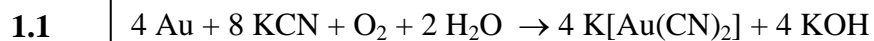


Frozen Solutions

Problem 1

17 marks

Metallurgy



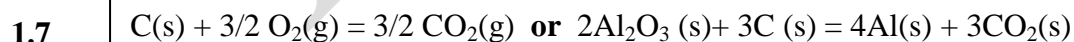
1.2 1454.3 g of KCN or 1.45 kg of KCN

1.3 2.38×10^{16}

1.4 $\text{Au}(\text{CN})_2^{-1} = 0.00847$
 $\text{Ag}(\text{CN})_2^{-1} = 0.09153$

1.5 Reduction: $3[\text{NO}_3]^{-1}(\text{aq}) + 6 \text{ H}^+(\text{aq}) + 3\text{e}^- \rightarrow 3\text{NO}_2(\text{g}) + 3\text{H}_2\text{O}(\text{l})$
 Oxidation: $\text{Au}(\text{s}) \rightarrow \text{Au}^{3+}(\text{aq}) + 3\text{e}^-$
 $\text{Au}^{3+}(\text{aq}) + 4\text{Cl}^{-1}(\text{aq}) \rightarrow \text{AuCl}_4^{-1}(\text{aq})$

- 1.6 i) c) $\Delta G^0 = \Delta H^0 - T\Delta S^0$ X
- ii) c) the standard entropy change of the above reaction is zero. X
- iii) b) the standard entropy change of the above reaction is negative X
- iv) a) 750°C X
- v) a) $\text{C}(\text{s}) + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{CO}(\text{g})$ X
- vi) a) below 2200°C X



1.8 4.1433 % of sodium fluoride should be added.

1.9 i) The energy consumed will be $= 5.07 \times 10^9 \text{ J}$.

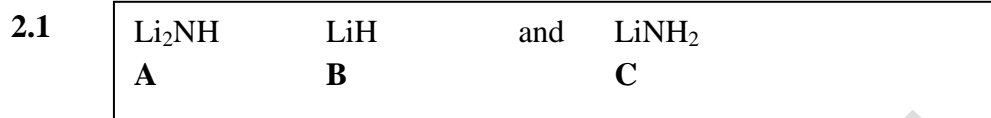
ii) g of CO_2 per hour $= 7.02 \times 10^4 \text{ g}$

Problem 2

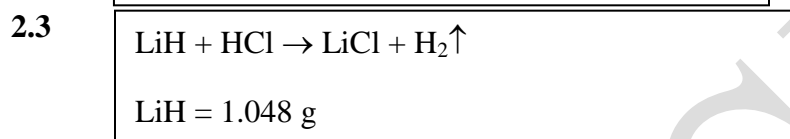
15 Marks

Energy storage devices

A. Hydrogen storage as metal hydrides

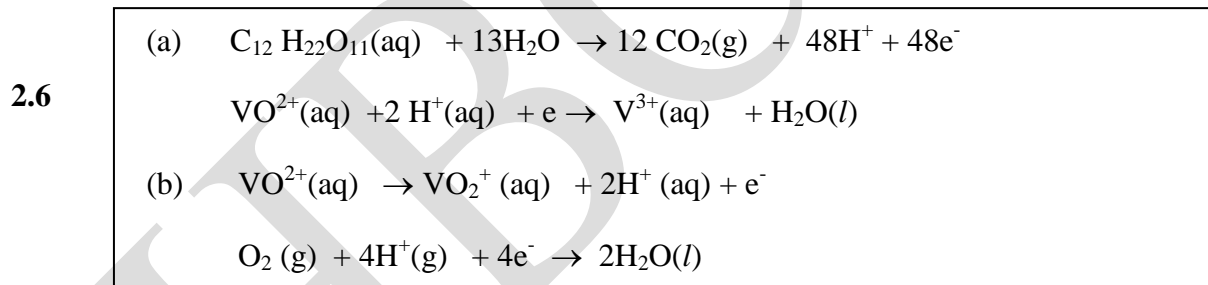


2.2 The maximum volume = 1280 L



2.4 $p = 119.85 \times 10^{-4} \text{ Pa} = 11.9 \text{ bar}$

2.5 $\Delta H^\circ = -36.1 \text{ kJ mol}^{-1}$



2.7 $V(\text{air}) = 0.041 \text{ L}$

2.8 $Y = -0.27 \text{ V}$ $X = 0.36 \text{ V}$

2.9 $[\text{VO}^{2+}] = 1.996$
 $[\text{VO}_2^+] = [\text{V}^{3+}] = 4 \times 10^{-3}$

