(1) FYBSc SemI Chemistry I

Code Number 56905

(1) 1.18

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Page No.....

Set - VI

Q. No.	Fill in the blanks.	Marks
Q-1 A)		
i)	b) positive.	
ii)	a) $\Delta H_2 - \Delta H_1 = \Delta C_p (T_2 - T_1)$ (a)	
iii)	b) intensive property.	
iv)	a) concentration.	
v)	a) one.	
vi)	b) one fifth of molecular mass.	
vii)	$E = h\nu$ (b).	
viii)	b) ~~strong~~ p.	
ix)	b) Bohr	
x)	a) Transuranic.	
xi	c) $ns^2 np^6$.	
xii)	b) slater.	
xiii)	b) formyl.	
xiv)	a) sp^3	
xv)	a) electron rich	
xvi)	a) 120^0.	
xvii)	a) sp.	
xviii)	Temporary	

Questions should be —
WRITTEN IN LEGIBLE HANDWRITING IN BLACK INK.
SIGNS, SKETCHES OR FIGURES IF ANY BE DRAWN IN NEAT BLACK INK,
so as to avoid mistakes in the printed question papers.

Duration ..... Hours. Total Marks assigned to the paper ..... (2)

Q. No.		Marks
	N.B. : VII	
B)	True or False.	
1)	True.	
2)	False	
3)	False.	
4)	True	
5)	True.	
6)	false	
C)	Match the following.	
1)	— c work done by the system	
2)	— e gram equivalent / L	
3)	— a visible	
4)	— g 6th period & VIII B grup	
5)	— d polarizability effect	
6)	e — h. 180°.	

(3)

Set-VI

Q2		Attempt any **four** of the following.	
	A	State first law of thermodynamics in any three forms. Give any two limitations of it?	05
		Statements of first law of thermodynamics: 1) Energy can neither be created nor destroyed but can be converted from one form to another. 2) The energy of isolated system remains constant. 3) Whenever one kind of energy is produced, an exactly equivalent amount of another kind of energy must disappear. 4) Energy of the universe is constant. 5) It is impossible to construct a perpetual motion machine which could produce work without consuming energy.	03
		Limitations: 1) The law fails to tell us the source of heat and direction of flow of heat. 2) It does not define the ease or extent of convertibility of one form of energy into another. 3) It fails to explain why natural processes are unidirectional. 4) This law cannot explain why all naturally occurring processes always tend to change spontaneously in the direction which leads to equilibrium. 5) It does not say whether heat change is endothermic or exothermic. 6) Work can be completely transformed into heat, but heat cannot be completely converted into work without causing permanent change in the system or surrounding. This observation could not be explained by this law. 7) According to this law, it is not possible to have 100% efficiency for heat engine. However, experience tells that, such engines are not possible in practice. 8) From the point of view of this law, difference between spontaneous and non-spontaneous process is of no significance.	02
	B	**Define the thermodynamic terms system and surrounding. With suitable example explain different types of systems.**	05
		System: A part of the universe which is under thermodynamics study is known as system. E.g. water in beaker, gas in a cylinder, etc.	01
		Surrounding: Everything in the universe which is not a part of the system is called surrounding.	01
		Types of systems: Depending upon the nature of boundary, the systems are classified as follows. **i) Open system:** If matter and energy both can pass across the boundary, the system is	01

(4)

		called an open system. E.g. Hot water in beaker kept on a table. ii) **Closed system:** If only energy can be exchanged across the boundary with its surrounding and not the matter, the system is called a closed system. e.g. Hot water kept in a sealed beaker. iii) **Isolated system:** If the boundary prevents any interaction with the surrounding, the system is called isolated system. E.g. Hot water kept in thermos flask.	01 01
	C	Define, thermodynamic term boundary. Calculate the work done, when 1.5 moles of an ideal gas are expanded isothermally and reversibly at 298 K to twice the original volume. (Given: R = 8.314 J K^{-1} mol^{-1})	05
		Boundary: Anything that separates the system and surrounding is called a boundary or wall. solution : $w = ?$ $n = 1.5$, $T = 298\ K$ $V_1 = 1$ $V_2 = 2$ $\therefore \frac{V_2}{V_1} = 2$ Work done, $w = -2.303\ n\ RT \log_{10} \frac{V_2}{V_1}$ $= -2.303 \times 1.5 \times 8.314 \times 298 \times \log 2$ $= -2.303 \times 1.5 \times 8.314 \times 298 \times 0.3010$ $= -2576.1905\ J$ $w = -2.57619\ KJ$ -Ve sign indicates that, work is done by the system.	01

