Set 4

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code no 65/47

Q 1.A. Select the correct option and complete the following statements**(Any twelve)**

i. b) 6.5

ii. ~~a) Sorensen~~ $NH_4OH + NH_4Cl$

iii. b) 3.

iv. c) ultravoilet waves

v. c) unit cell

vi. a) super cooled liquids

vii. a) four

viii. b) 8

ix. b) 2

x. c) 180^0

xi. c) Pourbaix

xii. b) Starch

xiii. b) 120°

xiv. a) FeH_3

xv. a) electron attracting

xvi. c) 14

xvii. a) aromatic

xviii. b) deactivating

Q.1.B. State whether the following statements are True or False (Any three)

i. ~~True~~ False.

ii. False

iii. True

iv. False.

v. False vi. True

Q.1.C. Match the following columns **(Any Five).**

i. d) 2.0

ii. f) 23

iii. b) reduction

iv. g) $KMnO_4$

v. c) m directing group

vi e) axial bonds become equatorial

Q. No.		Marks
2. A.	$BOH \rightleftharpoons B^+ + OH^-$ ..... 1 mark	
	$K_b = [B^+][OH^-] / [BOH]$ ..... 1 mark	
	$[OH^-] = K_b [BOH] / [B^+]$ $[OH^-] = K_b [base] / [salt]$ Where $[BOH] = [base]$ and $[B^+] = [salt]$ $\log[OH^-] = \log K_b + \log [base]/[salt]$ $-\log[OH^-] = -\log K_b + \log [salt]/[base]$ $pOH = pK_b + \log [salt]/[base]$ ..... 1 mark	2 marks
2. B.	$pH = pKa + \log [salt] / [acid]$ .... 1 mark	
	$4.5 = 4.74 + \log [salt]/[acid]$ ..... 1 mark	
	$\log [salt] / [acid] = 4.5-4.74 = -0.24$ ..... 2 marks $[salt] : [acid] = \text{Antilog } (-0.24)$	
	$[salt] : [acid] = 0.5754 mol : 1 mol$ .....1 mark	
2.C.	Definition of Degree of Ionization 1mark	
	Factors affecting degree of Ionization 4marks	

Set 4

Q.2.D.

Frequency (υ) $= c / \lambda$ (½ mark)

a) Wavelength (λ) $= c / \upsilon$ (½ mark)

$= 3 \times 10^{8} \ / \ 76$

$= 3.947 \times 10^{6}$ m (½ mark)

b) Wave number ($\bar{\upsilon}$) $= 1 / \lambda$ (1 mark)

$= 1 /(3.947 \times 10^{6})$

$= 2.533 \times 10^{-7}$ m^{-1} (½ mark)

c) Energy $E = hc/ \lambda$ (1 mark)

$= 6.626 \times 10^{-34} \times 3 \times 10^{8} \ / 3.947 \times 10^{6}$ (½ mark)

Energy E $= 5.036 \times 10^{-32}$ J (½ mark)

Q.2.E.

Definition of crystallography and interfacial angle …. (2 marks)

Explanation of law of Constancy of interfacial angle … (3 marks)

Q.2.F.

Mention of 7 crystal systems …… (2 marks)

Unit Parameters of three crystal systems …… (3 marks)

Q. No. | Attempt any four of the following | Marks 15m

Q.3 A Define the following term

a) polarizability – Definition 1·1/4 each
b) ionic bond 1·1/4 each
c) metallic bond 1·1/4 each
d) covalent bond. 1·1/4 each

B. Draw Lewis dot structure for the following molecule/ion

a) BF_3 b) NH_4^+.

Ans: a) Step 1: Arrange the atoms F B F — 1/2 M — 2 1/2 M

Step 2: count up total valence $\vec{e}$ 3(7) + 3 = 24 $\bar{e}$ – total

Step 3: Draw single bonds bet^n central atom and surrounding atoms: B

F – B – F — 1 M

step 4: place remaining electrons, in pairs, around appropriate atoms; start with outer atoms.

24 – 6 = 18 $\bar{e}$ – left. ∴ 9 lone pairs to add

:F: :F – B – F: — 1 M

Step 5: make sure all atoms have octets: B is poor element that can have an incomplete octet so B only needs 6. — 1 M.

b) NH_4^+ — follow the same steps as above — 2 1/2 M

$$\left[\begin{array}{c} H \\ | \\ H - N - H \\ | \\ H \end{array} \right]^+$$

Q3.