2.10 Efficiency = 0.54

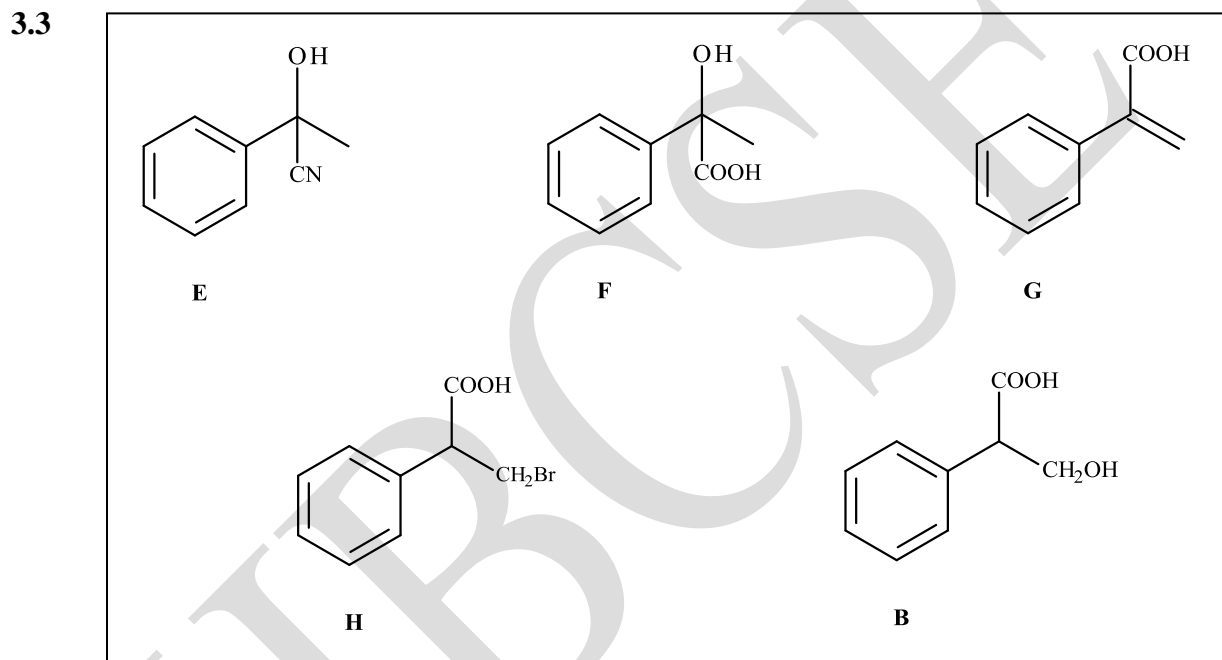
Problem 3

25 marks

ALKALOIDS

- 3.1 a) B has a hydroxyl group X
- c) B has a carboxyl group X
- d) B is an aromatic compound X

- 3.2 a) X b) X



- 3.4 a) X b) X d) X

- 3.5 b) X d) X

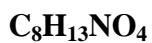
- 3.6 a) a) 3 b) 2 or a) 4 b) 3

b)

