

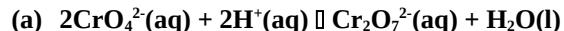
## Year 12 Chemistry Exam Semester 1, 2003 Solutions

### PART 1

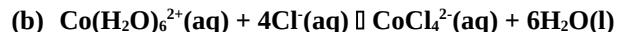
1c, 2a, 3c, 4b, 5a, 6a, 7a, 8c, 9d, 10d, 11d, 12a, 13b, 14d, 15d, 16b, 17b(or c), 18d, 19c, 20a, 21b, 22a, 23b, 24c, 25d, 26b, 27c, 28a, 29c, 30b

### PART 2

#### Question 1



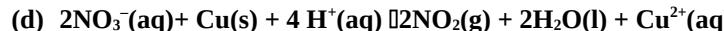
Yellow solution turns orange



Pink solution turns blue



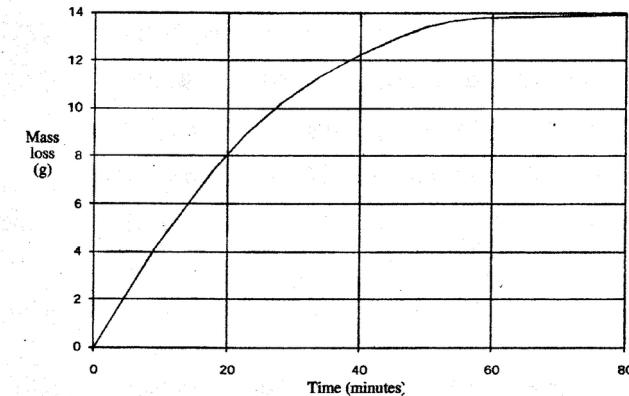
Colourless oxalic turns green and bubbles formed



Metal dissolves; Vigorous bubbling; brown gas; solution turns green then blue

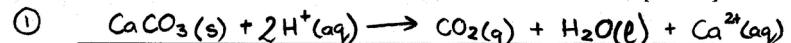
#### Question 2

An excess of  $\text{CaCO}_3$  in the form of large pieces of marble is reacted with 500 mL hydrochloric acid in an open flask standing on a balance. The loss in mass of the contents of the flask as a function of time is shown graphically below.



- (a) Write the equation for the reaction which occurs. Why is there a loss in mass of the flask and its contents?

[2 marks]



② There is a loss in mass of the flask and its contents because  $\text{CO}_2(\text{g})$  is leaving the system to the atmosphere

- (b) Calculate the average rate of reaction between 0–20 minutes and also between 20–40 minutes (Take care with units). Explain any difference between these two rates of reaction.

[2 marks]

③ Average Rate (0–20 mins) =  $\frac{8 \text{ g CO}_2 \text{ loss}}{20 \text{ mins}}$

=  $0.4 \text{ g/min mass loss}$

④ Average Rate (20–40 mins) =  $\frac{4.4 \text{ g CO}_2 \text{ loss}}{20 \text{ mins}}$

=  $0.22 \text{ g/min mass loss}$

① As time progresses the reactant HCl becomes less concentrated & so rate decreases

- (c) Why does the mass loss of the contents of the flask not increase after 70 minutes?

[1 mark]

THE HYDROCHLORIC ACID IS TOTALLY CONSUMED SINCE THE CALCIUM CARBONATE IS IN EXCESS. HENCE THE REACTION STOPS AND NO MORE  $\text{CO}_2(\text{g})$  IS PRODUCED AND LOST

- (d) Explain clearly what would have been the effect on the initial rate of reaction if small chips of marble had been used?

[1 mark]

BECAUSE THE REACTION RATE INCREASES WITH INCREASED SURFACE AREA OF REACTANT, SMALLER MARBLE CHIPS WILL CAUSE A HIGHER INITIAL RATE OF REACTION

### Question 3

- (a) Haber Process: iron/iron oxide  
Contact Process: vanadium pentoxide
- (b) A catalyst lowers the activation energy barrier of a reaction thus making the forward and reverse reactions faster (1)

### Question 4

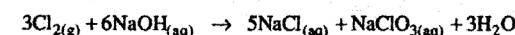
Identify by name or formula an example of each of the following

Description	Name or Formula
A positively charged complex ion	$[\text{Ag}(\text{NH}_3)_2]^+$
A halogen which is liquid at room temperature and pressure	Bromine
A salt that dissolves in water to give an acidic solution	$\text{NH}_4\text{Cl}$
A weak acid other than acetic acid	CARBONIC ACID
A substance that can be used as a primary standard for redox titrations	$\text{H}_2\text{C}_2\text{O}_4$
A diprotic acid	$\text{H}_2\text{SO}_4$
A secondary standard used in many acid-base titrations	Hydrochloric Acid.