C. Explain isoelectronic principle. Give any two application

Ans: principle with explanation 3 M.

Any two applications – 1 M each = 2 M

D. Give a brief account of Sidgwick-Powell theory. On the basis of this theory predict the shape of the following molecule

(a) BeH_2 (b) – BCl_3

Ans: (a) BeH_2. → principle of Sidgwick-Powell theory – [1M]

Be – has electronic config^n $1s^2, 2s^2$. and H has $1s^1$

Be has $4 e^-s$ + H has $1 e^-$.

The total no. valence electron are $2(2 \times 1) = 4 e^-s = 2$ e pair – [1M]

which according to Sidgwick-Powell theory will arrange themselves linearly to minimize the repulsion.

It has linear structure, with bond angle 180°.

H -- Be -- H (180°) ⟶ H·× Be ×·H – [1M]

Linear st.

(b) BCl_3.

Boron electronic config^n $1s^2, 2s^2, 2p^1$.

$Cl = 1s^2, 2s^2, 2p^6, 3s^2, 3p^5$.

B is the central atom & has 3 valence e^-s. two Cl atoms have seven e^-s. Total no. of valence e^- $3 + (7 \times 3) = 24$. – [1M]

Cl – B(–Cl) – Cl ⟵ :C̈l·× B ×·C̈l: (with :C̈l: above B)

Expected geometry is trigonal planar.

bond angle 120°. – [1M].

– Trigonal planar geometry.

Q3 E $Fe^{2+} + MnO_4^- + H^+ \rightarrow Mn^{2+} + Fe^{3+} + H_2O$ acidic 65147

Solution:

$MnO_4^- \rightarrow Mn^{2+}$ Reduction Half reaction (01)

(+7 → +2)

$Fe^{2+} \rightarrow Fe^{3+}$ oxidation Half reaction (02)

Balancing reduction half reaction

(i) adding $4H_2O$ to RHS to balance O-atoms

(ii) add $8H^+$ to LHS to balance H-atoms

(iii) add $5e^-$ to LHS

$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$ (02)

Balancing oxidation half reaction

$Fe^{2+} \rightarrow Fe^{3+} + e^-$

$5Fe^{2+} \rightarrow 5Fe^{3+} + 5e^-$

$MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}$

Q3 F.

Solution:

(i) when $5.0\ cm^3$ of $0.1\ M\ Ce^{4+}$ solution is added (2 1/2)

Conc. of $Fe^{3+} = \frac{5 \times 0.1}{15}$

Conc of $Fe^{2+} = \frac{5 \times 0.1}{15}$

$\frac{[Fe^{2+}]}{[Fe^{3+}]} = 1$ apply Nernst equation,

$Fe^{3+}_{(aq)} + e^- \rightarrow Fe^{2+}_{(aq)}$ $n = 1$ $E^\circ_{Pt|Fe^{3+},Fe^{++}} = 0.771\ V$.

(ii) when $11.0\ cm^3$ Ce^{4+} solution is added (2 1/2)

$[Ce^{3+}] / [Ce^{4+}] = 10.$

applying Nernst equation,

$E_{Pt|Ce^{4+},Ce^{3+}} = E^\circ_{Pt|Ce^{4+},Ce^{3+}} - \frac{0.05916}{1} \log \frac{[Ce^{3+}]}{[Ce^{4+}]}$

