Please write clearly in block capitals.

Centre number	☐☐☐☐☐	Candidate number	☐☐☐☐

Surname MODEL ANSWERS

Forename(s)

Candidate signature

A-level
CHEMISTRY

Paper 1 Inorganic and Physical Chemistry

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Tuesday 13 June 2017 Afternoon Time allowed: 2 hours

Materials

For this paper you must have:

- the Periodic Table/Data Booklet, provided as an insert (enclosed)
- a ruler with millimetre measurements
- a calculator, which you are expected to use where appropriate.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of the page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is ~~105~~. 103

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
TOTAL	

Answer **all** questions in the spaces provided

0 1 This question is about silver iodide.

0 1 . 1 Define the term enthalpy of lattice formation.

[2 marks]

- Enthalpy change / heat change when 1 mole of solid ionic compound M1
- is formed from its gaseous ions. M2

0 1 . 2 Some enthalpy change data are shown in **Table 1**.

Table 1

	Enthalpy change / kJ mol^{-1}
$AgI(s) \rightarrow Ag^+(aq) + I^-(aq)$	+112
$Ag^+(g) \rightarrow Ag^+(aq)$	–464
$I^-(g) \rightarrow I^-(aq)$	–293

Use the data in **Table 1** to calculate the enthalpy of lattice formation of silver iodide.

[2 marks]

$$\begin{tikzcd}
Ag^+(g) + I^-(g) \arrow[rr, "\Delta H^\ominus_L"] \arrow[dr, "\Delta H^\ominus_{hyd}"', "\begin{array}{c}-464\\-293\\=-757\end{array}"] & & AgI(s) \arrow[dl, "+112"', "\Delta H^\ominus_{SOL}"] \\
& Ag^+(aq) + I^-(aq) &
\end{tikzcd}$$

M1

$$\Delta H^\ominus_L = \Delta H^\ominus_{hyd} - \Delta H^\ominus_{SOL}$$

$$= -757 - 112$$

Enthalpy of lattice formation – 869 kJ mol^{-1} M2

0 1 . 3 A calculation of the enthalpy of lattice formation of silver iodide based on a perfect ionic model gives a smaller numerical value than the value calculated in Question **1.2**

Explain this difference.

[2 marks]

- AgI contains some covalent bonding M1
- Which are stronger bonds M2

0 1 . 4 Identify a reagent that could be used to indicate the presence of iodide ions in an aqueous solution and describe the observation made.

[2 marks]

Reagent $AgNO_3$

Observation yellow ppt

8

Turn over for the next question

0 2 This question is about acidic solutions.

0 2 . 1 The acid dissociation constant, K_a, for ethanoic acid is given by the expression

$$K_a = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]}$$

The value of K_a for ethanoic acid is 1.74×10^{-5} mol dm^{-3} at 25 °C

A buffer solution with a pH of 3.87 was prepared using ethanoic acid and sodium ethanoate. In the buffer solution, the concentration of ethanoate ions was 0.136 mol dm^{-3}

Calculate the concentration of the ethanoic acid in the buffer solution.
Give your answer to three significant figures.

[3 marks]

$[H^+] = 10^{-3.87} = 1.35 \times 10^{-4}$ M1

$$[CH_3COOH] = \frac{[CH_3COO^-][H^+]}{Ka}$$

$$= \frac{0.136 \times 1.35 \times 10^{-4}}{1.74 \times 10^{-5}}$$ M2

Concentration of acid 1.05 mol dm^{-3} M3

0 2 . 2 In a different buffer solution, the concentration of ethanoic acid was 0.260 mol dm^{-3} and the concentration of ethanoate ions was 0.121 mol dm^{-3}

A 7.00 × 10^{-3} mol sample of sodium hydroxide was added to 500 cm^3 of this buffer solution.

Calculate the pH of the buffer solution after the sodium hydroxide was added. Give your answer to two decimal places.

[6 marks]

n CH_3COOH start $0.26 \times 500 \times 10^{-3} = 0.13$

n CH_3COO^- start $0.121 \times 500 \times 10^{-3} = 0.0605$ M1

n NaOH added $= 0.007$

n CH_3COOH final $0.13 - 0.007 = 0.123$ M2

n CH_3COO^- final $0.0605 + 0.007 = 0.0675$ M3

$$ka = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]}$$

$$[H^+] = \frac{ka\,[CH_3COOH]}{[CH_3COO^-]}$$

$$= \frac{1.74 \times 10^{-5} \times 0.123}{0.0675}$$

$$= 3.171 \times 10^{-5}$$ M4

M5

$$pH = -\log 3.171 \times 10^{-5}$$

pH of buffer solution 4.50 M6

9

Turn over ▶

0 3 The ionic product of water, $K_w = 2.93 \times 10^{-15}$ mol^2 dm^{-6} at 10 °C

0 3 . 1 Which is the correct expression for K_w?
Tick (✓) **one** box.