[7 marks]

### Question 5

Consider the following reaction:



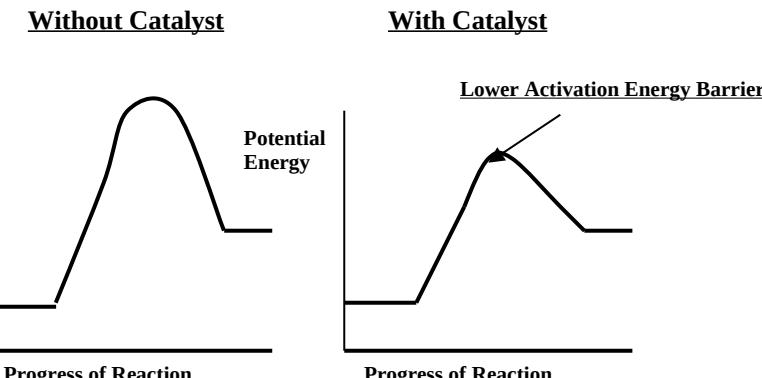
[4 marks]

What is the oxidation state of

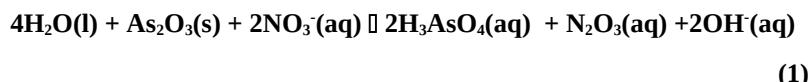
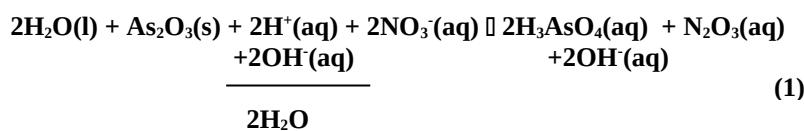
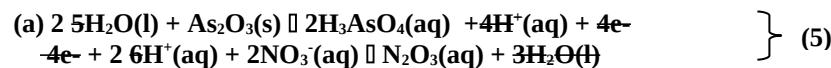
- (a) Cl in  $\text{Cl}_{2(\text{g})}$  ..... O
- (b) Cl in  $\text{NaCl}_{(\text{aq})}$  ..... -1
- (c) Cl in  $\text{NaClO}_3_{(\text{aq})}$  ..... +5

- (d) Explain why the above reaction is classified as a disproportionation reaction.

BECAUSE  $\text{Cl}_2$  UNDERGOES BOTH OXIDATION AND REDUCTION



(2)

**Question 6**

(b) oxidant:  $\text{NO}_3^-(\text{aq})$  (1)

(c) oxidising agent:  $\text{NO}_3^-(\text{aq})$  (1)

(d) +5 (1)

**Question 7**

Use the information given below to identify the elements X and Y. Justify your choices.

The oxides have formulae of  $\text{XO}$  and  $\text{YO}_2$ .

$\text{XO}$  is a solid which dissolves in water producing a basic solution.

$\text{YO}_2$  is a colourless, odourless gas which dissolves in water producing an acidic solution.

The element X is the third member of its group in the periodic table.

[3 marks]

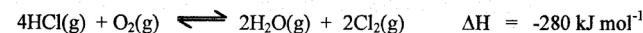
①  $X$  must form  $\text{X}^{2+}$  since  $\text{XO}$  exists

②  $X$  must be Ca since this is the 3<sup>rd</sup> member of group 2 and  $\text{CaO}$  reacts with water to form  $\text{Ca(OH)}_2(\text{aq})$

③  $Y$  is C since  $\text{CO}_2$  is a colourless, odourless gas to form  $\text{H}_2\text{CO}_3(\text{aq})$  in water

**Question 8**

Consider the equilibrium reaction between hydrogen chloride gas and oxygen gas using a suitable catalyst:



Complete the table below by:

- (a) indicating the change in the amount of hydrogen chloride gas (write either "more", "less" or "unchanged") after each of the following changes to conditions at equilibrium have been made.
- (b) giving also a brief reason for your choice based on accepted chemical principles.

Change imposed on the system	Effect on amount of $\text{HCl(g)}$ present
1. The temperature of the system is raised.	<p>(a) Amount Increases</p> <p>(b) Reason REACTION IS EXOTHERMIC</p> <p>∴ IF HEAT GIVEN, SYSTEM REESTABLISHES EQUILIBRIUM BY REVERSE REACTION WHICH OPPOSES THE CHANGE</p>
2. The pressure of the system is doubled by halving the volume of the reaction vessel.	<p>(a) Amount Decreases</p> <p>(b) Reason SYSTEM TRIES TO REDUCE PRESSURE BY LOWERING NUMBER OF PARTICLES. THEREFORE FORWARD REACTION (5 particles <math>\rightarrow</math> 4 particles) IS Favoured</p>
3. The surface area of the catalyst is increased	<p>(a) NO CHANGE</p> <p>(b) Reason CATALYST EFFECTS RATE OF REACTIONS NOT EQUILIBRIUM YIELDS OF SUBSTANCES</p>

### Question 9

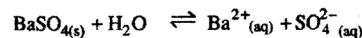
- (a) The horizontal section of the graph indicates that the system reaches equilibrium (1). This is because the concentration of products and reactant are constant. Chemical equilibrium has constant macroscopic properties with forward and reverse reactions occurring at the same rate (1).
- (b) 0.2 moles of A are consumed. This produces 0.4 moles of B and 0.2 moles of C.  
Therefore, 1 mol A  $\rightleftharpoons$  2 mol B and 1 mol C.



$$(c) K = ([B]^2[C])/[A] = (0.4^2 \times 0.2) / 0.6 = 5.3 \times 10^{-2} \text{ mol}^2\text{L}^{-2} \quad (2)$$

### Question 10

Consider the equilibrium:



- (a) Why is this described as a **dynamic equilibrium**? [2 marks]

"Dynamic" because the forward and reverse reactions are always occurring.

