Centre Number						Candidate Number				
Surname						Other Names				

Notice to Candidate. The work you submit for assessment must be your own. If you copy from someone else or allow another candidate to copy from you, or if you cheat in any other way, you may be disqualified.

Candidate Declaration. I have read and understood the Notice to Candidate and can confirm that I have produced the attached work without assistance other than that which is acceptable under the scheme of assessment.

Candidate Signature		Date	

For Examiner's Use Total EMPA mark	
Examiner's Initials	
Section	Mark
Task 1	
Task 2	
Section A	
Section B	
Section C	
TOTAL EMPA MARK	

General Certificate of Education
Advanced Level Examination
June 2011

Chemistry CHM6X

Unit 6X A2 Externally Marked Practical Assignment

For submission by 15 May 2011

For this paper you must have:	**Time allowed**
• the Periodic Table/Data Sheet provided as an insert (enclosed) • your Task Sheets 1 and 2, including your own Candidate Results Sheets • a ruler with millimetre measurements • a calculator.	• 1 hour 20 minutes
Instructions • Use black ink or black ball-point pen. • Fill in the boxes at the top of this 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. • 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 36. • You will be marked on your ability to: – organise information clearly – use scientific terminology accurately.

Details of additional assistance (if any). Did the candidate receive any help or information in the production of this work? If you answer yes give the details below or on a separate page.

Yes ☐ No ☐

Teacher Declaration:

I confirm that the candidate has met the requirements of the practical skills verification (PSV) in accordance with the instructions and criteria in section 3.8 of the specification.

Practical Skills Verification	**Yes** ☐

Signature of teacher ..... Date .....

Section A

These questions are about the task, the investigation of a weed killer.

You should use your Task Sheets 1 and 2, including your own Candidate Results Sheets, to answer them.

Answer **all** questions in the spaces provided.

1 The manufacturer of the weed killer published the following results when the tests used in Task 1 were repeated using a solution of the weed killer.

Test	Observations
Test 1 Ammonia solution Place about 10 drops of the sample in a test tube. Add ammonia solution, dropwise with shaking, until in excess.	Green precipitate formed. The precipitate was insoluble in excess ammonia solution.
Test 2 Sodium carbonate solution Place about 10 drops of the sample in a test tube. Add 10 drops of sodium carbonate solution and shake the mixture.	Green precipitate formed.
Test 3 Potassium thiocyanate solution Place about 10 drops of the sample in a test tube. Add 10 drops of potassium thiocyanate solution and shake the mixture.	Orange solution formed that turns red on standing.
Test 4 Potassium hexacyanoferrate(II) solution Place about 10 drops of the sample in a test tube. Add 10 drops of potassium hexacyanoferrate(II) solution and shake the mixture.	Pale blue precipitate formed.

Explain whether or not your observations from Task 1, and the manufacturer's results, allow you to confirm that iron(II) ions are present in the solution of the weed killer.

.....

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(1 mark)

2 Describe a simple test to confirm that there are sulfate ions in the solution of the weed killer. State what you would observe.

Test .....

Observation .....

(2 marks)

3 Record the average titre from your Candidate Results Sheet for Task 2.

Average titre .....

(1 mark)

4 Half-equations for the redox reactions occurring in the reaction between iron(II) and potassium manganate(VII) in acidic solution are shown below.

$$Fe^{2+} \longrightarrow Fe^{3+} + e^-$$

$$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$$

Deduce an overall equation for the reaction between iron(II) and manganate(VII) ions in acidic solution.

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(1 mark)

5 The concentration of the potassium manganate(VII) used was 0.0200 mol dm^{-3}. Use your answers from Questions **3** and **4** to calculate the amount, in moles, of iron(II) ions in 25.0 cm^3 of the weed killer solution.

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(1 mark)

6 Use your answer from Question **5** to calculate the concentration, in mol dm^{-3}, of iron(II) ions in the weed killer solution.
Give your answer to the appropriate precision.

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(2 marks)

Turn over ▶

7 The weed killer solution was prepared by dissolving hydrated iron(II) sulfate, $FeSO_4.7H_2O$, in water.

7 (a) Use data from the Periodic Table to calculate the M_r of $FeSO_4.7H_2O$
Give your answer to one decimal place.

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(1 mark)

7 (b) Use your answers from Questions **6** and **7 (a)** to calculate the concentration, in g dm^{-3}, of hydrated iron(II) sulfate in the weed killer solution.

