General Certificate of Education
Advanced Level Examination
June 2010

Chemistry CHM6X/TN

Unit 6X A2 Externally Marked Practical Assignment

Teachers' Notes Confidential

To be given immediately to the teacher(s) responsible for GCE Chemistry

Open on receipt

Teachers' Notes

Confidential

These notes must be read in conjunction with *Instructions for the Administration of the Externally Marked Practical Assignment: GCE Chemistry* published on the AQA Website.

The investigation of a hair bleach

Task 1 Observation exercises

Materials

Each candidate should be provided with the following reagents in suitable closed containers.

Reagent	Approximate concentration	Volume	Note
Hydrogen peroxide	1.0 mol dm^{-3}	10 cm^3	Labelled '**Solution A for Task 1**'
Chromium(III) sulfate	0.1 mol dm^{-3}	5 cm^3	Labelled '**Chromium(III) sulfate**' Individual supply not required
Sodium hydroxide	2.0 mol dm^{-3}	10 cm^3	Labelled '**Sodium hydroxide**' Individual supply not required
Universal indicator solution	standard indicator		Labelled **'Universal indicator'** Individual supply not required
Manganese(IV) oxide	approximately 0.5 g of solid		Labelled '**Manganese(IV) oxide**'

General

Reagents of good analytical quality should be used and spare supplies of all solutions specified in these notes must be available.

Apparatus

Each candidate will require the following:

Number	Apparatus
3	test tube
4	dropping pipette
1	test tube rack
1	small spatula
	a plentiful supply of purified water (either distilled or de-ionised)
	suitable eye protection

Teacher Result

A teacher must carry out Task 1, using the same stock solutions. A teacher set of observations is required for **each** group of candidates. The teacher's observations, along with the Teacher Group, must be recorded in the space provided on the Teacher Results Sheet for Task 1. These observations will be used by the examiner to assess the accuracy of the candidates' results. The teacher must **not** carry out Task 1 in the presence of the candidates.

In order to ensure that the appropriate Teacher Result can be matched with each candidate, teachers must ensure that all candidates complete all details on the Candidate Results Sheets for Task 1 and Task 2, including 'Teacher Group'.

The Teacher Results Sheets must be included with the scripts sent to the examiner.

Task 2 Redox titration

Materials

Each candidate should be provided with the following reagents in suitable closed containers.

Reagent	Concentration	Volume	Note
Hydrogen peroxide	between 0.045 and 0.055 mol dm^{-3}	150 cm^3	Labelled '**Hair bleach for Task 2**'
Potassium manganate(VII)	between 0.0195 and 0.0205 mol dm^{-3}	200 cm^3	Labelled '**Potassium manganate(VII)**'
Sulfuric acid	approximately 1 mol dm^{-3}		Labelled '**Sulfuric acid**' Individual supply not required

General

Reagents of good analytical quality should be used and spare supplies of all solutions specified in these notes must be available.

Apparatus

Each candidate will require the following:

Number	Apparatus
1	50 cm^3 burette and stand
1	funnel suitable for filling a burette
1	25 cm^3 pipette
1	pipette filler
1	250 cm^3 conical flask
1	measuring cylinder (10 cm^3, 25 cm^3 or 50 cm^3)
	a plentiful supply of purified water (either distilled or de-ionised)
	suitable eye protection

Turn over ▶

Teacher Result

A teacher must carry out Task 2, using the same stock solutions, in order to obtain a value for the average titre. A teacher result is required for **each** group of candidates. The teacher's value for the average titre, along with the Teacher Group, must be recorded in the space provided on the Teacher Results Sheet for Task 2. This value will be used by the examiner to assess the accuracy of the candidates' values. The teacher must **not** carry out Task 2 in the presence of the candidates.

In order to ensure that the appropriate Teacher Result can be matched with each candidate, teachers must ensure that all candidates complete all details on the Candidate Results Sheets for Task 1 and Task 2, including 'Teacher Group'.

The Teacher Results Sheets must be included with the scripts sent to the examiner.

Managing the tasks

Centres with more than one teaching set

Centres may wish to divide their candidates into manageable groups and to conduct assessments at different times. This is acceptable provided that candidates in a later session are given a hydrogen peroxide solution for Task 2 whose concentration is slightly different from that given to candidates in the earlier sessions.

One week before sitting stage 1 of the EMPA you may inform your candidates:

The aim of this task is to identify the compound present in a hair bleach by means of a series of observation exercises and a titration of an acidified solution of the hair bleach with potassium manganate(VII) solution.

There should be no further discussion of this topic.

Teacher Results Sheet for Task 1

Centre Number | | | | | |

Teacher Name ..... Teacher Group .....

Results

Record your observations in the table below.

Use a separate sample of solution A in each of the following tests.	**Observations with Solution A**
Test 1 with chromium(III) sulfate solution and sodium hydroxide solution Place about 20 drops of chromium(III) sulfate solution in a test tube. Add sodium hydroxide solution, dropwise with shaking, until the test tube is about one quarter full. Now add 20 drops of **A** and shake the mixture. Leave the mixture to stand for a few minutes. While you are waiting, begin the tests below.	
Test 2 with universal indicator solution Place about 10 drops of **A** in a test tube. Add 3 drops of universal indicator solution, and shake the mixture.	
Test 3 with manganese(IV) oxide Place about 10 drops of **A** in a test tube. Add a small amount of manganese(IV) oxide.	