[1 mark]

A $K_w = \frac{[H_2O]}{[H^+][OH^-]}$ ☐

B $K_w = [H^+][H_2O]$ ☐

C $K_w = [H^+][OH^-]$ ☑

D $K_w = \frac{[H^+][OH^-]}{[H_2O]}$ ☐

0 3 . 2 Calculate the pH of pure water at 10 °C
Give your answer to two decimal places.

[2 marks]

$kw = [H^+]^2$

$[H^+] = \sqrt{Kw}$

$= \sqrt{2.93 \times 10^{-15}} = 5.41 \times 10^{-8}$

$pH = -\log 5.41 \times 10^{-8}$ M1

pH of water 7.27 M2

0 3 . 3 Suggest why this pure water at 10 °C is **not** alkaline.

[1 mark]

$[H^+] = [OH^-]$

0 3 . 4 Calculate the pH of a 0.0131 mol dm^{-3} solution of calcium hydroxide at 10 °C
Give your answer to two decimal places.

$Ca(OH)_2 \rightarrow 2OH^-$

[3 marks]

$k_w = [H^+][OH^-]$

$[H^+] = \frac{k_w}{[OH^-]}$

$= \frac{2.93 \times 10^{-15}}{(2 \times 0.0131)}$ M1

$= 1.118 \times 10^{-13}$ M2

$pH = -\log 1.118 \times 10^{-13}$

pH of solution 12.95 M3

0 3 . 5 The 0.0131 mol dm^{-3} calcium hydroxide solution at 10 °C was a saturated solution.

A student added 0.0131 mol of magnesium hydroxide to 1.00 dm^3 of water at 10 °C and stirred the mixture until no more solid dissolved.

Predict whether the pH of the magnesium hydroxide solution formed at 10 °C is larger than, smaller than or the same as the pH of the calcium hydroxide solution at 10 °C

Explain your answer.

[2 marks]

pH of magnesium hydroxide compared to calcium hydroxide

lower (less alkaline)

Explanation

$Mg(OH)_2$ is less soluble

9

Turn over ▶

0 4 A sample of titanium was ionised by electron impact in a time of flight (TOF) mass spectrometer. Information from the mass spectrum about the isotopes of titanium in the sample is shown in **Table 2**.

Table 2

m/z	46	47	48	49
Abundance / %	9.1	7.8	74.6	8.5

0 4 . 1 Calculate the relative atomic mass of titanium in this sample.
Give your answer to one decimal place.

[2 marks]

$$\frac{(46\times 9.1)+(47\times 7.8)+(48\times 74.9)+(49\times 8.5)}{100}$$ M1

Relative atomic mass of titanium in this sample 47.8 M2

0 4 . 2 Write an equation, including state symbols, to show how an atom of titanium is ionised by electron impact and give the m/z value of the ion that would reach the detector first.

[2 marks]

Equation $Ti\,(g) \rightarrow Ti^{+}\,(g) + e^{-}$

m/z value 46

0 4 . 3 Calculate the mass, in kg, of one atom of ^{49}Ti

The Avogadro constant $L = 6.022 \times 10^{23}\ mol^{-1}$

[1 mark]

1 mole = 49g = 6.022×10^{23} atoms

1 atom = $\frac{49}{6.022\times10^{23}}$ = 8.137×10^{-23} g

$(\times 10^{-3})$

Mass 8.137×10^{-26} kg

0 4 . 4 In a TOF mass spectrometer the time of flight, *t*, of an ion is shown by the equation

$$t = d\sqrt{\frac{m}{2E}}$$

distance is fixed

In this equation *d* is the length of the flight tube, *m* is the mass, in kg, of an ion and *E* is the kinetic energy of the ions.

In this spectrometer, the kinetic energy of an ion in the flight tube is 1.013×10^{-13} J

The time of flight of a $^{49}Ti^+$ ion is 9.816×10^{-7} s

Calculate the time of flight of the $^{47}Ti^+$ ion.
Give your answer to the appropriate number of significant figures.