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(1 mark)

8 When iron(II) sulfate is used for killing weeds in lawns, it is often mixed with the fertiliser ammonium sulfate. Ammonium sulfate also makes the soil acidic.

8 (a) Write an equation to show how the ammonium ion behaves as a Brønsted–Lowry acid in water.

.....

(1 mark)

8 (b) Compounds such as ammonium sulfate react on warming with sodium hydroxide solution as shown in the equation below.

$$(NH_4)_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2NH_3 + 2H_2O$$

Use this information to describe a simple test, other than smell, to show that ammonia is evolved. State what you would observe.

Test .....

.....

Observation .....

(2 marks)

9 The table below shows some standard electrode potentials.

	$E^{\ominus}$ / V
$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$	+1.51
$Cl_2(g) + 2e^- \longrightarrow 2Cl^-(aq)$	+1.36
$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$	+1.33

A student determined the concentration of iron(II) ions in a solution of iron(II) chloride by titration with acidified potassium dichromate(VI) solution. A second student titrated the same solution of iron(II) chloride with acidified potassium manganate(VII) solution. By reference to the table, explain why the second student obtained a greater value for the concentration of iron(II) ions.

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(2 marks)

15

Turn over for the next question

Section B

Answer **all** questions in the spaces provided.

Introduction

Iron(II) sulfate is used to kill weeds in garden lawns. It is a by-product of the manufacture of steel. When a lawn is treated with iron(II) sulfate, the iron(II) ions are oxidised to form iron(III) ions.

10 Iron(III) ions are acidic in aqueous solution as shown by the following equation.

$$[Fe(H_2O)_6]^{3+}(aq) \rightleftharpoons [Fe(H_2O)_5(OH)]^{2+}(aq) + H^+(aq)$$

In an experiment, a calibrated pH meter was used to measure the pH of an iron(III) salt in solution. At 20 ºC the pH of a 0.100 mol dm^{-3} solution of iron(III) sulfate was found to be 1.62

10 (a) Explain briefly why a pH meter should be calibrated before use.

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(1 mark)

10 (b) Write an expression for the equilibrium constant, K_a, for the dissociation of iron(III) ions in aqueous solution.

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(1 mark)

10 (c) Use your answer from Question **10 (b)** to calculate the value of K_a for this reaction at 20 ºC.
Give your answer to the appropriate precision. Show your working.

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(4 marks)

10 (d) Name the substance that is most likely to oxidise the iron(II) ions when iron(II) sulfate is used as a weed killer.

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(1 mark)

10 (e) Suggest a value for the pH of a 0.100 mol dm^{-3} solution of iron(II) sulfate.

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(1 mark)

11 Steel rods are cleaned before they are painted. The rods are cleaned by passing them through a bath of dilute sulfuric acid. This process produces large quantities of iron(II) sulfate.

11 (a) Write an equation for the reaction between iron and dilute sulfuric acid.

.....

(1 mark)

11 (b) State **one** chemical hazard in this process and suggest an appropriate safety precaution for this hazard.

Hazard .....

Precaution .....

