OCR
RECOGNISING ACHIEVEMENT

SPECIMEN

Advanced GCE

CHEMISTRY A

Unit F326: Practical Skills in Chemistry 2:
Evaluative Task

Specimen Task

For use from September 2008 to June 2009.

F326 (3)

All items required by teachers and candidates for this task are included in this pack.

INFORMATION FOR CANDIDATES

- Evaluative Task: Water of crystallisation

INFORMATION FOR TEACHERS

- Mark scheme.
- Instructions for Teachers and Technicians.

  [Turn Over

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Advanced GCE

CHEMISTRY A

Unit F326: Practical Skills in Chemistry 2:
Evaluative Task

Specimen Task

F326 (3)

For use from September 2008 to June 2009.
Candidates answer on this task sheet.

INSTRUCTIONS TO CANDIDATES

- Answer **all** parts of the task.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each part of the task.
- The total number of marks for this task is **15**.

INFORMATION FOR TEACHERS

- Before carrying out this task, it would normally be expected that candidates will have carried out Unit F326 Task 2: '*Determination of the formula of hydrated iron(II) sulfate*'.

ADVICE TO CANDIDATES

- Read each part carefully and make sure you know what you have to do before starting your answer.

FOR TEACHER'S USE		
Part	**Max.**	**Mark**
C1	**5**	
C3	**5**	
C4	**5**	
TOTAL	**15**	

This task consists of **7** printed pages and **1** blank page.

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Water of crystallisation

A student carried out an experiment to determine the value of *x* in hydrated iron(II) nitrate $Fe(NO_3)_2 \bullet xH_2O$.

The student first prepared an aqueous solution by dissolving 3.60 g of $Fe(NO_3)_2 \bullet xH_2O$ in water and making up the solution to 250.0 cm^3 in a volumetric flask.

The student then determined *x* by two methods.

1 Titration

A 25.0 cm^3 sample of this solution was measured using a pipette. The solution was acidified and then titrated with a standard solution of potassium manganate(VII).

The process was repeated until consistent titres had been obtained.

From the results, the value of *x* in $Fe(NO_3)_2 \bullet xH_2O$ was determined.

2 Displacement

A 25.0 cm^3 sample of this solution was taken and a more reactive metal was added, displacing the iron in a redox reaction.

The student chose a suitable metal from redox systems below.

I	$Fe^{2+}(aq) + 2e^- \rightleftharpoons Fe(s)$		$E^{\ominus} = -0.41$ V
II	$Al^{3+}(aq) + 3e^- \rightleftharpoons Zn(s)$		$E^{\ominus} = -1.66$ V
III	$Cr^{3+}(aq) + 3e^- \rightleftharpoons Cr(s)$		$E^{\ominus} = -0.74$ V
IV	$Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s)$		$E^{\ominus} = +0.34$ V
V	$Ag^{+}(aq) + e^- \rightleftharpoons Ag(s)$		$E^{\ominus} = +0.80$ V

The iron obtained was filtered off, washed with distilled water and dried. The iron was then weighed as follows.

Mass of empty weighing bottle = 20.16 g

Mass of weighing bottle + iron = 20.23 g

From the results, the value of *x* in $Fe(NO_3)_2 \bullet xH_2O$ was determined.

Analysis

(a) Choose a suitable metal that could be used for the displacement reaction.

Justify your answer in terms of electrode potentials and write an equation for the displacement reaction.

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..... C1 **[3]**

(b) In the displacement experiment, 0.00125 mol of Fe was obtained.

Use this amount of Fe to help you calculate the value of x in $Fe(NO_3)_2 \cdot xH_2O$.

Show all your working.

C1 **[2]**

(c) The titration method gives a more reliable and accurate result for *x* than the displacement method.

(i) State and explain **two** reasons for this.

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..... C3 **[2]**

(ii) Suggest **two** modifications to the displacement reaction that would produce more reliable and accurate results.

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..... C4 **[2]**

(d) The value of *x* could also be determined by heating the hydrated compound to drive off the water of crystallisation to obtain anhydrous iron(II) nitrate.

$$Fe(NO_3)_2 \bullet xH_2O(s) \rightarrow Fe(NO_3)_2(s) + xH_2O(l)$$

A problem with this approach is that the anhydrous iron(II) nitrate will further decompose to iron(II) oxide. This is shown in **equation 2.1** below.

$$Fe(NO_3)_2(s) \rightarrow FeO(s) + 2NO_2(g) + \tfrac{1}{2}O_2(g) \qquad \textbf{equation 2.1}$$

Some of the anhydrous iron(II) nitrate is likely to decompose in this way.

(i) Explain the most likely effect of further decomposition on the value of *x* obtained from this method.