"Equilibrium" because the forward and reverse reactions occur at the same rate rendering the macroscopic properties as constant.

- (b) Given a small amount of  $\text{BaSO}_{4(s)}$  containing radioactive barium, explain how this could be used in an experiment to show that the equilibrium above is dynamic. [2 marks]

AT EQUILIBRIUM THE CONCENTRATION OF RADIOACTIVE  $\text{Ba}^{2+}_{(aq)}$  MAY BE DETERMINED

IF A NUMBER OF TESTS ARE PERFORMED AT VARIOUS TIMES DURING EQUILIBRIUM, THE CONCENTRATION OF RADIOACTIVE BARIUM IONS WILL ALWAYS BE DIFFERENT EVEN THOUGH EQUILIBRIUM OCCURS. THIS IS BECAUSE THE RADIOACTIVE BARIUM IS MOVING WITH NORMAL BARIUM BETWEEN SOLID BARIUM SULFATE AND THE IONS. HENCE, DYNAMIC PROCESS

### Question 11

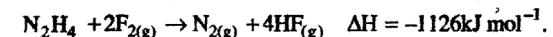
What is the function of carbon in the CIP process? [1 mark]

Adsorbs  $[\text{Au}(\text{CN})_2]^-$  FROM THE ORE PULP

WITHIN THE ADSORPTION TANKS.

### Question 12

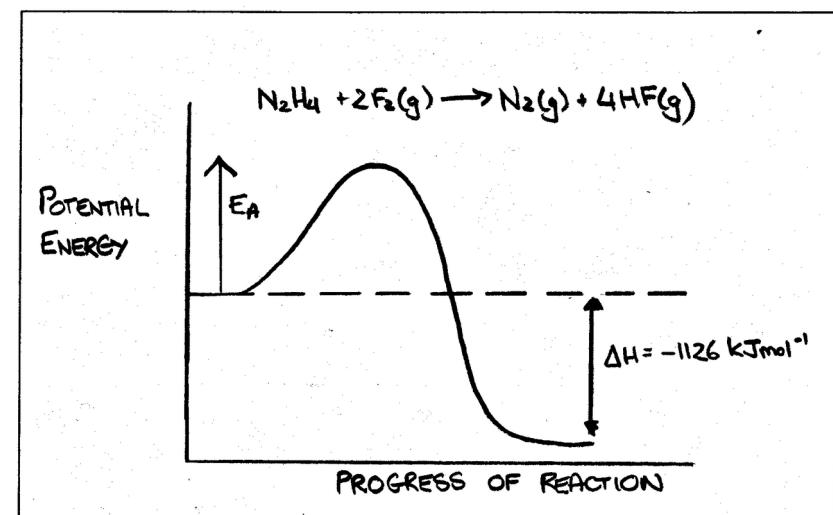
Hydrazine,  $\text{N}_2\text{H}_4$ , is sometimes used as a rocket fuel. If  $\text{F}_{2(g)}$  is used as an oxidant, its heat of combustion is:



Draw a potential energy diagram for the above reaction.

Show all information on the diagram.

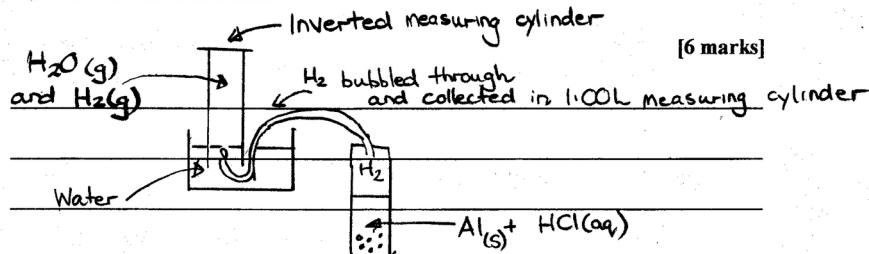
[3 marks]



### PART 3

#### Question 1

Maria designed an experiment to measure the molar volume of hydrogen gas. To do this she planned to dissolve a carefully weighed piece of pure aluminium in excess hydrochloric acid and collect the resulting hydrogen gas. Since a 1.00 L measuring cylinder is the largest she has at her disposal, determine the maximum mass of pure aluminium Maria should use. Assume the laboratory temperature is 25 °C and the gas is collected at 100.7 kPa. Water has a vapour pressure of 3.17 kPa at these conditions.