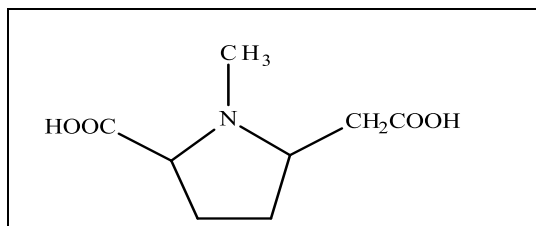
a	b	c	d	e
X	X	X	X	X

3.7

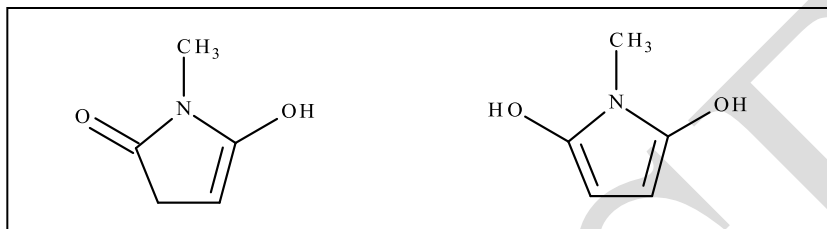
3.8



3.9



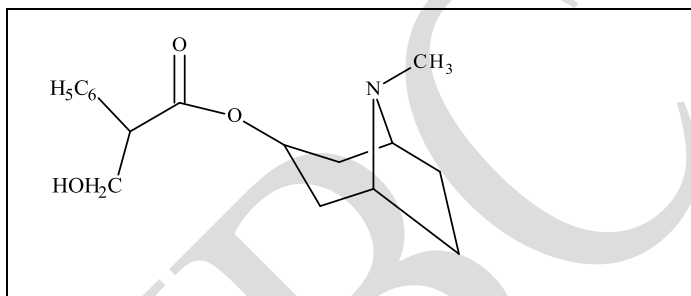
3.10



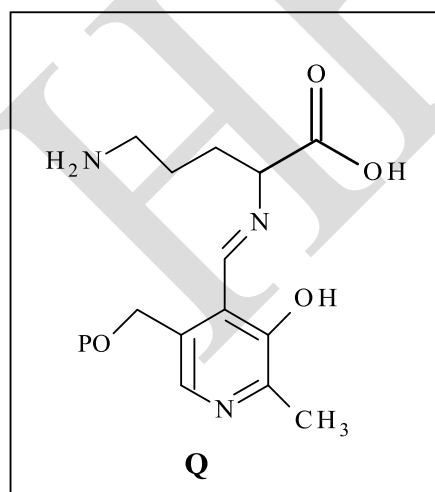
3.11

b) X

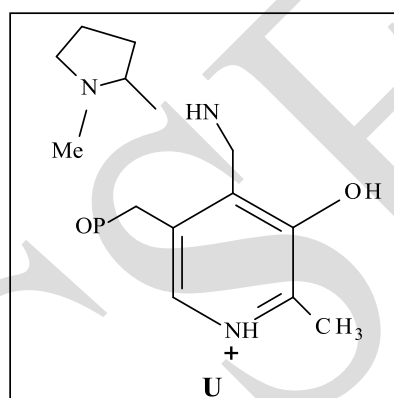
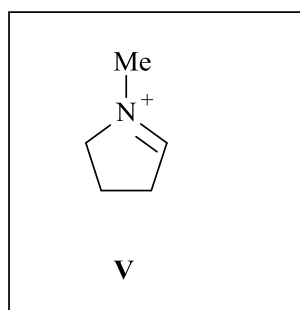
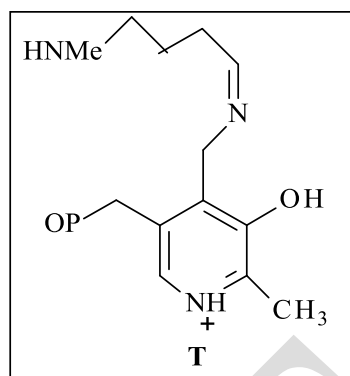
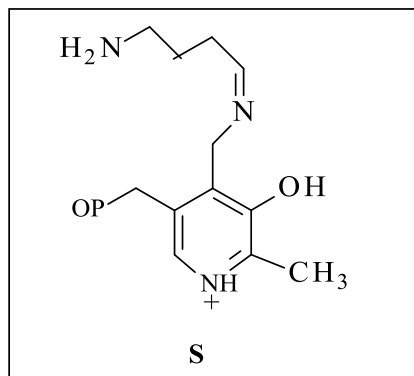
3.12