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..... C3 **[1]**

(ii) A student suggested that this approach could still be used to obtain an accurate value of *x* by strongly heating the $Fe(NO_3)_2 \bullet xH_2O$ until it had all decomposed into iron(II) oxide.

Explain, with a reason whether you agree with the student.

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..... C3 **[1]**

(iii) Iron(II) oxide, FeO, readily oxidises in the air to form iron(III) oxide, Fe_2O_3. This reaction takes place slowly.

What would be most likely effect on the value of *x* obtained if some of the iron(II) oxide was oxidised? Explain your answer.

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..... C3 **[1]**

(e) Another modification to the experiment in **(d)** would be to work out the mass of water that was released.

(i) Draw a labelled diagram to show how this could be carried out experimentally.

C4 **[2]**

(ii) The student suggested that any further decomposition, as in **equation 2.1**, would then not matter using this modification.

Explain, with a reason whether you agree with the student.

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..... C4 **[1]**

C1: 5; C3: 5; C4 5 **[Total: 15]**

END OF TASK

Total [15]

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OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

CHEMISTRY A F326 (3)

Unit F326: Practical Skills in Chemistry 2: Evaluative Task

Specimen Mark Scheme

The maximum mark for this task is **15**.

For use from September 2008 to June 2009.

Instructions for teachers

Before carrying out this task, it would normally be expected that candidates will have carried out Unit F326 Task 2: '*Determination of the formula of hydrated iron(II) sulfate*'.

	Quality C1	**Max Mark**
1	chooses suitable metal: Cr or Al	**[1]**
	justifies choice of metal in terms of electrode potentials	**[1]**
	writes correct equation: $2Cr + 3Fe^{2+} \rightarrow 2Cr^{3+} + 3Fe$ or $2Al + 3Fe^{2+} \rightarrow 2Al^{3+} + 3Fe$	**[1]**
	calculates correctly the number of moles of $Fe(NO_3)_2 \cdot xH_2O$: 10 x 0.00125 = 0.0125 mol	
	calculates correct relative formula mass of $Fe(NO_3)_2 \cdot xH_2O$ = 3.60/0.0125 = 288	**[1]**
	calculates correctly the value of *x*: = (288 – 179.8)/18 = 6	**[1]**
	Quality C3	
	identifies error 1: experiment only carried out once	**[1]**
	identifies error 2: large % error from weighings	**[1]**
	identifies that '*x*' would be larger as mass loss will be larger than from H_2O alone	**[1]**
	agrees with student if calculations based entirely on FeO	**[1]**
	identifies that '*x*' would be smaller: mass loss will be smaller (O added)	**[1]**
	Quality C4	
	identifies modification 1: repeat experiment until consistent results are obtained	**[1]**
	identifies modification 1: use more accurate balance: reduce large % error from weighings	**[1]**
	draws a diagram with container being heated with effective collection of H_2O	**[1]**
	draws diagram with **no** closed system	**[1]**
	identifies that decomposition doesn't matter as mass of anhydrous salt can be determined from the mass of water evolved.	**[1]**
	Total	**[15]**

Oxford Cambridge and RSA Examinations

Advanced GCE

CHEMISTRY A F326 (3)

Unit F326: Practical Skills in Chemistry 2: Evaluative Task

Instructions for Teachers and Technicians

For use from September 2008 to June 2009.

This is an Evaluative Task. There is no time limit but it is expected that it can be completed within one hour.

Candidates may attempt more than one Evaluative task with the best mark from this type of task being used to make up the overall mark for Unit F326.

Preparing for the assessment

It is expected that before candidates attempt Practical Skills in Chemistry 2 (Unit F326) they will have had some general preparation in their lessons. They will be assessed on a number of qualities such as recognising and interpreting data, identifying anomalies and reaching valid conclusions, assessing the reliability and accuracy of an experimental task, identifying significant weaknesses in experimental procedures and measurements, and understanding and selecting simple improvements to experimental procedures and measurements. It is therefore essential that they should have some advance practice in these areas so that they can maximise their attainment.

Preparing candidates

At the start of the task the candidates should be given the task sheet.

Candidates must work on the task individually under controlled conditions with the completed task being submitted to the teacher at the end of the lesson. Completed tasks should be kept under secure conditions until results are issued by OCR.

Candidates should not be given the opportunity to redraft their work, as this is likely to require an input of specific advice. If a teacher feels that a candidate has under-performed, the candidate may be given an **alternative** task. In such cases it is essential that the candidate be given detailed feedback on the completed assessment before undertaking another Evaluative Task. Candidates are permitted to take each task **once** only.

Assessing the candidate's work

The mark scheme supplied with this pack should be used to determine a candidate's mark out of a total of 15 marks. The cover sheet for the task contains a grid for ease of recording marks. To aid moderators it is preferable that teachers mark work using red ink, including any appropriate annotations to support the award of marks.