$$P_{\text{TOT}} (\text{measuring cylinder}) = P(\text{H}_2\text{O}(g)) + P(\text{H}_2(g))$$

$$\therefore P(\text{H}_2(g)) = P_{\text{TOT}} - P(\text{H}_2\text{O}(g))$$

$$= 100.7 \text{ kPa} - 3.17 \text{ kPa}$$

$$= 97.53 \text{ kPa}$$

①

$$\therefore P_1 = 97.53 \text{ kPa} \quad P_2 = 101.3 \text{ kPa}$$

$$V_1 = 1.00 \text{ L}$$

$$V_2 = ?$$

} STP

$$T_1 = 298 \text{ K} \quad T_2 = 273 \text{ K}$$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$V_2 = \frac{P_1 V_1 T_2}{P_2 T_1}$$

$$= \frac{97.53 \times 1 \times 273}{101.3 \times 298}$$

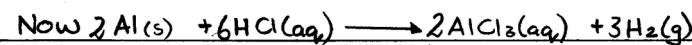
$$= 0.8820 \text{ L}$$

①

$$\text{Now } n = \frac{V}{22.4} \text{ (at STP)}$$

$$\therefore n = \frac{0.8820}{22.4} = 0.0394 \text{ moles.}$$

①



①

$$n(\text{Al}) = \frac{2 n(\text{H}_2)}{3} = \frac{2 \times 0.0394}{3} = 0.02625 \text{ moles}$$

①

$$m(\text{Al}) = n(\text{Al}) \times M = 0.0262 \times 26.98 = 0.708 \text{ g (3 sig fig)}$$

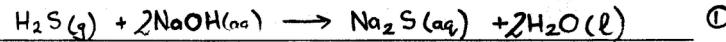
①

Maximum Mass of Al is 0.708 g

Question 2

Hydrogen sulfide gas ( $\text{H}_2\text{S}$ ) readily dissolves in a sodium hydroxide solution to produce a sodium sulfide solution and water. In an experiment 4.92 g of  $\text{H}_2\text{S}(g)$  is bubbled through 155 mL of  $1.100 \text{ mol L}^{-1}$   $\text{NaOH}$  solution. What maximum mass of  $\text{Na}_2\text{S}$  could be produced in this experiment?

[8 marks]



$$n(\text{H}_2\text{S}) = \frac{m}{M} = \frac{4.92}{34.086} = 0.14434 \text{ moles} \quad ①$$

$$n(\text{NaOH}) = cV = 1.100 \times 0.155 = 0.1705 \text{ moles} \quad ①$$

Now  $0.1705$  moles of  $\text{NaOH}$  needs  $(0.1705/2)$  moles

of  $\text{H}_2\text{S}$  for total consumption. This equals

$0.08525$  moles of  $\text{H}_2\text{S}$

We have  $0.14434$  moles of  $\text{H}_2\text{S}$  which is more than enough. Hence,  $\text{H}_2\text{S}$  is excess reagent and  $\text{NaOH}$  is limiting reagent

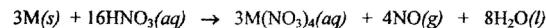
$$n(\text{Na}_2\text{S}) = n(\text{NaOH}) = \frac{0.1705}{2} = 0.08525 \text{ moles} \quad ①$$

$$m(\text{Na}_2\text{S}) = n \times M = 0.08525 \times 78.05 = 6.65 \text{ g} \quad ①$$

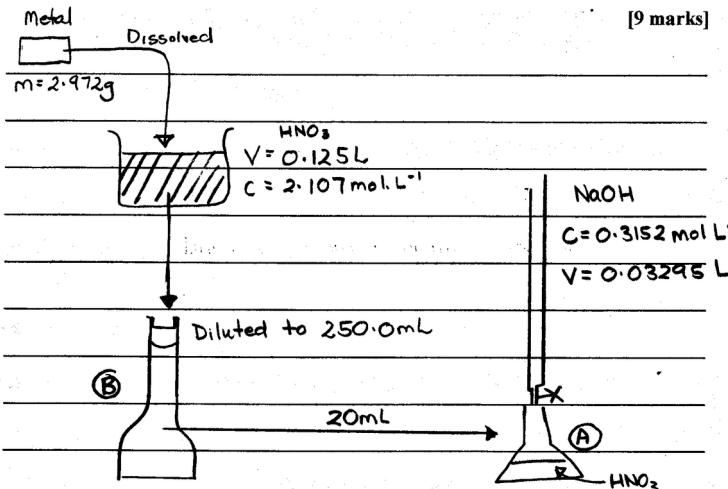
$\therefore$  Maximum mass of  $\text{Na}_2\text{S}$  is  $6.65 \text{ g}$  (3 sig figs)

Question 3

A 2.972 g sample of an unknown metallic element was dissolved in 125.0 mL of  $2.107 \text{ mol L}^{-1}$   $\text{HNO}_3(aq)$ . The reaction produced a salt with formula  $\text{M}(\text{NO}_3)_4$ .