[3 marks]

$$d = \frac{t}{\sqrt{m/2E}} \Rightarrow d = t\sqrt{\frac{2E}{m}}$$

mass 1 atom (kg) $= \frac{Ar \times 10^{-3}}{L}$ M1

$$d = t_{47}\sqrt{\frac{\cancel{2E}}{47 \times 10^{\cancel{-3}}/\cancel{L}}} = t_{49}\sqrt{\frac{\cancel{2E}}{49 \times 10^{\cancel{-3}}/\cancel{L}}}$$

$$\frac{t_{47}}{\sqrt{47}} = \frac{t_{49}}{\sqrt{49}}$$

M2

$$t_{47} = \frac{9.816 \times 10^{-7}}{\sqrt{49}} \times \sqrt{47}$$

$$= 1.402 \times 10^{-7} \times 6.856$$

Time of flight 9.61×10^{-7} s M3

8

0 5 Titanium(IV) chloride can be made from titanium(IV) oxide as shown in the equation.

$TiO_2(s) + 2C(s) + 2Cl_2(g) \rightarrow 2CO(g) + TiCl_4(l)$ $\Delta H^\ominus = -60.0\ \text{kJ mol}^{-1}$

0 5 . 1 Some entropy data are shown in **Table 3**.

Table 3

Substance	$TiO_2(s)$	$C(s)$	$Cl_2(g)$	$CO(g)$	$TiCl_4(l)$
$S^\ominus$ / J K^{-1} mol^{-1}	50.2	5.70	223	198	253

Use the equation and the data in **Table 3** to calculate the Gibbs free-energy change for this reaction at 989 °C
Give your answer to the appropriate number of significant figures. 3 s.f.

Use your answer to explain whether this reaction is feasible.

[6 marks]

$\Delta G^\ominus = \Delta H^\ominus - T\Delta S^\ominus$ $T = 989 + 273 = 1262\text{K}$ M3

$\Delta S^\ominus = \Sigma S^\ominus(P) - \Sigma S^\ominus(R)$ M1

$= (2S(CO) + S(TiCl_4)) - (S(TiO_2) + 2S(C) + 2S(Cl_2))$

$= (396 + 253) - (50.2 + 11.4 + 446)$

$= 649 - 507.6$

$= 141.4\ \text{J K}^{-1}\text{mol}^{-1}$ M2

$\Delta G^\ominus = -60 - (1262 \times 141.4 \times 10^{-3})$ M4

$= -60 - 178.45$

Gibbs free-energy change −238 kJ mol^{-1} M5

Explanation Feasible – $\Delta G^\ominus$ is less than zero M6

6

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

0 6 This question is about some Period 3 elements and their oxides.

0 6 . 1 Write an equation for the reaction of phosphorus with an excess of oxygen.

[1 mark]

$P_4 + 5O_2 \rightarrow P_4O_{10}$

0 6 . 2 Describe a test you could carry out in a test tube to distinguish between sodium oxide and the product of the reaction in Question **6.1**

[3 marks]

- Add to water M1
- Test solution with litmus indicator M2
  or universal indicator or pH meter
- litmus : blue - sodium oxide red - phosphorous oxide M3
  UI : blue/purple - sodium oxide red - phosphorous oxide
  pH : > 7 - sodium oxide < 7 - phosphorous oxide

0 6 . 3 State the type of crystal structure shown in silicon dioxide and in sulfur trioxide.

[2 marks]

Silicon dioxide macromolecular

Sulfur trioxide simple molecule

0 6 . 4 Explain why silicon dioxide has a higher melting point than sulfur trioxide.

[4 marks]

- SiO_2 contains strong covalent bonds between all the atoms M1
- SO_3 has weak van der Waals forces between molecules / intermolecular forces M2
- Covalent bonds are stronger than van der Waals forces M3
- covalent bonds take more energy to overcome / break than van der Waals (or reverse statement) M4

0 6 . 5 Write an equation for the reaction of sulfur trioxide with potassium hydroxide solution.

[1 mark]

$2KOH + SO_3 \rightarrow K_2SO_4 + H_2O$

0 6 . 6 Write an equation for the reaction of an excess of magnesium oxide with phosphoric acid.

Mg^{2+} PO_4^{3-}

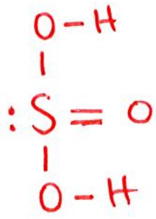
3 : 2

[1 mark]

$3MgO + 2H_3PO_4 \rightarrow Mg_3(PO_4)_2 + 3H_2O$

0 6 . 7 Draw the displayed formula of the undissociated acid formed when sulfur dioxide reacts with water. H_2SO_3

[1 mark]



13

Turn over for the next question

0 7 Solution **A** contains the compound $[Cu(H_2O)_6]Cl_2$

0 7 . 1 State the type of bonding between the oxygen and hydrogen in this compound.

