

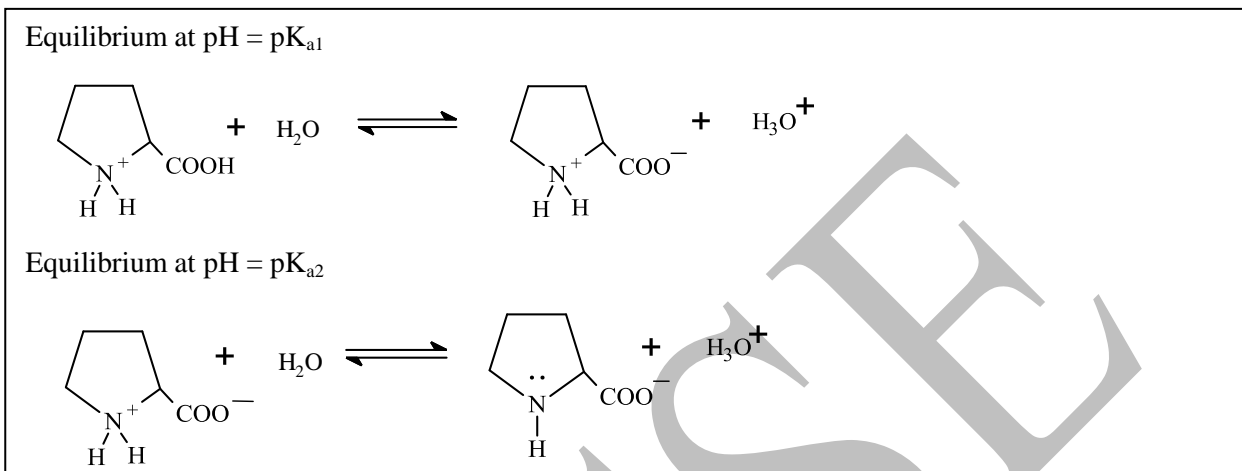
Tentative Solutions

Problem 1

23 marks

Common and Uncommon Amino Acids

1.1



(1 mark)

$$\text{pI} = \frac{\text{pK}_{a1} + \text{pK}_{a2}}{2}$$

1.2

(2.5 marks)

1.3. a.

True

X
X

b.

True

(1 mark)

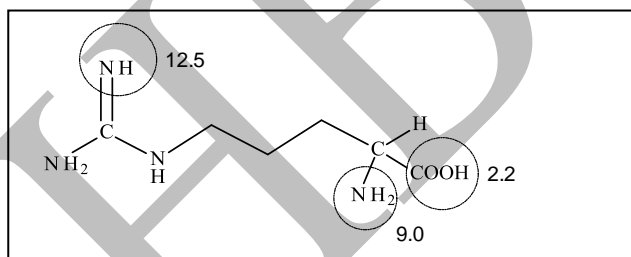
1.4. a.

iv. 2.2, 9.0, 12.5

X

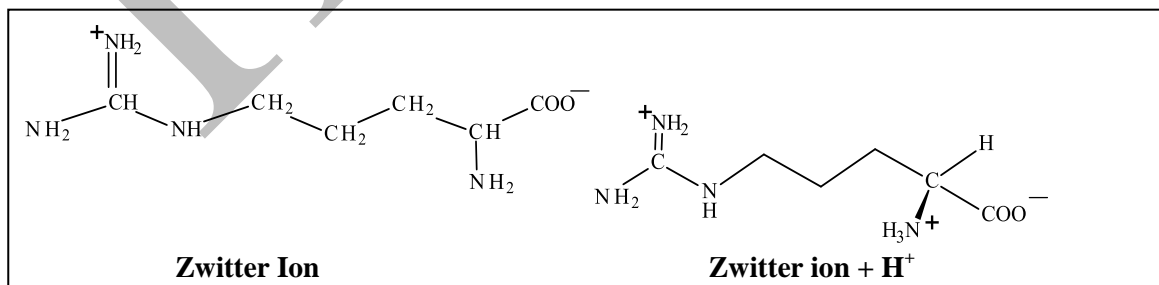
(1 mark)

b.