The remaining solution which was known to contain excess  $\text{HNO}_3(aq)$  was diluted to 250.0 mL. A 20 mL sample of the diluted solution containing excess  $\text{HNO}_3(aq)$  was titrated to equivalence using  $32.95 \text{ mL}$  of  $0.3152 \text{ mol L}^{-1}$   $\text{NaOH}(aq)$ . What is the molar mass of the metal? Use your answer to identify the metal element.



need Molar mass of metal



$$① n(\text{NaOH}) = cV = 0.3152 \times 0.03295 = 0.0103858 \text{ moles}$$

$$① n(\text{HNO}_3 \text{ at } B) = n(\text{NaOH}) = 0.0103858$$

$$① c(\text{HNO}_3 \text{ at } B) = \frac{n}{V} = \frac{0.0103858}{0.020} = 0.519292 \text{ mol L}^{-1}$$

$$① n(\text{HNO}_3 \text{ at } B) = n(\text{HNO}_3 \text{ remaining after metal addition}) \\ = cV = 0.519292 \times 0.250 \\ = 0.129823 \text{ moles}$$

$$① n(\text{HNO}_3 \text{ before metal addition}) = cV = 2.107 \times 0.125 \\ = 0.263375 \text{ moles}$$

①  $n(\text{HNO}_3 \text{ reacting with metal})$

$$= n(\text{HNO}_3 \text{ before metal addition})$$

$$- n(\text{HNO}_3 \text{ remaining after metal addition})$$

$$= 0.263375 - 0.129823$$

$$= 0.133552 \text{ moles}$$

① now  $n(M) = \frac{3n(\text{HNO}_3)}{M} = \frac{3 \times 0.133552}{118.68}$

$$= 0.025041 \text{ moles}$$

② Molar mass ( $M$ ) =  $\frac{m}{n} = \frac{2.972}{0.025041} = 118.68 \text{ g mol}^{-1}$

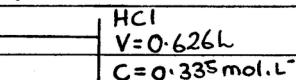
$$\therefore \text{Molar mass} = 118.7 \text{ g mol}^{-1} \quad 119 \text{ (3 sig fig)}$$

② The metal is Sn (Tin)

#### Question 4

A 4.65 g sample of pure  $\text{NaOH}(s)$  is added to 626 mL of  $0.335 \text{ mol L}^{-1} \text{ HCl}(aq)$ . Assume the final volume of mixture is unchanged and determine the pH of the mixture when the reaction is complete.

[8 marks]



①  $n(\text{NaOH}(s)) = \frac{m}{M} = \frac{4.65}{39.998} = 0.11626$

①  $n(\text{HCl}) = cV = 0.335 \times 0.626 = 0.20971$



② { 0.11626 mol NaOH needs 0.11626 mol HCl. We have

② { 0.20971 mol of HCl which is more than enough.

∴ HCl is excess reagent. NaOH is limiting reagent.

①  $n(\text{HCl after reaction}) = n(\text{HCl original}) - n(\text{HCl used})$

$$= 0.20971 - 0.11626$$

$$= 0.09345 \text{ moles}$$

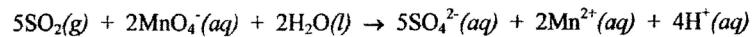
①  $c(\text{HCl after reaction}) = \frac{n}{V} = \frac{0.09345}{0.626} = 0.14928 \text{ mol L}^{-1}$

$$c(\text{H}^+) = c(\text{HCl after reaction}) = 0.14928 \text{ mol L}^{-1}$$

①  $\text{pH} = -\log(c(\text{H}^+)) = -\log(0.14928)$   
 $= 0.826$

**Question 5**

The concentration of the atmospheric pollutant sulfur dioxide ( $\text{SO}_2$ ) can be found by bubbling air through a dilute  $\text{KMnO}_4(aq)$  solution of known concentration.



The concentration of the remaining  $\text{KMnO}_4(aq)$  can be found by titration with standardised oxalic acid. This allows the amount of  $\text{KMnO}_4$  reacting with sulfur dioxide to be found and thus its concentration in the air sample can be calculated. In such a procedure  $43.9 \text{ m}^3$  of  $\text{SO}_2$  polluted air was bubbled through  $215.0 \text{ mL}$  of  $5.007 \times 10^{-3} \text{ mol L}^{-1} \text{ KMnO}_4(aq)$ . The unreacted  $\text{KMnO}_4$  was acidified and diluted to a volume of  $250.0 \text{ mL}$ .  $20.00 \text{ mL}$  samples of this  $\text{KMnO}_4$  solution were titrated to equivalence with  $38.50 \text{ mL}$  of  $2.194 \times 10^{-3} \text{ mol L}^{-1}$  oxalic acid solution. What is the concentration of the pollutant  $\text{SO}_2(g)$  in ppm if the air has a density of  $1.18 \text{ kg m}^{-3}$ ?