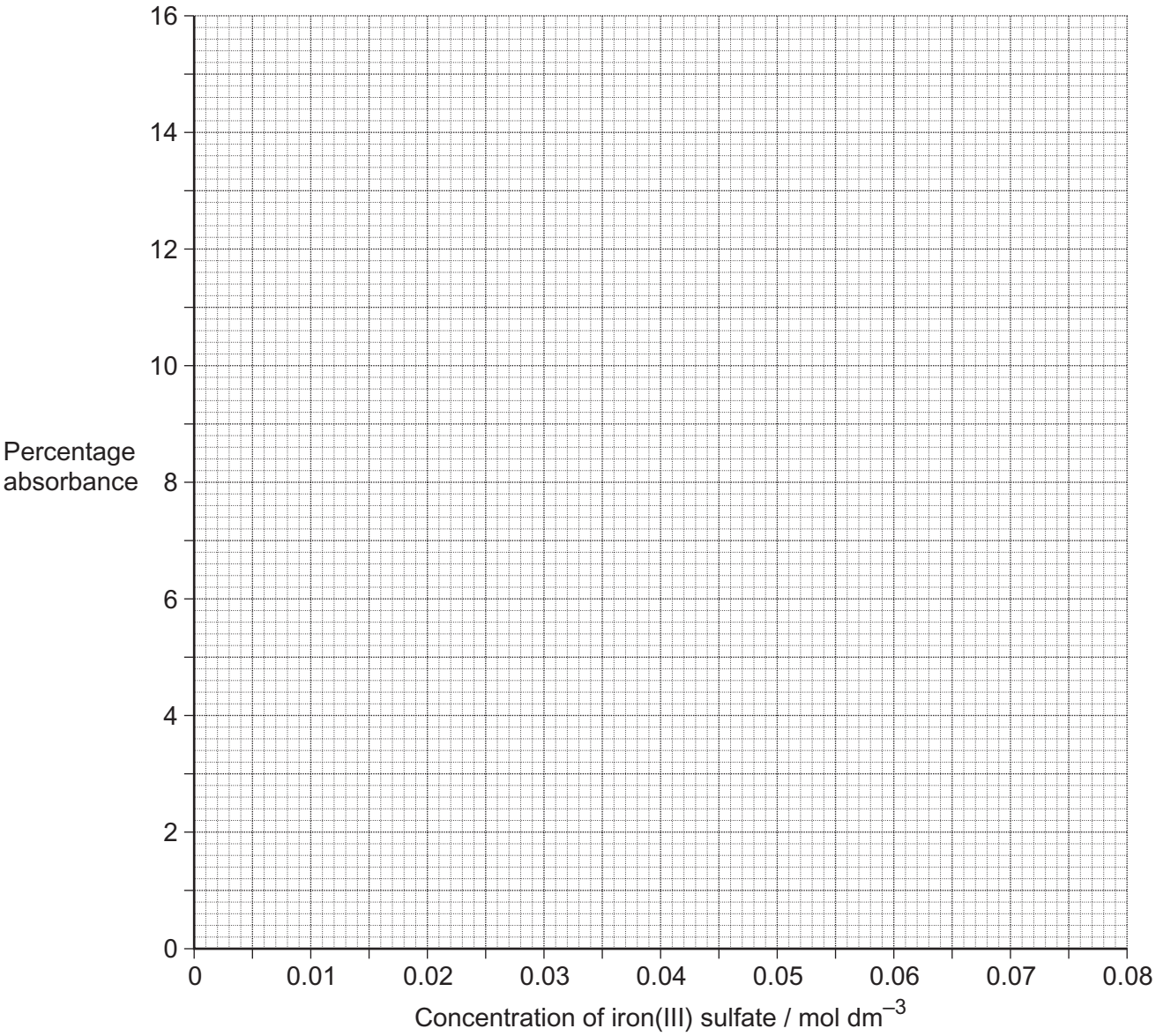
(2 marks)

Turn over for the next question

12 The concentration of iron(III) ions in a dilute solution can be determined by visible spectrometry. The absorption of light of a particular frequency by solutions of iron(III) sulfate of different concentrations was measured. The results are shown in the table below.

Percentage absorbance	Concentration of iron(III) sulfate / mol dm^{-3}
1.0	7.5×10^{-3}
2.5	14.0×10^{-3}
5.0	27.5×10^{-3}
7.0	37.5×10^{-3}
10.0	54.0×10^{-3}
12.0	65.0×10^{-3}

12 (a) Use these results to plot a graph of percentage absorbance (*y*-axis) against concentration of iron(III) sulfate on the grid opposite.
Draw a straight line of best fit. *(2 marks)*



12 (b) Use your graph to determine the concentration of an iron(III) sulfate solution that has a percentage absorbance of 14.0%.

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(1 mark)

12 (c) Use your observations from Task 1 to explain why it is an advantage to add thiocyanate ions to the iron(III) sulfate solution before measuring the percentage absorbance.

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(1 mark)

15

Section C

These questions test your understanding of the skills and techniques you have acquired during your A-level course.

Answer **all** questions in the spaces provided.

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13 (a) State why it is necessary to maintain a constant temperature in an experiment to measure an equilibrium constant.

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(1 mark)

13 (b) Suggest **one** method for maintaining a constant temperature in an experiment.

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(1 mark)

14 Draw a diagram to show the apparatus you would use to filter a mixture under reduced pressure.
You are **not** required to show the pump that is used to reduce the pressure.

(2 marks)

15 Samples of 1-chloropropane and ethanoyl chloride can be distinguished by the addition of an aqueous solution of silver nitrate.
State what you would observe with each sample.

Observation with 1-chloropropane

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Observation with ethanoyl chloride.

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(2 marks)

6

END OF QUESTIONS

There are no questions printed on this page

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