[1 mark]

covalent

0 7 . 2 State why the chloride ions in this compound are **not** considered to be ligands.

[1 mark]

Cl^- not forming a co-ordinate bond with the Cu^{2+} ion

0 7 . 3 An excess of ammonia was added to a sample of solution **A** to form solution **B**.

Write an ionic equation for the reaction that occurs when solution **A** is converted into solution **B** and state the colour of solution **B**.

[2 marks]

Equation $[Cu(H_2O)_6]^{2+} + 4NH_3 \rightarrow [Cu(NH_3)_4(H_2O)_2]^{2+} + 4H_2O$

Colour deep blue / royal blue

0 7 . 4 Aqueous sodium carbonate was added to another sample of solution **A** to form a blue-green solid **C**.

Identify the blue-green solid **C**.

[1 mark]

$CuCO_3$

0 7 . 5 Reagent **D** was added to another sample of solution **A** to form a yellow-green solution.

Identify reagent **D** and write an ionic equation for the reaction that occurs when the yellow-green solution is formed from solution **A**.

[2 marks]

Identity of reagent **D** hydrochloric acid

Equation $[Cu(H_2O)_6]^{2+} + 4Cl^- \rightarrow [CuCl_4]^{2-} + 6H_2O$

0 7 . 6 Explain why colorimetry cannot be used to determine the concentration of solutions containing $[CuCl_2]^-$
In your answer refer to the electron configuration of the metal ion.

[2 marks]

- Cu^+ ion has configuration $[Ar]\,3d^{10}$ which is full

M1

- so solution is colourless and unable to absorb visible light

M2

9

Turn over for the next question

0 8 This question is about ion testing.

0 8 . 1 Describe how a student could distinguish between aqueous solutions of potassium nitrate, KNO_3, and potassium sulfate, K_2SO_4, using **one** simple test-tube reaction.

[3 marks]

Reagent $BaCl_2$

Observation with KNO_3(aq) no visible change

Observation with K_2SO_4(aq) white ppt

0 8 . 2 Describe how a student could distinguish between aqueous solutions of magnesium chloride, $MgCl_2$, and aluminium chloride, $AlCl_3$, using **one** simple test-tube reaction.

[3 marks]

Reagent NaOH – add to excess

Observation with $MgCl_2$(aq) white ppt
no visible change in excess

Observation with $AlCl_3$(aq) white ppt
dissolves in excess

6

0 9 There are several stages in the industrial production of methanol from methane.

0 9 . 1 The first stage involves a gaseous equilibrium between the reactants (methane and steam), and some gaseous products. **Figures 1** and **2** show the percentage conversion of methane into the gaseous products under different conditions at equilibrium.

Figure 1

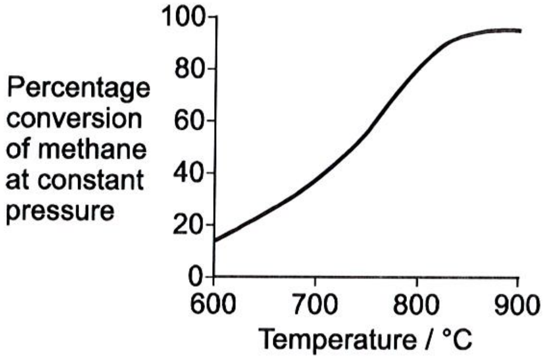
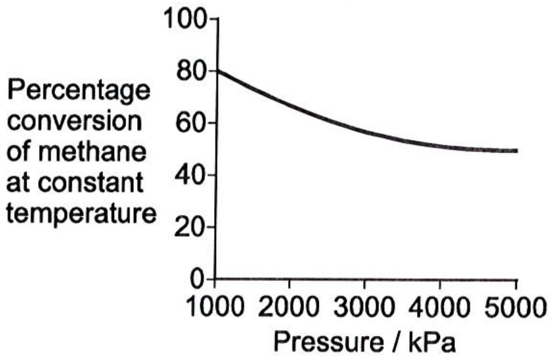


Figure 2



Deduce the optimum conditions for the industrial conversion of methane and steam into the gaseous products.

Explain your deductions.