$= 1.3808\ V.$

Code M 85147

Q. No.	4	Marks
A	A) Nitration of Benzene	
	Reaction — ½M	
	Nitrating Mixture — ½M	
	3 steps –	
	Generation of electrophile ½M	
	Attack of electrophile ~~½M~~ 1M	
	Loss of proton ½M	
	ii) Baeyers strain Theory – Theory – 1M	
B	Huckels Rule calculation – 1M	
	state Huckels Rule 2M	
	 10 Π e⁻ 4(2)+2 = 10 Π e⁻s	1½M
	 14 Π e⁻ 4(3)+2 = 14 Π e⁻s	1½M
	How they obey Huckels Rule	
C	i) a) axeal bond b) axeial bond	
	c) equatorial bond	3M
	Ans a & b	
	ii) Antiaromaticity defⁿ — 1M	
	2 examples 1M	
D	Hammond's postulate — 1M	
	significance 1M	
	case I case II case III ½M each	
E	steric strain explanation 1½M	
	example 1M	
	Pitzer strain explanation 1½M	
	example 1M	
F	Activated aromatic rings -	
	Electron Releasing groups attached to ring → activation towards electrophilic substitution reaction groups → $-NH_2$, $-CH_3$, $-Cl$, OH	1½M 1M
	deactivated aromatic rings	
	Electron withdrawing groups attached to ring deactivation towards electrophilic substitution	1½M
	$-CHO$ $-NO_2$ $-COOH$ $-CN$	1M

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Set-4

Q. No.		Marks
Q.5. A.	$H_2O \rightleftharpoons H^+ + OH^-$ ..... 1mark $K = [H^+][OH^-]/[H_2O]$ $K\ [H_2O] = [H^+][OH^-]$ } .....3marks $Kw = [H^+][OH^-]$ ..... 1 mark	

Q.5. B).

Definition of wavelength and frequency --- (2 marks)

Three characteristics of electromagnetic radiation --- (3 marks)

Q5

C (i) Oxidation numbers of S — Code M 65/47 (02)

$Na_2S_2O_3$: $+1\times2 + 2\times S + 3\times(-2) = 0$

$\therefore S = +2$

H_2SO_4 : $+1\times2 + S + 4\times(-2) = 0$

$\therefore S = +6$

(ii) Self oxidation and reduction is called disproportionation (03)

Disproportionation of Cu^+ to Cu^{2+} and Cu^0

$2\,Cu^+_{(aq)} \longrightarrow Cu^{2+}_{(aq)} + Cu^0_{(s)}$

Cu^{2+}/Cu^+ couple undergoes oxidation &

Cu^+/Cu couple undergoes reduction

E° cell is +ve where ΔG° = -ve.

Q5

D. Frost Diagram for Mangarese ion in various Oxidation states : (01 mark for each)

Frost diagram is a graphical plot of volt equivalents (nE°) or free energy Vs oxidation number of a chemical species

Important features :

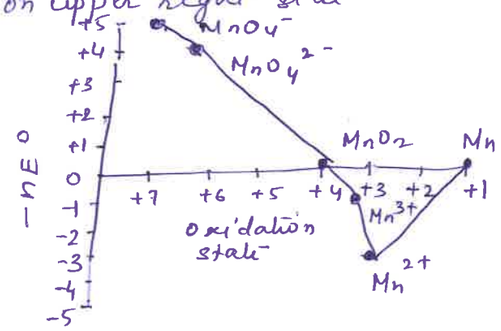
① Steeper the line higher the values of reduction pot.

② The lowest species are more stable, highest species are strong oxidizer (MnO_4^-)

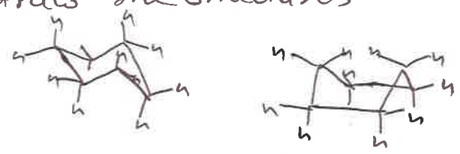
③ strong oxidizer species are on the upper left side are strong oxidizing agent & on upper right side are reducing agent

④ Any oxidation state on a concave point - MnO_2 is thermodynamically stable with respect to disproportionation

⑤ +ve reduction potential liable to undergo reduction
less +ve reduction is liable to undergo oxidation



Code no 65147

Q. No.		Marks
5 E	chair conformation & Boat conformation draw the structures  1M each explaination of the structure 1½ M each axeal bonds, equatorial bonds, distance betn the 2planes, flappole bonds bowsprint bonds. etc.	
F a)	 4π e⁻s of carbon atom 1 lone pair on sulphur is involved in the aromatic Sextet Total 6πe⁻s are delocalised over the ring. Obeys Huckel's Rule ∴ Aromatic	1½M
b)	 4πe⁻s from carbon atom ~~pair of electrons on carbon as it is carbon~~. Total 4πe⁻s are delocalised over the ring does not Obeys Huckels Rule ∴ Non Aromatic	2M
c)	 pyridine – 6π e⁻s satisfies Huckels Rule ∴ Aromatic	1½M