[12 marks]

Bubb Before Bubbling

(A) KMnO4

$$V = 0.215 \text{ L}$$

$$C = 5.007 \times 10^{-3} \text{ mol L}^{-1}$$

After Bubbling  $43.9 \text{ m}^3$  of Polluted Air

(B) KMnO4

$$V = 0.215 \text{ L}$$

$$C = ?$$

Acidified + Diluted

$\text{H}_2\text{C}_2\text{O}_4$

$$V = 0.03850 \text{ L}$$

$$C = 2.194 \times 10^{-3} \text{ mol L}^{-1}$$

(C) V = 0.250 L

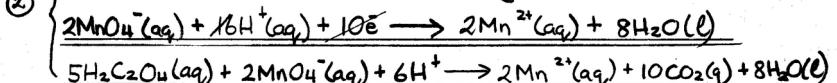
20mL

KMnO4

Need ppm of  $\text{SO}_2(g)$  in air

$$\text{density of air} = 1.18 \text{ kg m}^{-3}$$

$$\textcircled{1} \quad n(\text{H}_2\text{C}_2\text{O}_4) = CV = 2.194 \times 10^{-3} \times 0.03850 = 8.4469 \times 10^{-5}$$



$$\textcircled{1} \quad n(\text{MnO}_4^- \text{ at } \textcircled{2}) = \frac{2}{5} n(\text{H}_2\text{C}_2\text{O}_4) = \frac{2}{5} \times 8.4469 \times 10^{-5}$$

$$= 3.37876 \times 10^{-5} \text{ mol}$$

$$\textcircled{1} \quad C(\text{MnO}_4^- \text{ at } \textcircled{2}) = \frac{n_0}{V} = \frac{3.37876 \times 10^{-5}}{0.020} : 1.68938 \times 10^{-3} \text{ mol L}^{-1}$$

$$\textcircled{1} \quad n(\text{MnO}_4^- \text{ at } \textcircled{2}) = CV = 1.68938 \times 10^{-3} \times 0.250 = 4.22345 \times 10^{-4}$$

$$n(\text{MnO}_4^- \text{ at } \textcircled{3}) = 4.22345 \times 10^{-4}$$

$$\textcircled{1} \quad n(\text{MnO}_4^- \text{ at } \textcircled{3}) = CV = 5.007 \times 10^{-3} \times 0.215 = 1.076505 \times 10^{-3}$$

$$\textcircled{1} \quad n(\text{MnO}_4^- \text{ reacting with SO}_2) = n(\text{MnO}_4^- \text{ at } \textcircled{2}) - n(\text{MnO}_4^- \text{ at } \textcircled{3}) \\ = (1.076505 \times 10^{-3}) - (4.22345 \times 10^{-4}) \\ = 6.5416 \times 10^{-4} \text{ moles}$$

$$\textcircled{1} \quad n(\text{SO}_2(g)) = \frac{5}{2} n(\text{MnO}_4^-) = \frac{5}{2} \times 6.5416 \times 10^{-4} = 1.6354 \times 10^{-3}$$

$$\textcircled{1} \quad m(\text{SO}_2(g)) = nM = 1.6354 \times 10^{-3} \times 64.07 = 0.10478 \text{ g} \\ = 104.78 \text{ mg}$$

$$\textcircled{1} \quad m(\text{air}) = \text{density} \times \text{Volume} = 1.18 \times 43.9 = 51.802 \text{ kg}$$

$$\textcircled{1} \quad \text{ppm}(\text{SO}_2) = \frac{m(\text{SO}_2) \text{ in mg}}{m(\text{air}) \text{ in kg}} = \frac{104.78}{51.802} = 2.02 \text{ ppm}$$

$$\therefore \text{concentration of SO}_2 = 2.02 \text{ ppm}$$

**Question 6**

In a laboratory procedure two students need to make a secondary standard solution of approximately  $0.04 \text{ mol L}^{-1}$   $\text{KMnO}_4(aq)$ . To do this they dissolved 3 g of solid  $\text{KMnO}_4$  in 500 mL of distilled water. The solution was then boiled, filtered through glass wool and stored in a dark bottle away from light.

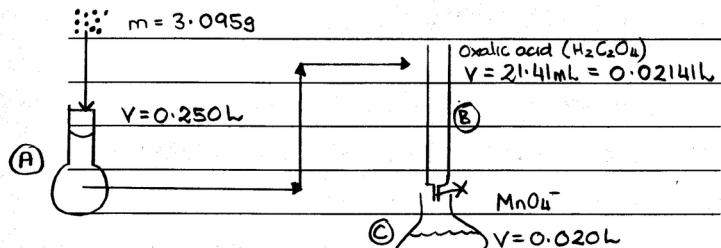
A second solution of oxalic acid was prepared by dissolving 3.095 g of  $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}(s)$  in water and making its volume up to 250.0 mL in a volumetric flask. Finally, the oxalic acid solution was added to a burette and titrated into 20.00 mL samples of the potassium permanganate solution. The burette readings for the  $\text{H}_2\text{C}_2\text{O}_4$  solution were as follows:

IGNORE						
Final volume (mL)	22.25	21.38	22.91	21.45	24.75	22.00
Initial volume (mL)	0.87	1.46	2.75	0.98	2.75	21.40

Using this information, determine the actual concentration of the approximately  $0.04 \text{ mol L}^{-1}$   $\text{KMnO}_4$  solution.

