Name : _____ ( ) **Class : 4E1**

GreenRidge Secondary School

PRELIMINARY EXAMINATION 2002

Subject : Chemistry (5068)
Secondary Four Express
Paper 3

Date : 10 Sep 2002 **Duration : 1 h 30 min**

INSTRUCTIONS TO CANDIDATES

Write your name, index number in the spaces at the top of this page.

Answer **both** questions.
Write your answers in the spaces provided on the question paper.
You should show the essential steps in any calculation and record all experimental results in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
Qualitative Analysis notes for this paper are printed on page 7.

FOR EXAMINER'S USE	
1	
2	
Total	/40

This paper consists of 7 printed pages, including this page.

Question 1.

Steels are alloys of iron. Different types of steels have different percentage by mass of iron and other alloying metals or non-metals. The percentage of iron may be determined by dissolving a sample of steel in dilute sulphuric acid and titrating the iron(II) sulphate formed with potassium manganate(VII).

No indicator is required because the products are colourless and one drop of potassium manganate(VII) in **excess** produces a readily seen **pink** colour.

P is 0.0400 mol/dm^3 potassium manganate(VII)
Q is a solution obtained by dissolving 12.0 g of steel in dilute sulphuric acid and then adding water until the final volume is 1.00dm^3.

(a) Put the potassium manganate(VII) solution **P** into the burette.

(b) Pipette a 25.0 cm^3 portion of **Q** into a flask and titrate with **P**. At first the purple colour disappears rapidly but as the titration proceeds, this disappearance is less rapid. At the end-point one drop of **P** produces a pink colour that does **not** disappear on swirling.

Record your results in the table, repeating the titration as many times as you consider necessary to achieve consistent results.

Results

Burette readings

Titration number	**1**	**2**	**3**	
Final reading / cm^3				
Initial reading / cm^3				
Volume of P used / cm^3				
Best titration results (√)				

Summary

Tick **(√)** the best titration results.
Using these results, the average volume of **P** required was _____ cm^3.

Volume of solution of **Q** used was _____ cm^3. **[12]**

(c) Five moles of iron(II) sulphate react with one mole of potassium manganate(VII). **P** is 0.0400 mol/dm^3 potassium manganate(VII).

Using your results from (b), calculate, in mol/dm^3, the concentration of iron(II) sulphate in solution **Q**.

Concentration of iron(II) sulphate in solution **Q** is ..... mol/dm^3 **[2]**

(d) Using your answer to (c), calculate the mass of iron present in 1.00dm^3 of solution **Q**. (A_r of iron = 56).

Mass of iron in 1.00dm^3 of solution **Q** is ..... g **[1]**

(e) Solution **Q** was prepared by dissolving 12.0g of steel in dilute sulphuric acid and diluting until the final volume was 1 .00 dm^3. Using your answer to (d), calculate the percentage of iron present in the steel.

Percentage of iron in the steel is ..... % **[1]**

Question 2.

You are provided with a sample of solution **S** and **T**.

Carry out the following experiments and record your observations in the table.

You should test any gas evolved.

Tests on Solution S

Test No.	Test	Observations
1.	To a portion of the test solution **S**, add an equal volume of dilute hydrochloric acid and leave to stand for a few minutes.	
2.	To a portion of solution **S**, add 3 cm^3 of silver nitrate solution and leave to stand for a few minutes.	
3.	To a portion of acidified potassium manganate (VII), add an equal volume of the test solution **S**. Leave to stand for a few minutes.	
4.	To a portion of acidified potassium dichromate (VI), add an equal volume of the test solution **S**. Leave to stand for a few minutes.	