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	D	Explain the terms: i) enthalpy and ii) internal energy. How are they related?	05
		Internal energy (U): A system in a fixed state has a definite and constant amount of energy known as internal energy of the system. Internal energy is a **state function and extensive property** of the system. Hence, it is expressed in terms of change in internal energy of the system. ΔU. $\Delta U = U_2 - U_1$ Where, U_1 = Internal energy of the system in the initial state. U_2 = Internal energy of the system in the final state. **Enthalpy:** At constant of pressure, amount of heat energy absorbed or given out by the system is called heat content of the system or enthalpy. Mathematically enthalpy defined as follows, $\mathbf{H = U + pV}$ Where, U = internal energy of the system, p = pressure of the system, V = volume of the system. Enthalpy is a **state function and is an extensive property** of the system. If H_1 is the enthalpy of the system in the initial state and H_2 is the enthalpy of the same system in the final state, then, for a process taking place at constant pressure, $H_2 = U_2 + pV_2$ in the final state ---------- 1. $H_1 = U_1 + pV_1$ in the initial state ---------- 2. Subtracting equation (2) From (1) $H_2 - H_1 = U_2 + pV_2 - (U_1 + pV_1)$ $\Delta H = (U_2 - U_1) + p(V_2 - V_1)$ $\Delta H = \Delta U + p\Delta V$ Where, ΔH = change in enthalpy of the system, ΔU = change in internal energy of the system ΔV = change in volume of a system	02 02 01

Q2 e Definition 1 Mark x 5 = 5 Marks

i) Acidity = It is defined as no. of replaceable hydroxyl groups present in one molecule or ion of base.

ii) Basicity = The basicity of an acid is the number of hydrogen ions, which can be produced by one molecule of the acid

iii) Reacting units = is the part of a chemical species participating in the chemical reaction. In a precipitation reaction, for example, the reaction unit is the charge of the cation or anion participating in the reaction.

iv) Milli moles: It is defined as one thousandth of a mole.
No.of mmol = V (mL) x Molarity

v) Parts per million: It is the number of parts of one component in 1 million parts of a solution.

$$ppm = \frac{wt\ of\ solute}{wt\ of\ solvent\ \ X\ \ wt.of\ solute} \times 10^6$$

f

$$M = \frac{wt.of\ solute\ in\ g}{Mol.wt\ _x\ vol.in\ L}$$ **2 Marks**

Wt of solute in g = 0.1 x 133.5 x 0.5 **2 Marks**

= 6.675g **1 Mark**

7

VI Pg - 7

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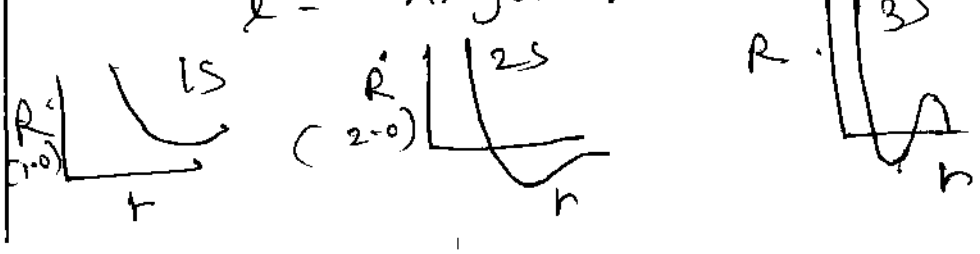
Q. No.		Marks
	N.B. :	
Q.3 A)	What is node ? Discuss the Angular shape of any one orbital.	
	The hydrogenic Orbital can be written as the product of radial function R(r) of radius and Θ and (Φ) of angular function of the co-ordinated/	01
	The position where either component passes through zero are called nodes. Hence two types of nodes Angular and radial	01.
	Angular component of wave function passes through zero is node	01
	Both types of nodes ↑ with ↑ in energy and related to quantum numbers n and l.	
	No of nodes = (n - l - 1)	
	n = principal quantum no.	
	l = Angular orbital.	01



Q8

Q. No. | Marks

plot of R(r) versus r for electron belonging to different orbital — 01

1s = n − l − 1

1 − 0 − 1

2 ans

2s and 3s has one and two radial nodes respectively

B) Principal quantum number n and angular momentum l.

