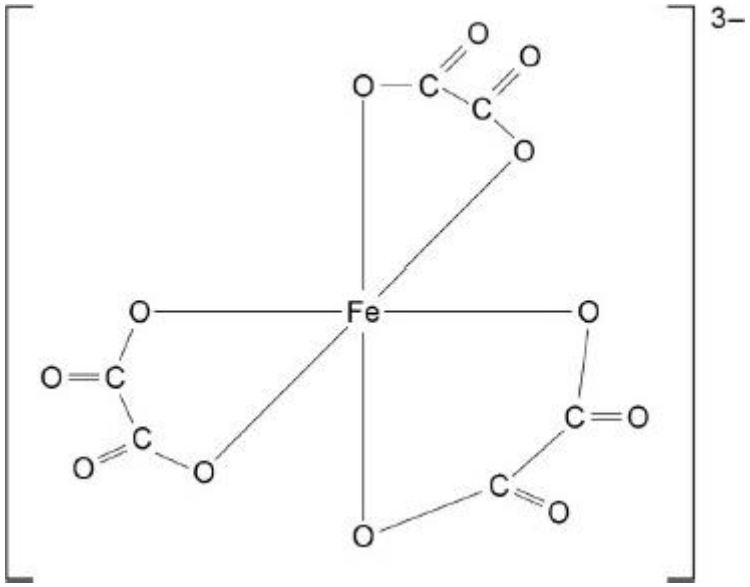
Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

Mark Schemes

Q1.

(a)



M1: 1 Mark for structure
Allow skeletal
M2: 1 mark for charge of 3⁻
Ignore charges inside bracket

2

(b) **M1** When bidentate/multidentate ligands replace monodentate ligands (to form a more stable complex)

M2 Because there is an increase in entropy/positive entropy change/disorder or more particles formed (so ΔG is negative and ΔH is approximately 0)

M2 Allow S increases or ΔS is positive.
Do not accept ΔS increases or S is positive

2

(c) This question is marked using levels of response. Refer to the *Mark Scheme Instructions for Examiners for guidance* on how to mark this question.

Level 3
5-6 marks
All stages are covered and the description of each stage is generally correct and virtually complete.

Answer is communicated coherently and shows a logical progression from stage 1 to stage 2 and stage 3.

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Level 2
3-4 marks
All stages are covered but the description of each stage may be incomplete or may contain inaccuracies OR two stages are covered and the explanations are generally correct and virtually complete.

Answer is mainly coherent and shows progression from stage 1 to stage 2 and/or stage 3.

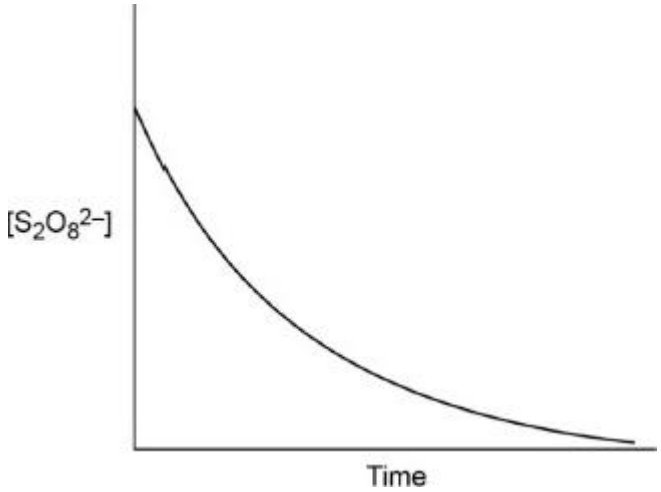
Level 1
1-2 marks
Two stages are covered but the description of each stage may be incomplete or may contain inaccuracies, OR only one stage is covered but the explanation is generally correct and virtually complete.

Answer includes isolated statements and these are presented in a logical order.

Level 0
0 marks
Insufficient correct chemistry to gain a mark.

Indicative Chemistry Content

stage 1



1a labelled axes
and *concentration (of $S_2O_8^{2-}$ ions) decreasing with time (ignore units)*
1b downwards curve of reducing steepness

stage 2 explanation
2a (reaction slow) because $S_2O_8^{2-}$ and I^- repel/high Ea
OR
(reaction slow) because two negative ions repel/high Ea
2b Fe^{2+} attracts the $S_2O_8^{2-}$ so lower E_a
OR
Fe^{2+} and $S_2O_8^{2-}$ oppositely charged so lower Ea
2c Iron/Fe has a variable oxidation state
OR
Fe^{2+} oxidised to Fe^{3+}
OR
$Fe^{2+} \rightarrow Fe^{3+} + e^-$

stage 3 equations
3a $2\ Fe^{2+} + S_2O_8^{2-} \rightarrow 2\ SO_4^{2-} + 2\ Fe^{3+}$
3b $2\ Fe^{3+} + 2\ I^- \rightarrow 2\ Fe^{2+} + I_2$
3c $S_2O_8^{2-} + 2\ I^- \rightarrow 2\ SO_4^{2-} + I_2$
Allow equations with hexaaqua ions

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(d) $[Fe(H_2O)_4(OH)_2]$

1

(e) Green precipitate

$[Fe(H_2O)_6]^{2+} + Na_2CO_3 \rightarrow FeCO_3 + 6\ H_2O + 2Na^+$

OR

$[Fe(H_2O)_6]^{2+} + CO_3^{2-} \rightarrow FeCO_3 + 6\ H_2O$

Ignore state symbols

2

(f) $2[Fe(H_2O)_6]^{3+} + 3\ Na_2CO_3 \rightarrow 2\ [Fe(H_2O)_3(OH)_3] + 3\ CO_2 + 3\ H_2O + 6Na^+$

OR

$2\ [Fe(H2O)6]^{3+} + 3\ CO3^{2-} \rightarrow 2\ [Fe(H2O)3(OH)3] + 3\ CO2 + 3\ H2O$

Ignore state symbols

1

[14]

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Q2.

(a) **M1** $E_{\ominus}$ V^{3+} ($/V^{2+}$) > $E_{\ominus}$ Zn^{2+} (/ Zn)

OR EMF of reaction between V^{3+} and Zn = (+)0.50 V

M2 $E_{\ominus}$ V^{2+}(/V) < $E_{\ominus}$ Zn^{2+} (/ Zn)

OR EMF of reaction between V^{2+} and Zn = - 0.44 V

2

(b) Mg

Only

1

(c) EMF = (+) 0.78 (V)

Fe(s) l Fe^{2+}(aq) ll VO^{2+}(aq), H^{+}(aq), V^{3+}(aq) l Pt(s)

Allow Fe(s) l Fe^{2+}(aq) ll VO^{2+}(aq), V^{3+}(aq) l Pt(s)
Ignore state symbols

$Fe(s) \rightarrow Fe^{2+}(aq) + 2e^{-}$

Ignore state symbols

3

(d) **M1** n MnO_4^- = $29.43 \times 10^{-3} \times 0.0200 = 5.89 \times 10^{-4}$ mol

M2 n V^{2+} = $5.89 \times 10^{-4} \times \frac{5}{3} = 9.81 \times 10^{-4}$ mol

M2 = M1 $\times \frac{5}{3}$

M3 mass NH_4VO_3 = $9.81 \times 10^{-4} \times 116.9 = 0.1147$ g

M3 = M2 × 116.9

M4 % purity = $\frac{0.1147 \times 100}{0.151} = 76.0$ %

M4 = M3 $\times \frac{100}{0.151}$

Allow 75.9 or 76.2 %
Answer to 3 significant figures

4

[10]

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