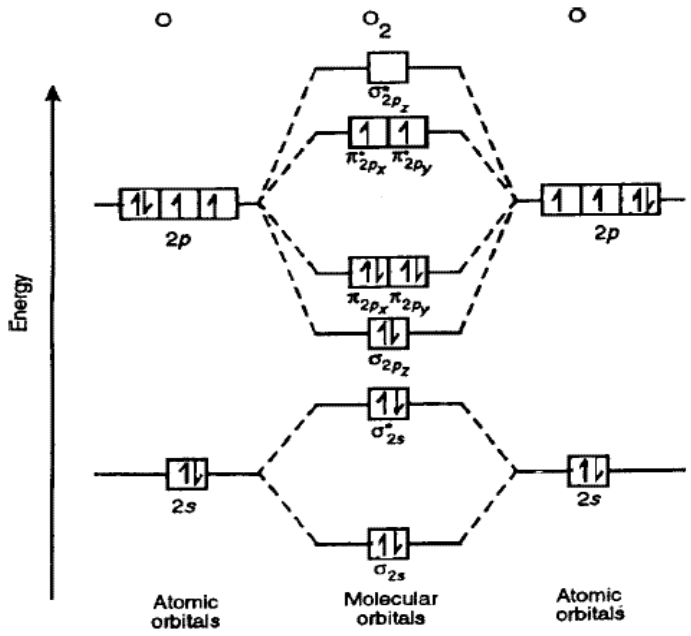
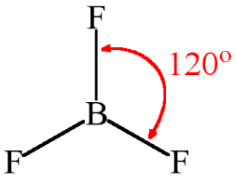
9.	(A)	Hex-4-en-1-oic acid	1	2
	(B)	Cyclohex-2-en-1-ol	1	
10.		CH_3-CH_2-CH_2-CH_2-CH_3 (Pentane or n-pentane)	1	2
		CH_3-CH(CH_3)-CH_2-CH_3 (2-Methyl butane or, isopentane)	1	
		Names or structures of any 2 chain isomers are required.		
		CH_3-C(CH_3)(CH_3)-CH_3 (2,2-Dimethylpropane or, neopentane)		
11.	(A)	Wurtz Reaction *[In the Qn. C_2H_5-C_2H_5 (n-Butane) is the product].*	1	2
	(B)	Friedel-Crafts alkylation reaction	1	
12.		Since it obeys Huckel rule. i.e. Cyclopentadienyl anion is cyclic and planar. It contains (4n+2) delocalised π electrons. So it is aromatic.	2	2
		Answer any 8 questions from 13 to 28. Each carries 3 scores. (8 x 3 = 24)		
13.	(i)	It states that a given compound always contains exactly the same proportion of elements by weight. Or, the same compound always contains the same elements combined in a fixed ratio by mass.	2	3
	(ii)	It is the reagent that limits a reaction. Or, the reagent that is completely consumed in a chemical reaction.	1	
14.	(i)	$1/12^{th}$ the mass of a C^{12} atom is called atomic mass unit (amu).	1	3
	(ii)	(A) 52 mole of Ar = 52 x 6.022 x 10^{23} Ar atoms	1	
		(B) 52 g of He = 52/4 = 13 mole of He = 13 x 6.022 x 10^{23} atoms of He	1	
15.	(i)	(a) O^-	1	3
	(ii)	Due to lesser no. of electrons (shells) and greater effective nuclear charge of Na^+.	2	
16	(i)	IE_2 is greater than IE_1. This is because it is more difficult to remove an electron from a positive charged ion than from a neutral atom/due to the stable electronic configuration of Na^+ [2,8 or, $1s^2$ $2s^2$ $2p^6$].	2	3
	(ii)	Because of the smaller size of the second shell, the electronic repulsion is greater in F. So it does not easily add electrons.	1	
17.	(i)	Due to the smaller size of the cation, Li^+ and larger size of the anion Cl^-, LiCl is covalent.	1	3
	(ii)		2	