[9]

Tests on Solution T

Test No.	Test	Observations
5.	To a portion of **T** add an equal volume of dilute sulphuric acid.	
6.	(a) To a portion of **T** add aqueous ammonia until a change is seen. (b) Add an excess of aqueous ammonia to the mixture from (a).	
7.	(a) To a portion of **T,** add aqueous sodium hydroxide until a change is seen, (b) Add an excess of sodium hydroxide to the mixture from (a). (c) To about $2cm^3$ of the mixture from (b) add a piece of aluminium foil, leave to stand for a few minutes and then warm gently	
8.	Pour $1cm^3$ of **T** into a large boiling tube, add a few drops of aqueous potassium iodide and then add $12cm^3$ of distilled water. Heat until a change is observed and then allow it to cool to room temperature.	

[13]

Conclusions

In test 3 and 4, substance **S** is acting as _____. **[1]**

The formula of the compound in solution **T** is _____. **[1]**

~ The End ~

NOTES FOR USE IN QUALITATIVE ANALYSIS (5068/3)

Test for anions

anion	*test*	*test result*
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
iodide (I^-) *[in solution]*	acidify with dilute nitric acid, then add *aqueous lead(II) nitrate*	yellow ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide then aluminium foil; warm carefully	ammonia produced
sulphate (SO_4^{2-}) [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.

Test for aqueous cations

cation	*effect of aqueous sodium hydroxide*	*effect of aqueous ammonia*
aluminium (Al^{3+})	white ppt., soluble in excess giving a colourless solution	white ppt., insoluble in excess
ammonium (NH_4^+)	ammonia produced on warming	–
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt.
copper(II) (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess giving a dark blue solution
iron(II) (Fe^{2+})	green ppt., insoluble in excess	green ppt., insoluble in excess
iron(III) (Fe^{3+})	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
lead(II) (Pb^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., insoluble in excess
zinc (Zn^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., soluble in excess giving a colourless solution

Test for gases

gas	*test and test result*
ammonia (NH_3)	*turns damp red litmus paper blue*
carbon dioxide (CO_2)	turns limewater milky
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	"pops" with a lighted splint
oxygen (O_2)	relights a glowing splint
sulphur dioxide (SO_2)	turns aqueous potassium dichromate(VI) from orange to green

Instructions for Preparation

Question 1

Labelled **P** - **0.020 mol/dm^3** ***potassium manganate(VII)***. **[150ml per student]**
Labelled **Q** - a freshly prepared solution containing **27.0g** of ***hydrated iron(II) sulphate*** ($FeSO_4.7H_2O$) in **1 dm3 of approximately 1.0 mol/dm^3 sulphuric acid.** **[150ml per student]**

Question 2

Labelled Solution **S** - ***$Na_2S_2O_3$*** {50g/l} **[30ml per student]**
Labelled Solution **T** – ***$Pb(NO_3)_2$*** {30g/l} **[30ml per student]**

Reagents:

(1) approximately 2.0mol/dm^3 sulphuric acid,
(2) approximately 2.0mol/dm^3 hydrochloric acid,
(3) approximately 1.0mol/dm^3 aqueous sodium hydroxide,
(4) approximately 1.0mol/dm^3 aqueous ammonia,
(5) approximately 0.2mol/dm^3 acidified potassium manganate(VII),
(6) approximately 0.1 mol/dm^3 acidified potassium dichromate(VI),
(7) approximately 0.1 mol/dm^3 aqueous potassium iodide,
(8) approximately 0.05 mol/dm^3 aqueous silver nitrate,
(9) small pieces of aluminium toil,
(10) limewater,

Apparatus:

(1) 2x conical flask
(2) 1x 25ml pipette and pipette filler
(3) 1x 50ml burette with clip
(4) 1x filter funnel (for filling burette in titration)
(5) 6x test-tubes with test-tube holder and rack
(6) 1x boiling tube
(7) 1x stirring rod
(8) 1x glass tubing
(9) 1x 10ml measuring cylinder
(10) red and blue litmus paper
(11) filter paper strips
(12) wooden splints
(13) bunsen burner and lighter
(14) retort stand and clamp