

Name of the Student: _____

Max. Marks : 24 Marks

Time : 24 Minutes

Mark Schemes

Q1.

(a) $(\Delta S = \Sigma(S \text{ products}) - \Sigma(S \text{ reactants}))$

$$= [(4 \times 211) + (6 \times 189)] - [(4 \times 193) + (5 \times 205)] = (1978 - 1797)$$

1

$$181 \text{ (J K}^{-1} \text{ mol}^{-1}\text{)}$$

1

(b) $(\Delta G = \Delta H - T\Delta S) = -905 - (600 + 273) \times 181 \times 10^{-3}$

If answer to (a) is incorrect, mark consequentially:

$$-905 - (873 \times (a) \times 10^{-3})$$

1

$$\Delta G = -1063 / -1060 \text{ (kJ mol}^{-1}\text{)}$$

If alternative value of $\Delta S = 211$ used, answer = -1089 (kJ mol⁻¹)

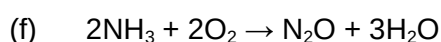
1

(c) ΔG becomes more negative/less positive*Ignore increase/decrease/larger/smaller ΔG*

1

The entropy change / ΔS is positive / $T\Delta S$ gets bigger / $-T\Delta S$ gets more negative.*Consequential on wrong (a)**If candidate does a calculation in (a) to produce ΔS negative then allow ΔG becomes less negative or more positive*

1

(d) Reactant(s) adsorbed onto the (platinum surface) / (platinum) provides a surface / active sites
1Reaction (on the surface) or bond breaking(weakening) / bond making occurs (on the surface)
1Desorption (of the product) or wtte
1(e) (Oxidation state changes from) -3 to +2 OR (+) 5
1*Allow multiples**Ignore state symbols*

1

[11]

Q2.

- (a) $\text{S}_2\text{O}_3^{2-} + 2 \text{H}^+ \rightarrow \text{SO}_2 + \text{S} + \text{H}_2\text{O}$
Allow $\text{S}_2\text{O}_3^{2-} + 2\text{H}_3\text{O}^+ \rightarrow \text{SO}_2 + \text{S} + 3\text{H}_2\text{O}$
Allow $\frac{1}{2}\text{S}_2\text{O}_3^{2-} + \text{H}^+ \rightarrow \frac{1}{2}\text{SO}_2 + \frac{1}{2}\text{S} + \frac{1}{2}\text{H}_2\text{O}$
Allow $\frac{1}{2}\text{S}_2\text{O}_3^{2-} + \text{H}_3\text{O}^+ \rightarrow \frac{1}{2}\text{SO}_2 + \frac{1}{2}\text{S} + 1\frac{1}{2}\text{H}_2\text{O}$
Ignore state symbols
NOT multiples
NOT if any spectator ions included (unless crossed out)

1

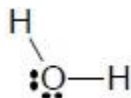
- (b) **M1** acid(ic) / acidity / produces H^+
M1 *Allow low(ers) pH*
Ignore toxic / soluble
Ignore sulfurous / sulfuric / H_2SO_4
Ignore rain
Ignore proton donor (unless qualified, e.g. reacts with water to form a proton donor)
NOT any other named acid

1

- M2** $\text{SO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_3$ / $\text{H}^+ + \text{HSO}_3^-$
M2 *Allow $\text{SO}_2 + \text{H}_2\text{O} \rightarrow 2 \text{H}^+ + \text{SO}_3^{2-}$*
Allow $\text{SO}_2 + 2 \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{HSO}_3^-$
Allow $\text{SO}_2 + 3 \text{H}_2\text{O} \rightarrow 2 \text{H}_3\text{O}^+ + \text{SO}_3^{2-}$
Allow multiples
Ignore state symbols

1

- (c) **M1**



- M1** bent shape and 2 lone pairs on O
Allow any suitable representation of lone pairs (e.g. dots, crosses, lobes with/without dots/crosses)

1

- M2** $104\frac{1}{2}^\circ$
M2 *Allow $104-105^\circ$*

1

- M3** lone pairs repel more (strongly) than bond(ing) pairs
M3 *Allow non-bonding pair for lone pair*
Allow covalent bond for bond(ing) pair
Allow shared pair for bond(ing) pair
Allow OH bond for bond(ing) pair
Allow bond for bond(ing) pair
NOT OH or O-H without the word bond for bond(ing) pair

1

- M4** so bond angle reduced from/less than $109\frac{1}{2}^\circ$ / tetrahedral
M4 *Allow bond angle reduced from 120° if bent with one lone pair in M1*

(d)

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 explanation of each stage is correct and virtually complete. (6 v 5) Answer is well structured, with no repetition or irrelevant points. Accurate and clear expression of ideas with no errors in use of technical terms.
Level 2 3-4 marks	All stages are covered but the explanation of each stage may be incomplete or may contain inaccuracies OR two stages covered and the explanations are generally correct and virtually complete (4 v 3) Answer has some structure. Ideas are expressed with reasonable clarity with, perhaps, some repetition or some irrelevant points. If any, only minor errors in use of technical terms.
Level 1 1-2 marks	Two stages are covered but the explanation 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 (2 v 1) Answer includes statements which are presented in a logical order and/or linked.
0 marks	Insufficient correct Chemistry to warrant a mark

Indicative Chemistry content**Stage 1 Method**

(1a) Idea of using disappearing cross or colorimetry

(1b) Puts acid or thiosulfate into container on/with cross or in colorimeter

(1c) Add second reactant and start timing

Stage 2 Measurements

(2a) Repeat at different temperatures (if number of temperatures stated, must be more than two)

(2b) Record time, t, for cross to disappear / defined reading on colorimeter

(2c) Idea of ensuring other variables (cross, volumes, concentrations) kept constant (apart from T)

Stage 3 Use of Results(3a) $1/t$ (or $1000/\text{time}$, etc) is a measure of rate(3b) plot of rate (or $1/t$ etc) (y-axis) against T (x-axis) (can come from labelled axes on sketch) (IGNORE T against rate)

(3c) sketch of plot as shown (Allow 3c if axes not labelled but NOT if incorrectly labelled)