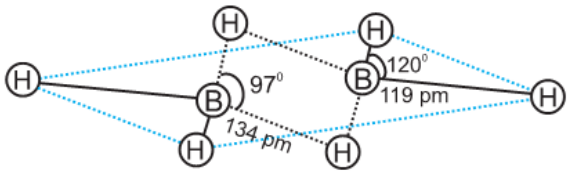
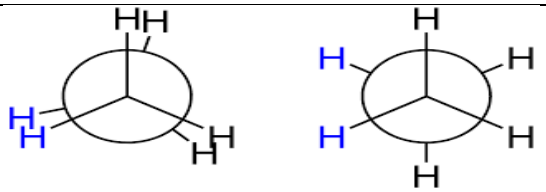
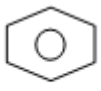
Sigma (σ) Bond	Pi (π) Bond
Formed by axial (end to end) overlapping of atomic orbitals.	Formed by lateral (sidewise) overlapping of atomic orbitals.
It is always present in single bonds.	It is present only in multiple bonds.
Extend of overlap is greater.	Extend of overlap is lesser.
Stronger bonds.	Weaker bonds compared to sigma bonds.

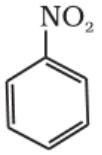
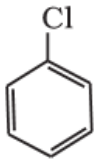
18.	(i)	Boyle's Law	1	3
	(ii)	From Boyle's law, $P_1V_1 = P_2V_2$ Here P_1 = 1.2 bar, V_1 = 120 mL, V_2 = 180 mL, P_2 = ? So 1.2 x 120 = P_2 x 180 P_2 = 1.2 x 120/180 = **0.8 bar**	2	
19.	(i)	**$(P + an^2/V^2)(V- nb) = nRT$**	1	3
	(ii)	1. Every gas contains a large number of minute and elastic particles (atoms or molecules). The actual volume of the molecules is negligible compared to the volume of the gas. 2. There is no force of attraction between the gas particles. 3. The particles of a gas are in constant and random motion in straight line. During this motion they collide with each other and also with the walls of the container. 4. The pressure of a gas is due to the wall collisions of the particles. 5. All collisions are perfectly elastic. i.e. the total energy of particles before and after collisions remains the same. 6. At any particular time, different particles of a gas have different speed and hence different kinetic energy. 7. The average kinetic energy of gas molecules is directly proportional to absolute temperature. **[Any 4 postulates required]**	2	
20.	(i)	(d) Temperature	1	3
	(II)	The law states that the total enthalpy change for a physical or chemical process is the same whether the reaction taking place in a single step or in several steps. Or, the total enthalpy change for a process is independent of the path followed. Or,  According to Hess's law: $\Delta H = \Delta H_1 + \Delta H_2 + \Delta H_3$	2	
21.	(i)	Lattice enthalpy is the enthalpy change when one mole of an ionic compound dissociates into gaseous ions. Or, it is the enthalpy change when 1 mol of an ionic compound is formed from corresponding gaseous ions.	1	
	(ii)	Born-Haber cycle for the formation of NaCl		