(1 mark)

c.



(1.5 marks)

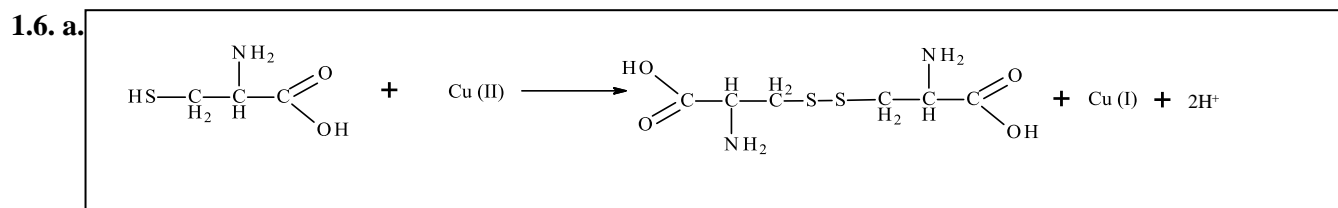
d.

$$\text{pI} = 10.75$$

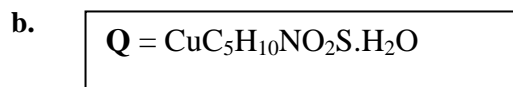
(1 mark)

1.5. ii) C, A, B X

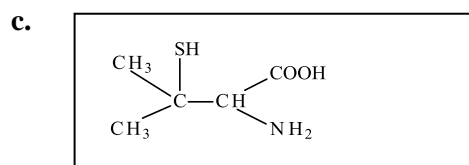
(1.5 marks)



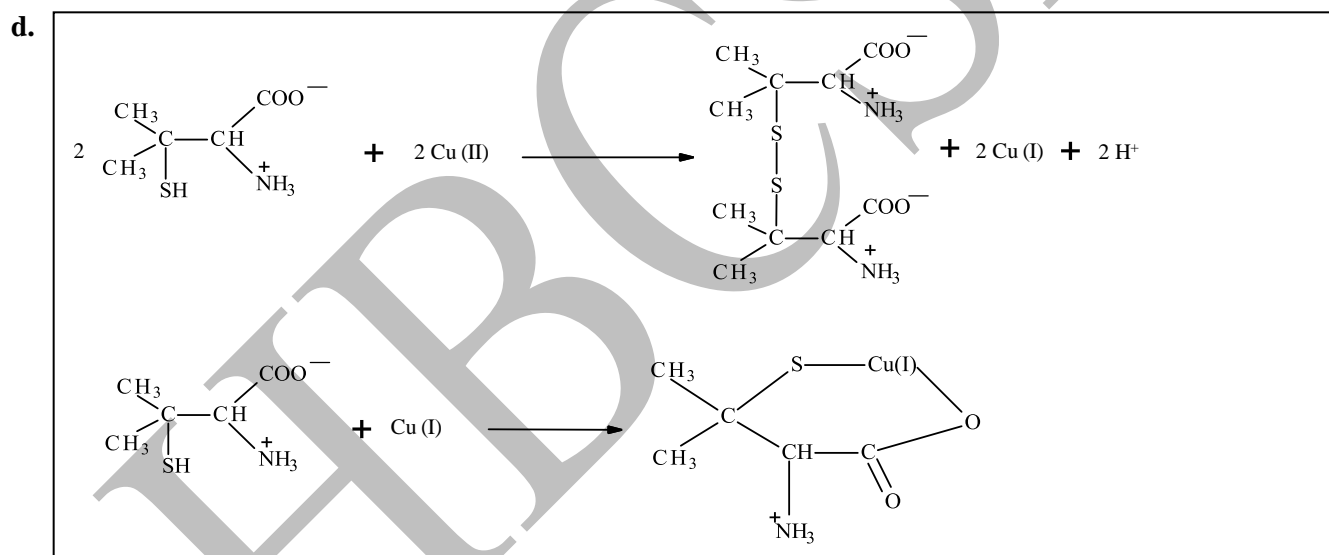
(0.5 mark)