Oxalic acid ( $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ )

[7 marks]

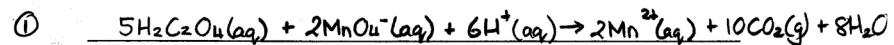


$$\textcircled{1} \quad n(\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}) = \frac{m}{M} = \frac{3.095}{126.02} = 0.0245595$$

$$\therefore n(\text{H}_2\text{C}_2\text{O}_4) = 0.0245595$$

$$\textcircled{1} \quad c(\text{H}_2\text{C}_2\text{O}_4 \text{ at } \textcircled{A}) = \frac{n}{V} = \frac{0.0245595}{0.250} = 0.0982383 \text{ mol L}^{-1}$$

$$\textcircled{1} \quad n(\text{H}_2\text{C}_2\text{O}_4 \text{ added from } \textcircled{B}) = cV = 0.0982383 \times 0.02141 \\ = 2.1032836 \times 10^{-3} \text{ moles}$$



$$\textcircled{1} \quad n(\text{MnO}_4^- \text{ at } \textcircled{C}) = \frac{5}{2} n(\text{H}_2\text{C}_2\text{O}_4) = \frac{5}{2} \times 2.1032836 \times 10^{-3}$$

$$= 8.4131344 \times 10^{-4} \text{ moles}$$

$$c(\text{MnO}_4^-) = \frac{n}{V} = \frac{8.4131344 \times 10^{-4}}{0.020} \quad \textcircled{1}$$

$$= 0.0421 \text{ mol L}^{-1} \quad (3 \text{ sig fig})$$

**Essay Next Page**

## Extended Answer 1

Item Presented		Reason Why	Details
Definition of Volumetric Analysis (1 mark)		<p>Sufficient volume of a known concentration is added to completely react with the substance being analysed (1 mark). From the measured volume and known concentration of the solution used, one can calculate the amount of the substance being determined (1 mark).</p> <p><b>The following glassware would be brought into class and shown to the students (1 mark):</b></p>	
Apparatus (1 mark)		Volumetric Flask (1 mark)	<p><b>Holds an accurately known volume indicated by a line etched into the neck of the flask (1 mark).</b></p> <p>Used for the preparation of solutions whose concentrations are to be accurately known. These solutions are called standards (1 mark).</p> <p>Standards prepared by measuring a mass of a pure substance in water to produce a definite volume of solution (1 mark).</p> <p><b>Must be rinsed with water before use (1 mark).</b></p>
		Pipette (1 mark)	<p>Used to accurately deliver a specific volume of solution such as 5.00 mL, 10.00 mL or 20.00 mL (1 mark).</p> <p>Used to deliver the appropriate volume of solution into a conical flask prior to titration (1 mark).</p> <p><b>Must be rinsed with the solution before use (1 mark).</b></p>
		Burette (1 mark)	<p>Used to accurately deliver variable volumes of solution (1 mark).</p> <p>Usually graduated from 0.0 mL to 50.0 mL with an error of ±0.02 mL (1 mark).</p> <p>The difference between the initial and final readings on the burette indicates the volume of solution delivered in a titration (1 mark).</p> <p><b>Must be rinsed with the solution before use (1 mark).</b></p>
Acid/Base Titration (1 mark)	Definition (1 mark)	<p>Sufficient volume of a known concentration of an acid (or base) is added to completely react with the base (or acid) being analysed. From the measured volume and known concentration of the acid used, one can calculate the concentration of base being determined (1 mark).</p>	
Indicators (1 mark)	Standard Solution (1 mark)	<p><b>One with an accurately known concentration (1 mark)</b></p> <p>Primary Standard (1 mark)</p> <p>An accurately measured mass of a substance is dissolved in water in a volumetric flask to form a known volume of solution (1 mark).</p> <p>The substance must be obtainable in a very pure form with a known formula (1 mark).</p> <p>The substance should not alter during weighing (1 mark).</p> <p>It should have a reasonably high relative formula mass to minimise weighing errors (1 mark).</p> <p><b>Common ones are sodium carbonate and hydrated oxalic acid (1 mark).</b></p>	
		<p>Secondary Standard (1 mark)</p> <p>A solution whose exact concentration is determined by titration against another standard solution (1 mark).</p> <p>Example: hydrochloric acid standardised by standard sodium carbonate (1 mark).</p>	
		<p>Students need to select the correct indicator so that the</p> <p>An indicator is added to the solution in the conical flask so that a colour change when the neutralisation reaction is complete (1 mark).</p>	

	<p>point of complete reaction is determined. If this is not accurate, the entire procedure fails as an analytical tool <b>(1 mark)</b>.</p>	<p>Equivalence point: the point at which chemically equivalent amounts of acid and base have been added <b>(1 mark)</b>.</p> <p>End point: the point at which the analyst sees a colour change <b>(1 mark)</b>.</p> <p>One wants the end-point to be as close to the equivalence point as possible <b>(1 mark)</b>. A table of indicators for different pH ranges would be given to students <b>(1 mark)</b>.</p>
Acid/Base Titration Demo <b>(1 mark)</b>	<p>Students may see how standards are prepared <b>(1 mark)</b>.</p> <p>Students may see how a titration is done <b>(1 mark)</b>.</p> <p>Students informed of the little “tricks” to make sure accuracy is maintained.</p> <p>Students may know how to perform the calculation. <b>(1 mark)</b></p>	<p>Preparation of standard sodium carbonate solution <b>(1 mark)</b>.</p> <p>Preparation of standard hydrochloric acid <b>(1 mark)</b>.</p>
Student practice <b>(1 mark)</b>	<p>Hands on practice is the best way to gain further understanding and to build precision and accuracy <b>(1 mark)</b>.</p>	<p>Preparation of standard sodium carbonate solution <b>(1 mark)</b></p> <p>Preparation of standard hydrochloric acid <b>(1 mark)</b></p>

4 marks spelling    4 marks grammar \_\_\_\_\_

Total: /59 x 0.34 to make a mark out of 20.