It arises from the radial part of ψ main energy shell or energy level to which the electron belongs. — 2½

n = 1, 2, 3, 4 — ∞

referred K, L, M, N shells.

sphere around the nucleus in which the electrons of the same energy level exist.

No limit to the number of shells or levels. n = 7 is the highest shell occupied by the known elements determines the avg. distance of an electron from the nucleus.

2) Orbital angular momentum number l it refers to subshell to which electron belongs and orbitals belonging to each shell. each subshell of shell is distinguished by quantum number l. — 2½

9

Q. No. | Marks

It describes motion of electron

Angular momentum = $\sqrt{l(l+1)}\ \frac{h}{2\pi}$

$l = 0, 1, 2, 3 \ldots (n-1)$.

When $n = 1$ there is only one subshell. with $l = 0$.

When $n = 2$ there are two subshell value $l = 0, 1$.

c) Discuss penetration and shielding in orbitals.

The extent to which an orbital of a shell interact with the lower quantum shell orbital is termed as the penetration of the orbitals. eg the energy of the 4s orbital is lower than that of the 3d orbitals so that filling of the 4s orbital commences even before the ~~third~~ shell has been completely filled up This is reffered to as penetration of the 3d orbital by the 4s orbital

The penetration is more as the shell number The 5s orbital penetrates both 4f and 4d. where as 6s orbitals penetrates the 4f, 5d

s > p > d > f. Stability of orbitals with some principal quantum no is also in the order of s > p > d > f. due to penetration of the orbitals. the order of shielding of an orbitals is

(01)

(2 ✓)

(01)

01

01

Q. No.		Marks
Q3	D) Any five period ie I^st to VII^th period with their elements at. no. & no. of shells expected.	5M
	E) Effect of Atomic & ionic radii on properties i) Small cations are less basic in nature eg. oxides of Li less basic than other	1 M
	ii) Smaller ions undergo hydration to maximum extent.	1 M
	iii) Smaller ion – maxm complexing ability	1 M
	iv) Ionicity in covalent bond — depends on size of cations & anions.	1 M
	v) Chemical reactivity – depends on at & ionic size.	1 M
	F) Electron gain enthalpy :- The enthalpy change when one mole of gas phase atom of an element accept electrons to form gseous ion	1M
	$Cl_{(g)} + e^- \rightarrow Cl^-_{(g)}$ $\Delta H = -349\ KJ\ mol^{-1}$	1M
	eg. B – 28, C – 122 $KJ\ mol^{-1}$	
	Electron gain enthalpy large if atom accepts electron to form anion. if it is uninegative, heat evolved (exothermic) $\Delta_{eg}H$ – –ve. For 2nd electron it is exothermic $\Delta_{eg}H$ – +ve.	
	Factors :- 1) Atomic size — smaller the size of atom, egain enthalpy will be more.	1 M
	2) Nuclear charge — Nuclear charge more, more energy released. i- Ele gain ethalpy is more.	1

Q. No. Q4. 12 Marks

a) i) 2- chloro - 3 - methyl pentane
ii) 2- bromopropanamide
iii) 2- amino cyclopentanone
iv) 4- chloro hex-2-yne
v) 2- iodo - methoxy propane.
1m each 5m.

b) sp^2 hybridization (1m)
Trigonal structure, bond angle 120° (1m) 5m.
Diagram showing type of orbitals and overlap (3m)
[No diagram, but only description cut 1m].

c) Any 5 relevant points of distinction e.g shape, bond angle, bond length, bond energy, example 5m.