(3 marks)

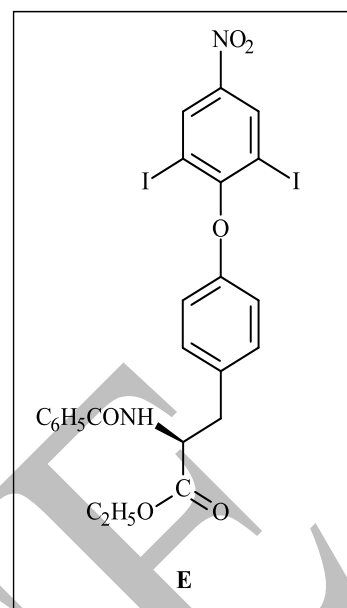
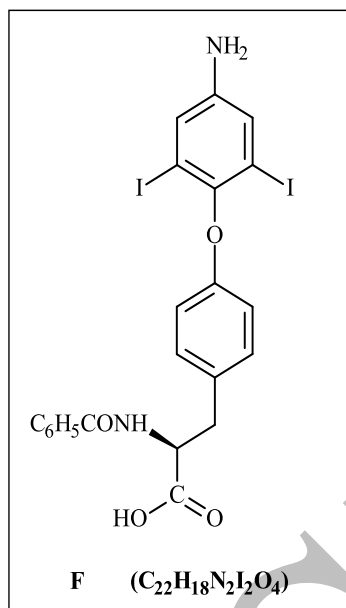
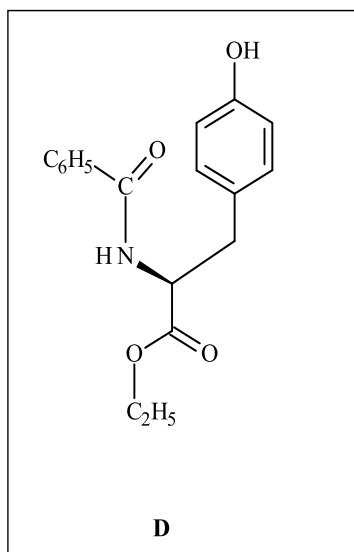


(1 mark)



(2 marks)

1.7.i)



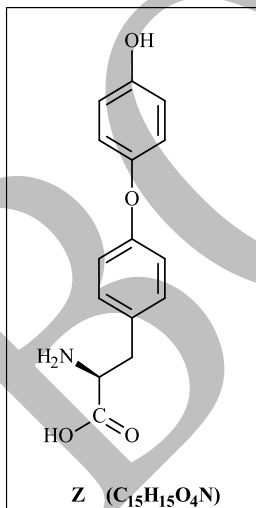
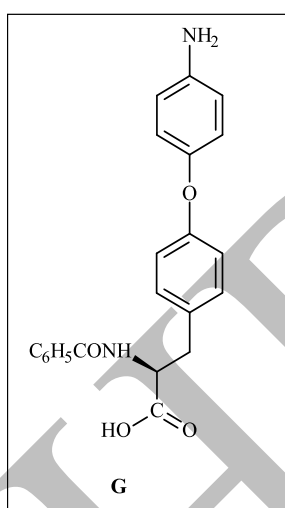
(3 marks)

ii)a) Reducing agent



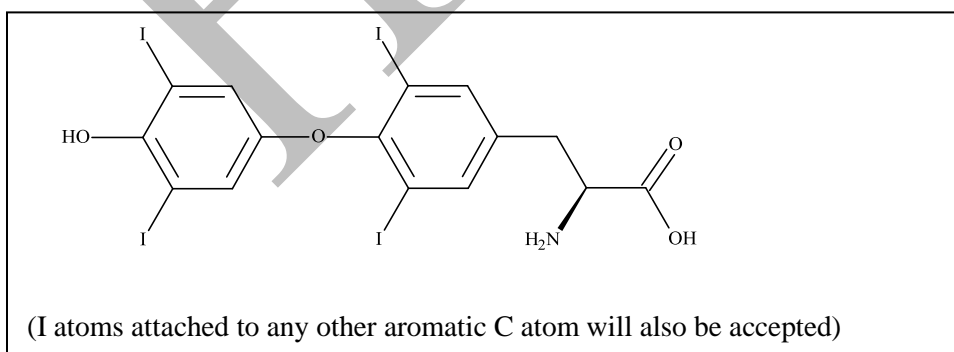
(0.5 mark)