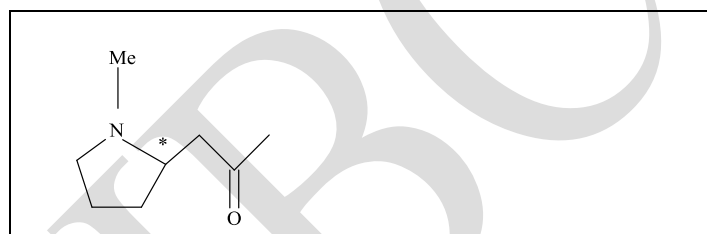
3.13



3.14



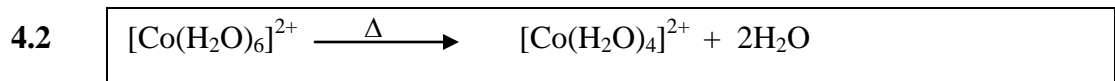
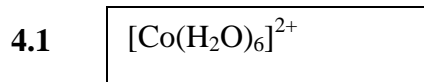
3.15



Problem 4

15 marks

Applications of Transition Metal Complexes



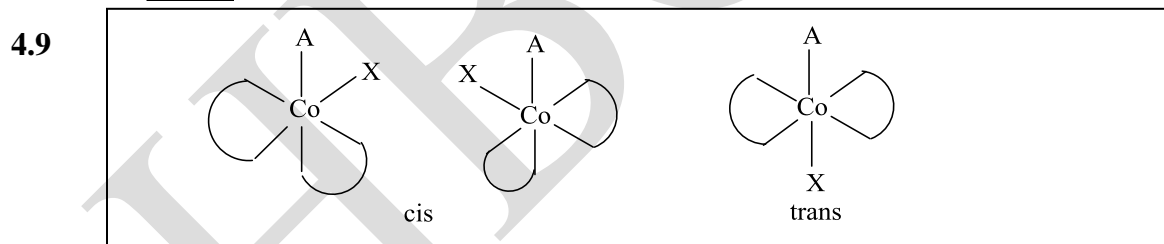
4.4 Yes

4.5 The CFSE of Co (III) in octahedral sites = $592.90 \text{ kJ mol}^{-1}$
 The CFSE of Co (III) in tetrahedral sites = 65.8 kJ mol^{-1}
 The CFSE of Co (II) in octahedral sites = $87.58 \text{ kJ mol}^{-1}$
 The CFSE of Co (II) in tetrahedral sites = $58.40 \text{ kJ mol}^{-1}$

4.6 The difference of CFSE for Co(III) in octahedral and tetrahedral site is = $527.10 \text{ kJ mol}^{-1}$
 The difference of CFSE for Co(II) in octahedral and tetrahedral site is = $29.18 \text{ kJ mol}^{-1}$

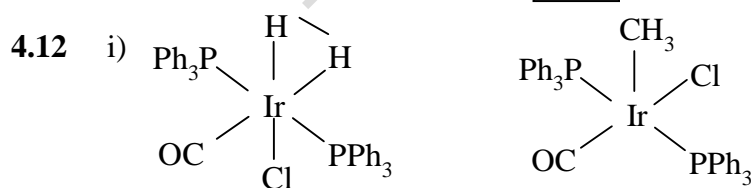
4.7 A normal spinel

4.8 3



4.10 only trans product

4.11 Mixture of cis and trans product



ii) a)

b)