d) i) $(CH_3)_2 \ddot{N}H$ (1m)
Ease of donation of e⁻ pair due to +I effect and stabilization of conjugate acid (2m) 3m

ii) More loosely held due to lateral overlap. (1+1m) 2m

e) Structures of primary, secondary and tertiary carbanions (3m)
1° > 2° > 3° (1m)
Reason – concentration of charge due to +I effect (2m) 5m

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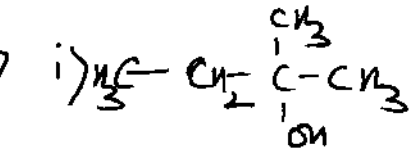
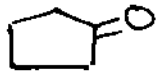
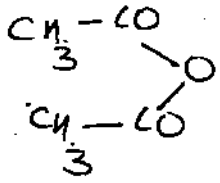
3) b) i) 

ii) $Cl CH_2 CH_2 CH_2 COOH$

iii) 

iv) 

v)  5m

Q5

E] Explanation about Inductive effect (2m) 5m
Effect on any 2 properties $1\frac{1}{2} + 1\frac{1}{2}$ (3m)

F] i) 4 points of distinction between homolytic and heterolytic fission 4m

ii) Any one example of substitution reaction 1m
(If reaction is written 1m, only example in words 1/2m]

(14) ~~13~~

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V1

Q5	A	Explain enthalpy of combustion and give its applications.	05
		Enthalpy of combustion is defined as enthalpy change accompanying the complete combustion of one mole of substance in standard state.	02
		e.g. The combustion of ethane under standard conditions to form carbon dioxide and water is, $C_2H_{6(g)} + 7/2\ O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_2O(l)$, $\Delta H^\circ_{298} = -1560.1$ kJ	
		Enthalpy of combustion of most of the reaction is negative; this indicates that the reaction is exothermic except for some substances like N_2 and F_2.	
		Applications:	
		iv) Calculations of enthalpy of formation:	
		It is difficult to determine the enthalpy of formation of organic compound but easy to determine heat of combustion. Hence, heat of combustion is used to calculate the heat of formation in such cases.	01
		v) Heat of formation of allotropic forms:	01
		Allotrope of carbon i.e. diamond and graphite has different values of heat of combustion. By knowing these values, the respective values of heat of formation can be calculated.	
		iii) The calorific values of fuels:	01
		The efficiencies of fuel can be compared by determining their standard heat of combustion.	

Q5 b Parts per billion = ppb = 1µg/L

$$ppb = \frac{w2}{w1} \times 10^9$$ 2 Mark

W_2 = weight of solute = 0.2×10^{-3}g
W_1 = weight of solvent = 1L = 1000g

$$Ppb = \frac{0.2 \times 10-3}{1000} \times 10^9$$ 2 Mark

Ppb = 200 1 Mark

Q. No.		Marks
Q.5 c)	Calculate the effective Nuclear charge of the last electron in an atom whose configuration is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$ $Z_{eff} = Z - S$	01
	$2+2+6+2+5 = 17$	01
	Group configuration $(1s^2)\ (2s^2 2p^6)\ (3s^2 3p^5)$	01
	$S = (2\times1) + 8\times0.85 + 5\times0.35 = 10.5$	01
	$Z_{eff} = 17.0 - 10.5 = 6.5$	01

Q. No. | Marks

Q5. D) Mulliken's method :-

R. S. Mulliken 1934, electronegativity could be regarded as the average of ionisation energy & electron affinity of the element. — 1 M

$$\text{Electronegativity} = \frac{(I + E)}{2}$$ — 1 M

I & E in KJ mol^{-1}

Mullikens values of electronegativity are 2.8 times larger than Pauling. — 1 M

$$x^m_B - x^m_A = 2.78 (x^p_B - x^p_A)$$ — 1 M

Electronegativity calculated for diff. elements with diff. o.s. — 1 M

(18)

Q.5

E) Explaination about Inductive effect 2 M 05

any 2 properties 1½ + 1½ 3 m.

F) i) 4 points of distinction between homolytic and heterolytic fission

ii) Any one example A reaction

reaction — m

only example in words ½ m.

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Q. No.		Marks
	3) Electronic configuration :- For the atoms with completely filled e⁻s or half filled orbitals have zero or less electron gain ethalpy.	1 M