iii) **



(1.5 marks)

iv)



(1mark)

**During the exam, the following additional instruction was communicated to the students.

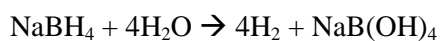
Q. 1.7(iii) Draw the structures of compounds **G** and **Z** with stereochemistry.

Problem 2

17 marks

Boron Compounds through the Ages

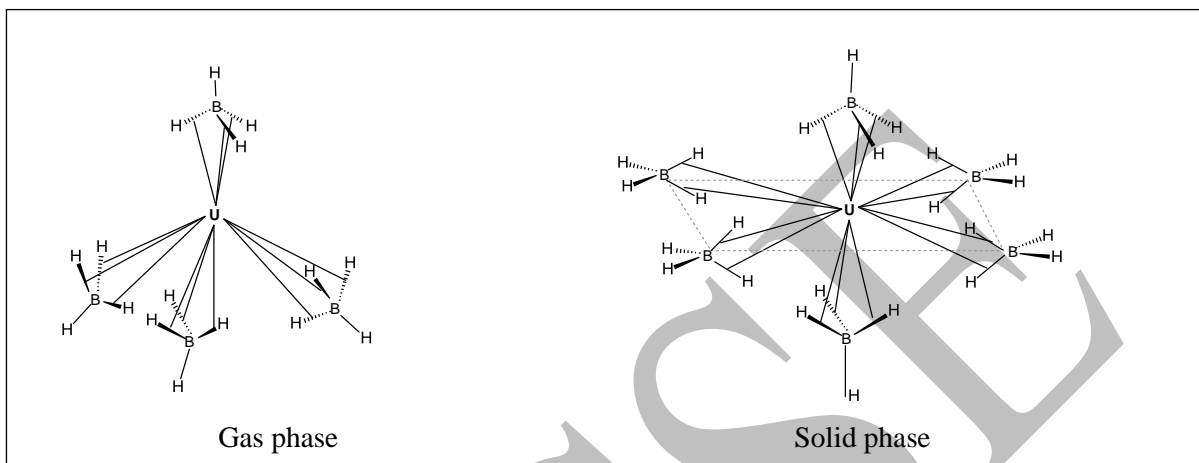
2.1



Volume $V = 257.6 \text{ L}$

(2.5 marks)

2.2



(3.5 marks)

2.3

$^{10}\text{B} = 20\%$

(1.5 marks)

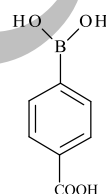
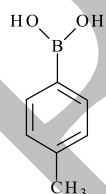
2.4

Saturated solution of H_3BO_3

(2.5 marks)

2.5

Mg/Dry ether



P

Q

R

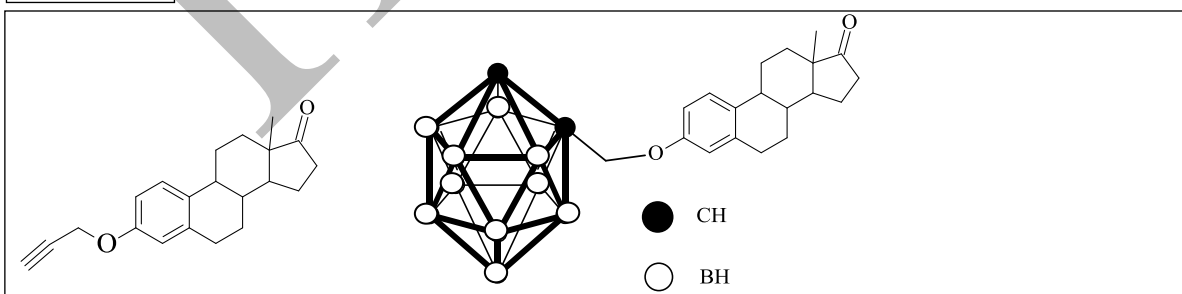
(2 marks)

2.6

6

(1 mark)

2.7



(2 marks)

2.8

i.