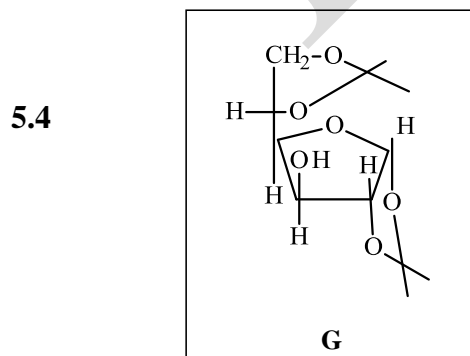
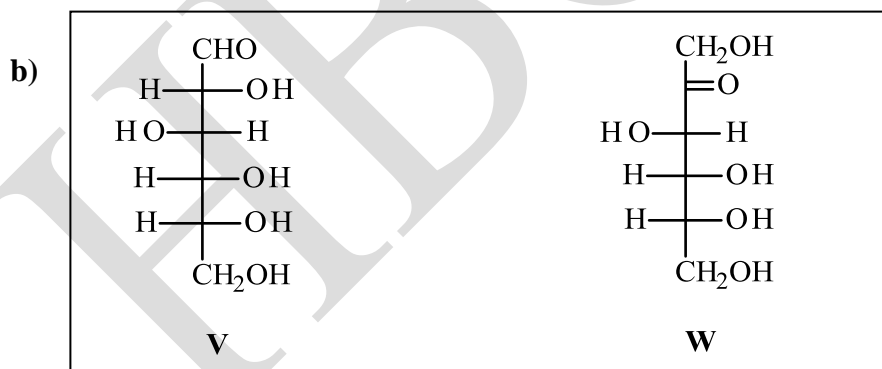
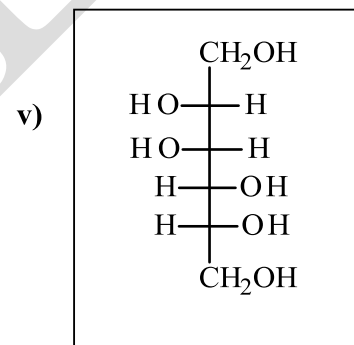
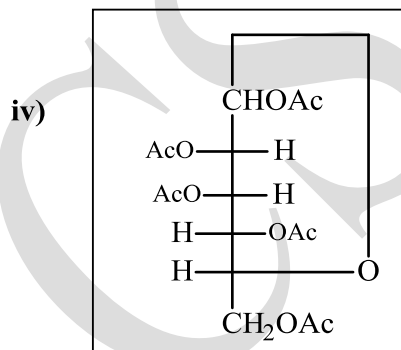
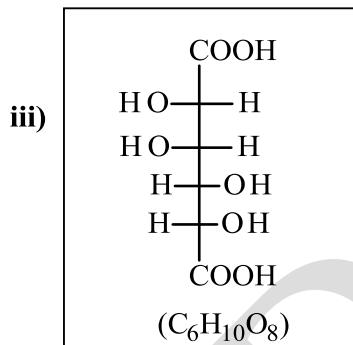
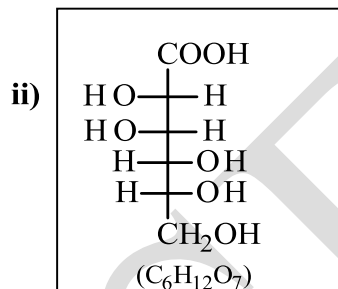
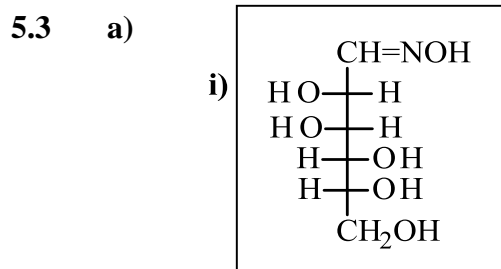
Problem 5

18 marks

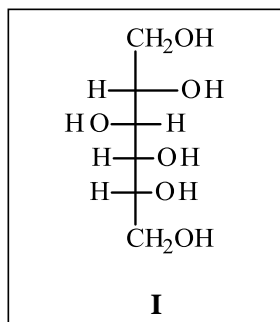
Chemistry of Carbohydrates

5.1 A B C

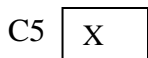
5.2 a) Diastereomer b) Enantiomer c) Identical