LEVELLED

[6 marks]

Temperature : 780 - 880°C (value in this range)

As temperature increases the yield increases

Reaching a maximum yield at ~850°C

An increase in temperature >850°C doesn't increase the yield but would result in a higher energy cost.

Pressure : 1000 - 2000 kPa (value in this range)

As the pressure increases the yield decreases

A maximum yield is obtained at 1000 kPa but this may be too slow a conversion so a compromise may be needed.

Needed to obtain level 3

0 9 . 2 The equation shows the final stage in the production of methanol.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$$

20.1 mol of carbon monoxide and 24.2 mol of hydrogen were placed in a sealed container. An equilibrium was established at 600 K. The equilibrium mixture contained 2.16 mol of methanol.

Calculate the amount, in moles, of carbon monoxide and of hydrogen in the equilibrium mixture.

[2 marks]

	CO +	$2H_2$ ⇌	CH_3OH
mol in	20.1	24.2	–
mol eqm	20.1 − 2.16	24.2 − (2×2.16)	2.16

Amount of carbon monoxide 17.9 mol M1

Amount of hydrogen 19.9 mol M2

Question 9 continues on the next page

Turn over ►

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0 9 . 3 A different mixture of carbon monoxide and hydrogen was allowed to reach equilibrium at 600 K

At equilibrium, the mixture contained 2.76 mol of carbon monoxide, 4.51 mol of hydrogen and 0.360 mol of methanol. The total pressure was 630 kPa

Calculate a value for the equilibrium constant, K_p, for this reaction at 600 K and state its units.

[6 marks]

$$K_p = \frac{pp(CH_3OH)}{pp(CO)\ pp(H_2)^2}$$ M1

Total moles = 2.76 + 4.51 + 0.360 = 7.63 M2

$$pp\ CO = \frac{2.76}{7.63} \times 630 = 228 \text{ kPa}$$

$$pp\ H_2 = \frac{4.51}{7.63} \times 630 = 372 \text{ kPa}$$

$$pp\ CH_3OH = \frac{0.36}{7.63} \times 630 = 29.7 \text{ kPa}$$

M3 + M4

$$K_p = \frac{29.7}{228 \times 372^2} \qquad \frac{\cancel{kPa}}{\cancel{kPa} \times kPa^2}$$

Value of K_p 9.41×10^{-7} Units kPa^{-2}

M5 M6

14

1 0 **Table 4** shows some electrode half-equations and their standard electrode potentials.

Table 4

	Electrode half-equation	***E*° / V**
	$Cl_2(g) + 2e^- \rightarrow 2Cl^-(aq)$	+1.36
HNO_3	$NO_3^-(aq) + 4H^+(aq) + 3e^- \rightarrow NO(aq) + 2H_2O(aq)$	+0.96
	$Fe^{3+}(aq) + e^- \rightarrow Fe^{3+}(aq)$	+0.77
	× $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$	+0.34
H_2SO_4	$SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightarrow SO_2(g) + 2H_2O(aq)$	+0.17
	$2H^+(aq) + 2e^- \rightarrow H_2(g)$	0.00
	$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$	−0.44

1 0 . 1 Deduce the oxidation state of nitrogen in NO_3^- and in NO

[2 marks]

Nitrogen in NO_3^- +5

Nitrogen in NO +2

1 0 . 2 State the weakest reducing agent in **Table 4**.

most: positive donate e^-

[1 mark]

Cl^-

~~**1 0 . 3**~~ Write the conventional representation of the cell that has an EMF of +0.43 V

~~**[2 marks]**~~

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1 0 . 4 Use data from **Table 4** to identify an acid that will oxidise copper.

Explain your choice of acid.

Use these data to suggest a possible equation for the reaction.

Calculate the EMF of the cell that has the same overall reaction.

[4 marks]

- Nitric acid / HNO_3 M1
- $E^\ominus$ NO_3^- is greater than $E^\ominus$ Cu^{2+} therefore it is a stronger oxidising agent than Cu^{2+} M2
- $2NO_3^- + 8\cancel{4}H^+ + \cancel{6\cancel{3}e^-} \rightarrow 2NO + 4\cancel{2}H_2O \times 2$ R

  $3Cu \rightarrow 3Cu^{2+} + \cancel{6\cancel{2}e^-} \times 3$ O

  $2NO_3 + 8H^+ + 3Cu \rightarrow 2NO + 3Cu^{2+} + 4H_2O$ M3
- Cell EMF $= E^\ominus_R - E^\ominus_O$

  $= 0.96 - 0.34 = 0.62\ V$ M4

~~9~~ 7

1 1 This question is about compounds containing ethanedioate ions.