+3

ii.

Tetrahedral

iii.

X = F

iv.

b

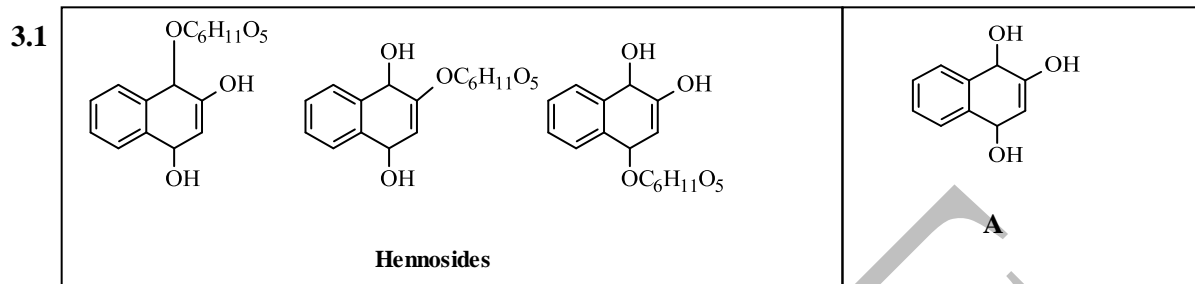
(2 marks)

Problem 3

19 Marks

Chemistry behind Henna – Lawsone

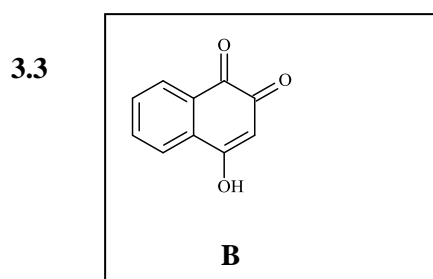
Part I: Properties of Lawsone



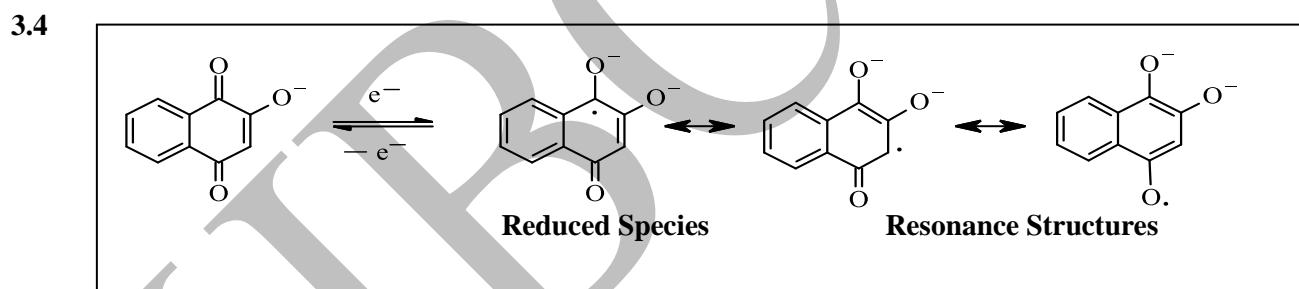
(2.5 marks)