			2	3
22.	(i)	+7	1	
	(ii)	Assign the oxidation number of each element +1 −1 +1 −2 0 $2H_2O_2\,(aq) \rightarrow 2H_2O(l) + O_2(g)$ The element undergoing disproportionation reaction is oxygen in H_2O_2.	1 1	3
23.		*Step-1: Assign the oxidation number of each element and find out the substance oxidised and reduced.* +2 +6 +3 +3 $Fe^{2+} + Cr_2O_7^{2-} \longrightarrow Fe^{3+} + Cr^{3+}$ *Here Fe is oxidised and Cr is reduced.* *Step-2: Separate the equation into 2 half reactions -oxidation half reaction and reduction half reaction.* *Oxidation half:* $Fe^{2+} \longrightarrow Fe^{3+}$ *Reduction half:* $Cr_2O_7^{2-} \longrightarrow Cr^{3+}$ *Step-3: Balance the atoms other than O and H in each half reaction individually.* *Oxidation half:* $Fe^{2+} \longrightarrow Fe^{3+}$ *Reduction half:* $Cr_2O_7^{2-} \longrightarrow 2\,Cr^{3+}$ *Step-4: Now balance O and H atoms. Add* H_2O *to balance O atoms and* H^+ *to balance H atoms since the reaction occurs in acidic medium.* *Oxidation half:* $Fe^{2+} \longrightarrow Fe^{3+}$ *Reduction half:* $Cr_2O_7^{2-} + 14H^+ \longrightarrow 2\,Cr^{3+} + 7\,H_2O$ *Step -5: Now balance the ionic charges. For this add electrons to one side of the half reaction.* *Oxidation half:* $Fe^{2+} \longrightarrow Fe^{3+} + e^-$ *Reduction half:* $Cr_2O_7^{2-} + 14H^+ + 6\,e^- \longrightarrow 2\,Cr^{3+} + 7\,H_2O$ *Step-6: Now add the two half reactions after equating the electrons.* *Oxidation half:* $(Fe^{2+} \longrightarrow Fe^{3+} + e^-) \times 6$ *Reduction half:* $(Cr_2O_7^{2-} + 14H^+ + 6\,e^- \longrightarrow 2\,Cr^{3+} + 7\,H_2O) \times 1$ *Overall reaction is:* $6\,Fe^{2+} + Cr_2O_7^{2-} + 14H^+ \longrightarrow 6\,Fe^{3+} + 2\,Cr^{3+} + 7\,H_2O$ *Now the equation is balanced.*	3	3
24.	(i)	Calcium chloride ($CaCl_2$)/Calcium sulphate ($CaSO_4$)/Magnesium chloride ($MgCl_2$)/Magnesium sulphate ($MgSO_4$) [***Any one***]	1	3
	(ii)	Explanation of any one method like treating with washing soda, Calgon's method, Ion-exchange method, synthetic resin method etc.	2	
25.	(i)	H_2O, NH_3, H_2S, PH_3, HCl, HF, HBr, HI etc. [***Any 2***]	1	3
	(ii)	H_2O_2 decomposes slowly on exposure to light. $2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$ In the presence of metal surfaces or traces of alkali, the above reaction is catalysed. So it is stored in wax-lined glass or plastic vessels in dark.	2	
26.	(i)	Solvay Process	1	

	(ii)	A | B Washing soda | $Na_2CO_3.10H_2O$ Caustic soda | NaOH Baking soda | $NaHCO_3$ Slaked lime | $Ca(OH)_2$	4 x ½ = 2	3
27.	(i)	Calcium sulphate hemihydrates or, $CaSO_4.½\ H_2O$ or, $(CaSO_4)_2\ H_2O$	1	3
	(ii)	When CO_2 is passed through lime water, it turns milky due to the formation of insoluble $CaCO_3$. On passing CO_2 continuously, the solution becomes clear due to the formation of soluble calcium bicarbonate. $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$ $CaCO_3 + H_2O + CO_2 \rightarrow Ca(HCO_3)_2$	2	
28.		(a) Distillation: The principle of this method is that liquids having different boiling points vapourise at different temperatures. The vapours are cooled and the liquids so formed are collected separately. (b) Crystallisation: It is based on the difference in the solubilities of the compound and the impurities in a suitable solvent.	1½ 1½	3
Answer any 6 questions from 29 to 40. Each carries 4 scores. (6 x 4 = 24)				
29.	(i)	Explanation of any 2 Quantum numbers	2	4
	(ii)	For 2p, n = 2 and l = 1 For 4s, n = 4 and l = 0	1 1	
30.	(i)	1. The electron in the hydrogen atom can move around the nucleus in circular paths of fixed radius and energy. These paths are called orbits or stationary states or allowed energy states. These energy levels are numbered as 1,2,3 etc or as K, L, M, N, etc. 2. The energy of an electron in an orbit does not change with time. However, when an electron absorbs energy, it will move away from the nucleus and when it loses energy, it will move towards the nucleus. 3. The frequency of radiation absorbed or emitted when transition occurs between two stationary states that differ in energy by ΔE, is given by: $v = \frac{\Delta E}{h} = \frac{E_2 - E_1}{h}$ Where E_1 and E_2 are the energies of lower and higher energy levels respectively. 4. The angular momentum of an electron is an integral multiple of h/2π. i.e. $m_e vr = \frac{nh}{2\pi}$ **[Any 2 postulates required]**	2	4
	(ii)	It states that "it is impossible to determine simultaneously, the exact position and momentum (or velocity) of a moving microscopic particle like electron". Mathematically, $\Delta x.\ \Delta p \geq \frac{h}{4\pi}$	1 1	