1 1 . 1 A white solid is a mixture of sodium ethanedioate ($Na_2C_2O_4$), ethanedioic acid dihydrate ($H_2C_2O_4.2H_2O$) and an inert solid. A volumetric flask contained 1.90 g of this solid mixture in 250 cm^3 of aqueous solution.

CHALLENGING

Two different titrations were carried out using this solution.

In the first titration 25.0 cm^3 of the solution were added to an excess of sulfuric acid in a conical flask. The flask and contents were heated to 60 °C and then titrated with a 0.0200 mol dm^{-3} solution of potassium manganate(VII). When 26.50 cm^3 of potassium manganate(VII) had been added the solution changed colour.

Both $Na_2C_2O_4$ and $H_2C_2O_4 \cdot 2H_2O$ will react

The equation for this reaction is

$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 10CO_2$$

In the second titration 25.0 cm^3 of the solution were titrated with a 0.100 mol dm^{-3} solution of sodium hydroxide using phenolphthalein as an indicator. The indicator changed colour after the addition of 10.45 cm^3 of sodium hydroxide solution.

Only $H_2C_2O_4 \cdot 2H_2O$ will react

The equation for this reaction is

$$H_2C_2O_4 + 2OH^- \rightarrow C_2O_4^{2-} + 2H_2O$$

Calculate the percentage by mass of sodium ethanedioate in the white solid.

Give your answer to the appropriate number of significant figures. 3 s.f.
Show your working.

[8 marks]

1st $n\ MnO_4^- = 0.02 \times 26.5 \times 10^{-3} = 5.3 \times 10^{-4}$ M1

$n\ C_2O_4^{2-} = 5.3 \times 10^{-4} \times \frac{5}{2} = 1.325 \times 10^{-3}$ M2

2nd $n\ NaOH = 0.1 \times 10.45 \times 10^{-3} = 1.045 \times 10^{-3}$ M3

n acid $= 1.045 \times 10^{-3}/2 = 5.225 \times 10^{-4}$ M4

$\therefore$ $n\ Na_2C_2O_4$ only $= 1.325 \times 10^{-3} - 5.225 \times 10^{-4}$ M5

$= 8.025 \times 10^{-4}$ (in 25 cm^3)

$n\ Na_2C_2O_4$ in original sample $= 8.025 \times 10^{-4} \times 10$

$= 8.025 \times 10^{-3}$ M6

$m\ Na_2C_2O_4 = 8.025 \times 10^{-3} \times 134 = 1.075\text{g}$ M7

$\%\ Na_2C_2O_4 = \frac{1.075}{1.90} \times 100$

M8

$= 56.6\%$ (3 s.f.)

(allow 56.5 – 56.8 %)

Percentage by mass of sodium ethanedioate 56.6 %

1 1 . 2 Ethanedioate ions react with aqueous iron(III) ions in a ligand substitution reaction.

Write an equation for this reaction.

Suggest why the value of the enthalpy change for this reaction is close to zero.

[2 marks]

$[Fe(H_2O)_6]^{3+} + 3C_2O_4^{2-} \rightarrow [Fe(C_2O_4)_3]^{3-} + 6H_2O$

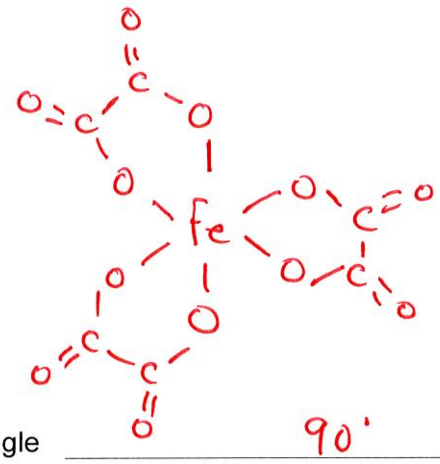
Same number and type of bonds broken and made

1 1 . 3 Draw the displayed formula of the iron complex produced in the reaction in Question **11.2**

Indicate the value of the O—Fe—O bond angle.

State the type of isomerism shown by the iron complex.

[3 marks]



Bond angle 90°

Type of isomerism optical

1 1 . 4 Ethanedioate ions are poisonous because they react with iron ions in the body. Ethanedioate ions are present in foods such as broccoli and spinach.

Suggest one reason why people who eat these foods do not suffer from poisoning.

[1 mark]

Only present in small quantities

END OF QUESTIONS

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