3.2 a) Lemon juice

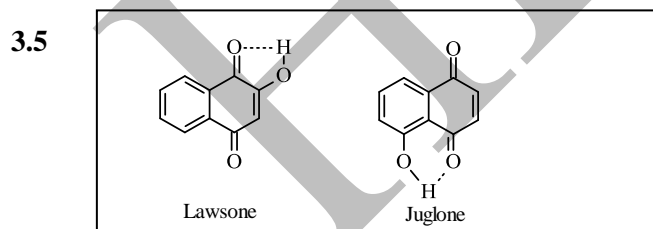
(1 mark)



(0.5 mark)



(2 marks)



(1 mark)

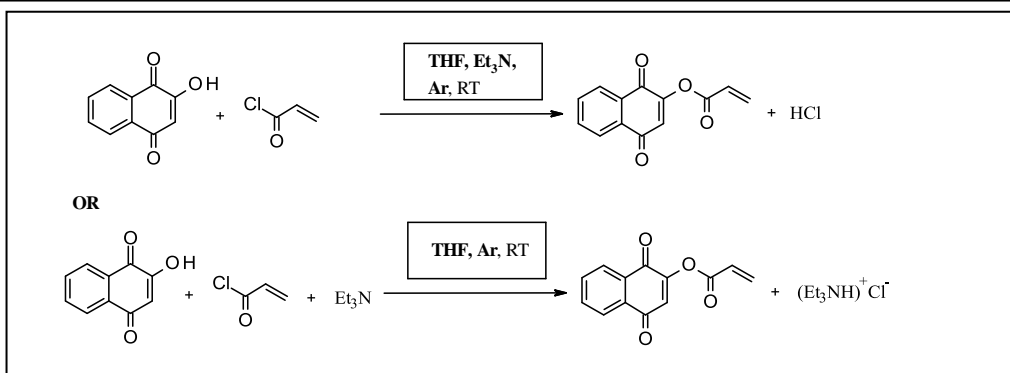
3.6 Lawsone Juglone

(1 mark)

3.7 Lawsone

(1 mark)

3.8



(2.5 marks)

3.9

a) Base

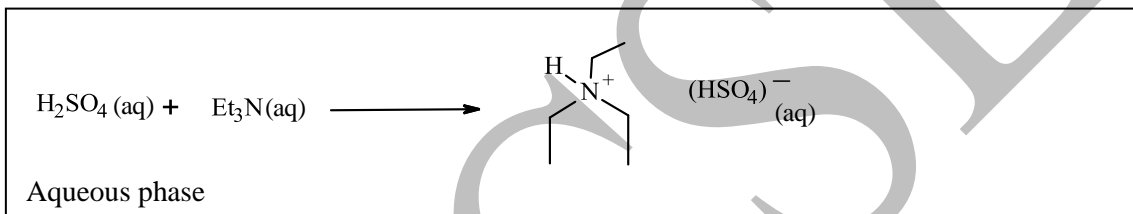
(0.5 mark)

3.10

2-propenoyl chloride

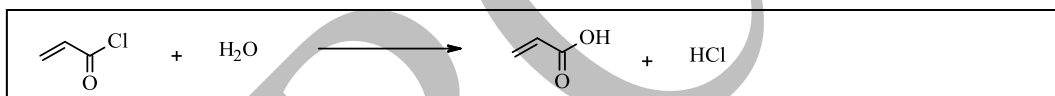
(2 marks)

3.11



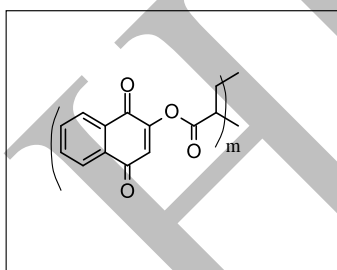
(1.5 marks)

3.12



(1 mark)

3.13



(1 mark)

3.14

	True	False
(i)	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(ii)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(iii)	<input checked="" type="checkbox"/>	<input type="checkbox"/>

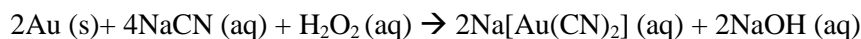
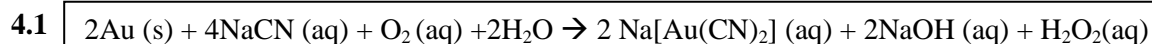
(1.5 marks)