31.	(i)	Bond order is defined as one half of the difference between the number of electrons in the bonding and the anti-bonding orbitals. Or, ***Bond order (B.O) = ½ [$N_b - N_a$]*** Or, It is the number of bonds between the two atoms in a molecule	1	
	(ii)	M.O configuration is = $\sigma 1s^2$ $\sigma^* 1s^2$ $\sigma 2s^2$ $\sigma^* 2s^2$ $\sigma 2p_z^2$ $\pi 2p_x^2$ $\pi 2p_y^2$ $\pi^* 2p_x^1$ $\pi^* 2p_y^1$  Due to the presence of unpaired electrons, O_2 molecule is paramagnetic.	3	4
32.	(i)	(b) Linear	1	
	(ii)	sp^2 hybridisation is the process of inter mixing of one s-orbital and two p-orbitals to form three new orbitals having equivalent energy and shape. E.g. BF_3 Here the central atom B is in sp^2 hybridisation. The three sp^2 hybrid orbitals of B overlap with 2p orbitals of F to form 3 B-F σ bonds. So the shape of the molecule is **Trigonal planar** or **planar triangular** with bond angle **120^0**.  	3	4
33.	(i)	Here $[H^+] = 3.8 \times 10^{-3}$ We know that $pH = -\log[H^+]$ $= -\log (3.8 \times 10^{-3}) = \underline{2.42}$	2	
	(ii)	The acid base pair that differs by only one proton is called a conjugate acid – base pair.	1	4
	(iii)	Conjugate base of $H_2CO_3 = HCO_3^-$ Conjugate base of HF = F^-	1	

34.	(i)	Solution which resists the change in pH on dilution or with the addition of small amount of acid or alkali is called Buffer solution. E.g. A mixture of acetic acid and sodium acetate acts as buffer solution around p^H 4.75.	2	4
	(ii)	NaCl - Neutral NaCN - Basic NH_4NO_3 - Acidic CH_3COONa - Basic	4 x ½ = 2	
35.	(i)	(b) Graphite	1	4
	(ii)	(b) $CO + N_2$	1	
	(iii)	Silicones are organosilicon polymers with $-R_2SiO-$ as repeating unit. They are used as sealant, greases, electrical insulators, for water proofing of fabrics and in surgical and cosmetic plants. [***Any one application required***]	2	
36.	(i)	In diborane, the two boron atoms and 4 hydrogen atoms lie in one plane. These four H atoms are called *terminal hydrogen atoms*. The other two hydrogen atoms lie one above and one below this plane. These H atoms are called *bridging hydrogen atoms*. The bridged B-H-B bonds *are three centre- two electron (3c-2e) bonds or banana bonds*. Or,  	2	4
	(ii)	Due to the absence of vacant d-orbitals in CCl_4, it cannot be hydrolysed.	2	
37.	(i)	Dumas method or Kjeldahl's method	1	4
	(ii)	**Lassaigne's test**: Here the organic compound is fused with metallic sodium in a fusion tube. It is then extracted by boiling with distilled water and then filtered. The filtrate is known as *sodium fusion extract*. 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 blue or green coloration or precipitate (ppt) is formed.	3	
38.	(i)	 Eclipsed conformation Staggered conformation	2	
	(ii)	(a) is  Benzene (b) is CH_3-CHBr-CH_3 (2-Bromopropane)	1 1	4

39.	(i)	(a) C_6H_6 (Benzene) (b) CH ≡ CH or C_2H_2 (Ethyne or Acetylene)	1 1	
	(ii)	(a) Nitrobenzene/ C_6H_5-NO_2 ,Or  (b) Chlorobenzene/ C_6H_5-Cl, Or 	1 1	4
40.	(i)	When the concentration of carbon dioxide in the increases, it absorbs more infra-red radiation from the solar energy and hence the temperature of the earth's atmosphere increases. This is known as Green house effect.	2	4
	(ii)	a) Liquefied CO_2 is used for dry cleaning of clothes. b) Hydrogen peroxide (H_2O_2) with suitable catalyst is used for bleaching paper. c) In synthesis of chemicals. (***Any 2 required***)	2	