## Extended Answer 2

Main Point	Details
Contrasting the Chemical Purification/Extraction of Fe/Au	<p>In nature, gold is mainly found as the free element (0 oxidation state). Its extraction involves the following changes in the oxidation state of gold: 0 <math>\rightarrow</math> +1 <math>\rightarrow</math> 0 (<b>1 mark</b>). The ore is leached with cyanide solution:</p> $4\text{Au(s)} + 8\text{CN}^-(\text{aq}) + 2\text{H}_2\text{O(l)} + \text{O}_2(\text{g}) \rightarrow 4[\text{Au(CN)}_2]^- (\text{aq}) + 4\text{OH}^-(\text{aq}) \quad (\textbf{1 mark})$ <p>Here, gold moves from an oxidation state (OS) of 0 to +1.</p> <p>The dissolved <math>[\text{Au(CN)}_2]^-</math> is separated from other materials (pulp) by adsorption on activated carbon in adsorption tanks (<b>1 mark</b>). The <math>[\text{Au(CN)}_2]^-</math> is then stripped from the carbon (<b>1 mark</b>) and the Au recovered by electrolysis which causes the following:</p> $4[\text{Au(CN)}_2]^- (\text{aq}) + 4\text{OH}^-(\text{aq}) \rightarrow 4\text{Au(s)} + 8\text{CN}^-(\text{aq}) + 2\text{H}_2\text{O(l)} + \text{O}_2(\text{g}) \quad (\textbf{1 mark})$ <p>Here, gold move from an OS of +1 back to 0.</p> <p>On the other hand, iron is found in an OS of +3 and its extraction has the following change in OS: +3 <math>\rightarrow</math> 0 (<b>1 mark</b>). Carbon monoxide gas reduces the iron ore to iron:</p> $3\text{CO(g)} + \text{Fe}_2\text{O}_3(\text{s}) \rightarrow 2\text{Fe(l)} + 3\text{CO}_2(\text{g}) \quad (\textbf{1 mark})$ <p>Unlike gold extraction iron extraction does not use adsorption or electrolysis (<b>2 marks</b>). The liquid iron is heavier than all other materials and simply sinks to the bottom of the blast furnace and then is tapped out (<b>1 mark</b>).</p> <p>In gold extraction, the carbon is in the form of activated charcoal and separates the required product by adsorption (<b>1 mark</b>).</p> <p>In iron extraction, the carbon is in the form of coke and separates the required product by oxidising to CO which then reduces the iron oxide (<b>1 mark</b>).</p>
Comparing the Chemical Purification/Extraction of Fe/Au	<p>The gold mud produced from electrolysis is purified in a similar manner to the extraction of iron from iron ore.</p> <p>Like iron ore, the gold mud is smelted at high temperatures (<b>1 mark</b>).</p> <p>Like iron extraction, undesirable impurities form a slag layer which floats on top of the gold (<b>1 mark</b>).</p> <p>Like iron, the gold is poured into moulds and solidifies (<b>1 mark</b>).</p> <p>The purities of the resulting iron and gold are approximately the same: respectively 98% and 95% (<b>1 mark</b>).</p> <p>Both iron and gold extraction require the use of carbon (<b>1 mark</b>).</p> <p>Both iron and gold extraction use redox reactions (<b>1 mark</b>).</p>

How the differences in the properties of gold and iron are reflected in their everyday use.	<p>Gold is chemically unreactive whereas iron is reactive readily oxidising to iron(II) and iron (III) <b>(1 mark)</b>. It is therefore understandable as to why gold is used as an international monetary standard or as teeth fillings whereas pure iron is not. We don't want our monetary standard or fillings to react! <b>(2 marks)</b></p> <p>Iron (in its oxide form) is found in greater amounts than gold <b>(1 mark)</b>. This is why it is used more extensively than gold especially in the building industry. It would be too expensive to use gold in the building industry <b>(1 mark)</b>.</p> <p>Unlike gold, iron is used in the building industry because it is strongly magnetic and this property is extremely useful in many mechanisms such as motors and bells <b>(1 mark)</b>.</p> <p>Gold is a prettier metal than iron. It is shiny and yellow <b>(1 mark)</b>. This, as well as its rarity and unreactive nature, make it a popular metal for jewellery <b>(1 mark)</b>.</p> <p>Gold is a better electrical conductor than iron. This is why gold is used to make electrical connections.</p>
Spelling	<b>(2 marks)</b>
Grammar	<b>(2 marks)</b>

Total: /30 x 0.67 to make a mark out of 20.