Problem 4

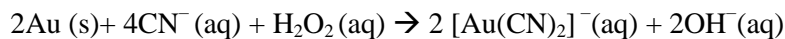
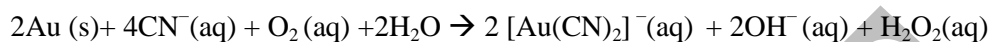
20 Marks

Gold Refining

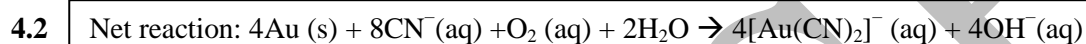
Part I: Cyanidation Method



Or [ionic equation]



(1.5 marks)



NaCN concentration = 0.105 g L^{-1} .

(2 marks)

4.3 Linear, $\mu_{\text{spin}} = 0$

(1 mark)

4.4
$$E_{\text{Au(CN)}_2^- / \text{Au}} = -0.57 - 0.059 \log \frac{[\text{CN}^-]^2}{[\text{Au(CN)}_2]^-}$$

(2.5 marks)

4.5 (i) Au, Ag, Pd, Pt

(ii) Au > Ag > Pd > Pt

(3 marks)

4.6 pH \approx 9.1

(1 mark)

4.7 $[\text{Cu(CN)}_4]^{3-}$, $[\text{Cu(CN)}_3]^{2-}$

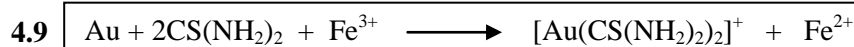
(1 mark)

4.8 a) X

d) X

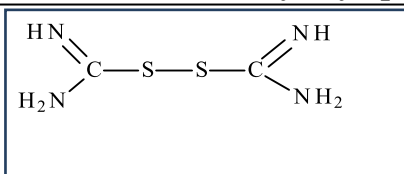
(2 marks)

Part II: Thiourea Method



(1 mark)

4.10



(1 mark)

4.11

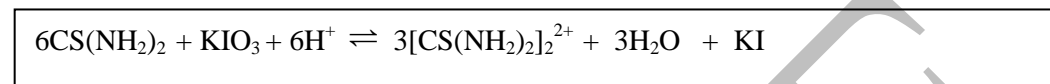
(2.5 marks)

4.12

(A) (C)

(1 mark)

4.13



(1 mark)

4.14

(3 marks)

Problem 5

24 marks

Phosphate and Struvite

Part I: Struvite from Phosphate

5.1

13.26 mg L⁻¹

(1.5 marks)

5.2

Molar ratio = 3.3: 1

(2 marks)

5.3

A = MgH₂O₄, Molar mass = 120.4 g mol⁻¹B = Mg₂P₂O₇, Molar mass = 222.6 g mol⁻¹

(3 marks)

Part II: Precipitation Conditions for Struvite

5.4

At pH 7,
 $([\text{PO}_4^{3-}]/[\text{H}_2\text{PO}_4^-]) = 3 \times 10^{-6}:1$
 At pH 11,
 $[\text{PO}_4^{3-}]/[\text{HPO}_4^{2-}] = 0.048:1$