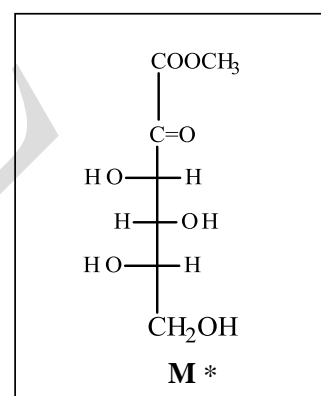
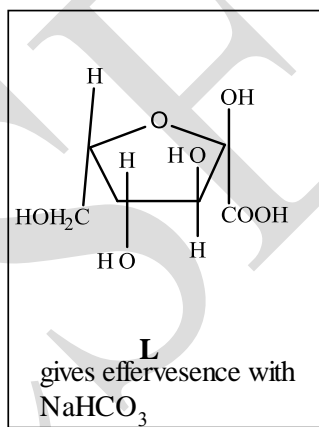
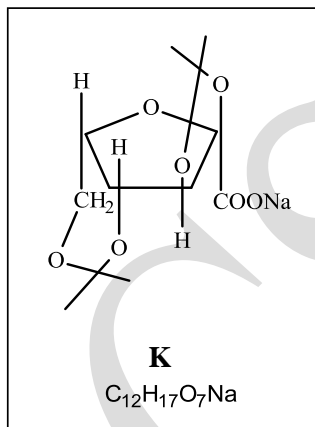
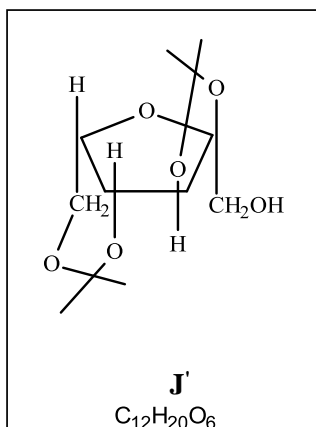
5.5



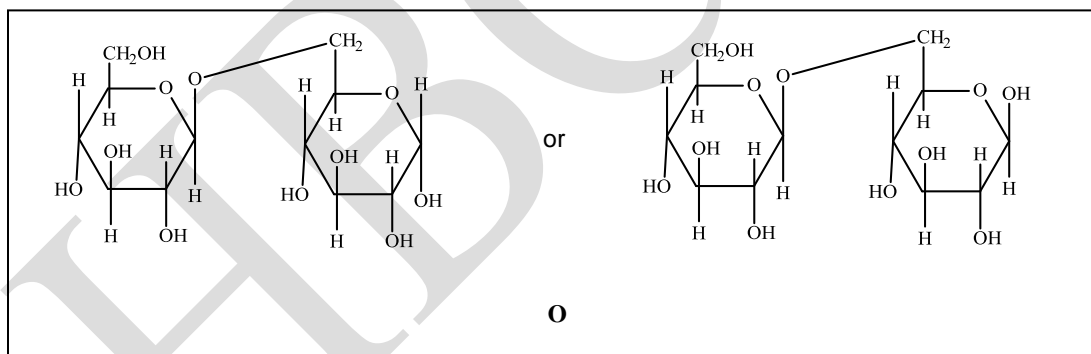
5.6



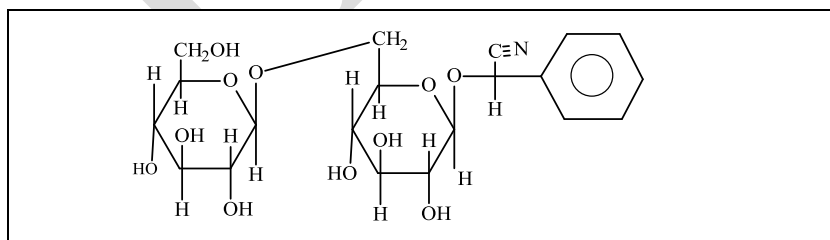
5.7



5.8



5.9



Problem 6

8 marks

Chemical equilibria in quantitative analysis

6.1

(i) pH = 5.15

(ii) At pH = 12.0,

 $[H^+] = 10^{-12}$ M, $[HS^-] = 0.05$; $[H_2S] = 5 \times 10^{-5}$, $[S^{2-}] = 6.5 \times 10^{-4}$, $[OH^-] = 10^{-2}$

(iii) Mass of NaOH added = 2.452g

6.2

pH range = 2.7 to 3.85

6.3

% of AsO_4^{3-} in 10g of the pesticide sample = 0.405%