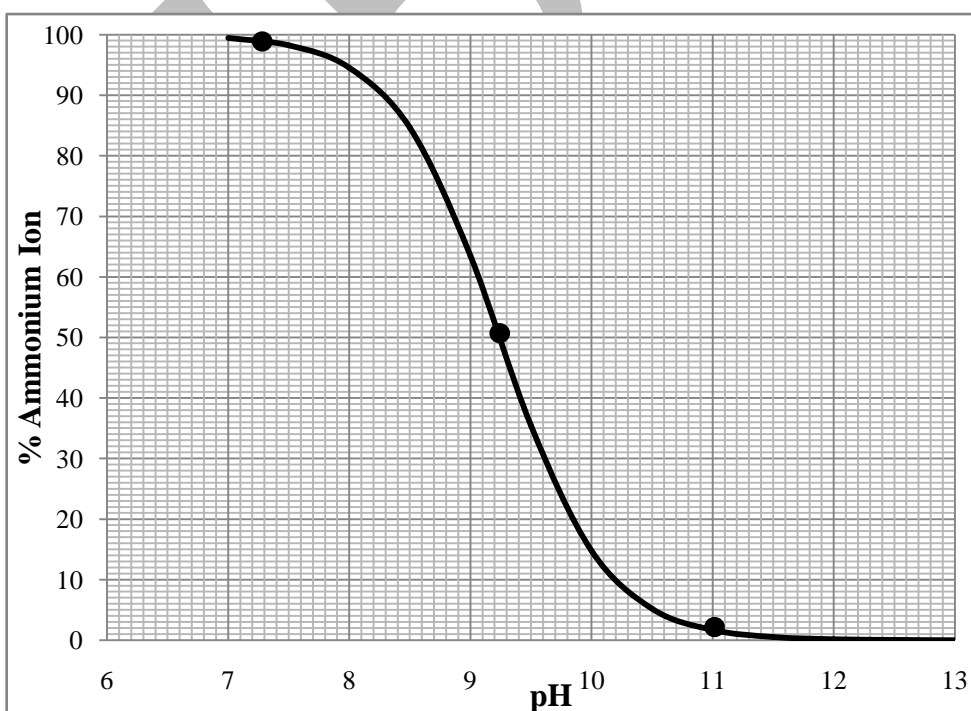
(2 marks)

5.5

a) % NH₄⁺ = 50%b) % NH₄⁺ = 1.67%

c) pH ≈ 7.24

(2.5 marks)



(1.5 marks)

5.6

$$\% \text{Mg}^{2+} = 71.56\%$$

(2 marks)

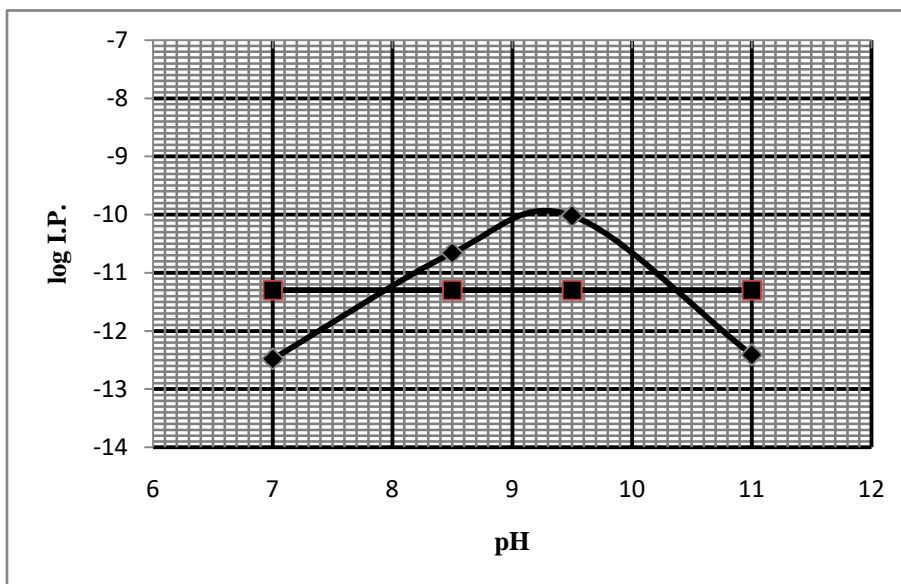
5.7

(i) At pH 7, I.P. = 3.24×10^{-13}

At pH 11, I.P. = 3.85×10^{-13}

(4 marks)

(ii)



pH Range: 7.9- 10.4

(2.5 marks)

5.9

c

X

(1 mark)

5.10

Condition

Effect

a) Addition of mineral acid

iii

b) Addition of water

iii

c) Passing carbon dioxide

iii

d) Partial Removal of struvite precipitate

i

(2 marks)