This sheet may be photocopied

Teacher Results Sheet for Task 2

Centre Number | | | | | |

Teacher Name ..... Teacher Group .....

Results

Present your titration results in a table in the space below.

Average titre / cm^3 .....

This sheet may be photocopied

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use
Total Task 1

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June 2010

Chemistry CHM6X/PM1

Unit 6X A2 Externally Marked Practical Assignment
Task Sheet 1

To be completed before Task Sheet 2.

For submission by 15 May 2010

For this paper you must have:
- a ruler
- a calculator.

Turn over ▶

The investigation of a hair bleach

Hydrogen peroxide can act as an oxidising agent and as a reducing agent. Aqueous solutions of hydrogen peroxide are used to bleach human hair. However, hydrogen peroxide is also a skin irritant, so it must only be used in dilute solution.

This practical assessment is in two parts, Task 1 and Task 2.

In Task 1 you will complete a series of observation exercises on a solution of a hair bleach. The results of these exercises will allow you to confirm that this hair bleach contains hydrogen peroxide.

In Task 2 you will determine the concentration of a solution of hydrogen peroxide in this bleach by titration with aqueous potassium manganate(VII) in the presence of dilute sulfuric acid.

Task 1 Observation exercises

Confirmation of the presence of hydrogen peroxide in a hair bleach

You are provided with an aqueous solution, labelled **A**, of the hair bleach.

Use a separate sample of solution A in each of the following tests.

Record what you **observe** in a table of your own design on the Candidate Results Sheet for Task 1. Where no visible change is observed, write 'no visible change'.

You are **not** required to identify solution **A** or any of the reaction products in this part of the task.

Wear eye protection at all times.
For the purpose of this task assume that all of the solutions are toxic and corrosive.

Test 1 Test with chromium(III) sulfate solution and sodium hydroxide solution
Place about 20 drops of chromium(III) sulfate solution in a test tube. Add sodium hydroxide solution, dropwise with shaking, until the test tube is about one quarter full. Now add 20 drops of **A** and shake the mixture. Leave the mixture to stand for a few minutes.
While you are waiting, begin the tests below.

Test 2 Test with universal indicator solution
Place about 10 drops of **A** in a test tube. Add 3 drops of universal indicator solution, and shake the mixture.

Test 3 Test with manganese(IV) oxide
Place about 10 drops of **A** in a test tube. Add a small amount of manganese(IV) oxide.

Candidate Results Sheet for Task 1

Results

Record your observations in a table of your own design in the space below.

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use
Total Task 2

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Advanced Level Examination
June 2010

Chemistry CHM6X/PM2

Unit 6X A2 Externally Marked Practical Assignment
Task Sheet 2

To be completed before the EMPA Written Test.

For submission by 15 May 2010

For this paper you must have:
- a ruler
- a calculator.

Turn over ▶

Task 2 Determination of the concentration of hydrogen peroxide in the bleach

Aqueous solutions of hydrogen peroxide are used to bleach human hair. However, hydrogen peroxide is also a skin irritant so must only be used in dilute solution.

You are provided with a solution of the hair bleach which has been diluted with water. You will titrate this diluted solution with the 0.0200 mol dm^{-3} solution of potassium manganate(VII) provided. The titration results will allow you to determine the concentration of hydrogen peroxide in the diluted hair bleach.

Wear eye protection at all times.
For the purpose of this task assume that all of the solutions are toxic and corrosive.

Procedure

1. Rinse the burette with the potassium manganate(VII) solution. Set up the burette and, using a funnel, fill it with the potassium manganate(VII) solution. Record the initial burette reading in a table of your own design on the Candidate Results Sheet for Task 2.

2. Using a pipette filler, rinse the pipette with the hair bleach solution provided for Task 2. Using this pipette, transfer 25.0 cm^3 of the hair bleach solution to a 250 cm^3 conical flask.

3. Using a measuring cylinder, transfer approximately 10 cm^3 of dilute sulfuric acid to the conical flask.

4. Add the potassium manganate(VII) solution from the burette until the mixture in the conical flask just turns pink. Record your final burette reading in your table.

5. Rinse the conical flask with distilled or de-ionised water and repeat the titration until you obtain a minimum of **two** titres which are concordant. (You should do no more than five titrations.)
   Have one of your final burette readings checked by your teacher.

6. Calculate and record the average titre on the Candidate Results Sheet for Task 2.
   Indicate clearly the titres used in calculating this average titre.

Candidate Results Sheet for Task 2

Results

Record your results from the titration in a table of your own design in the space below.

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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	

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Advanced Level Examination
June 2010

Chemistry CHM6X

Unit 6X A2 Externally Marked Practical Assignment

Written Test

For submission by 15 May 2010

For this paper you must have:
- 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.

Time allowed
- 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.
- The Periodic Table / Data Sheet is provided as an insert.
- You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use accurate scientific terminology.

Turn over ▶

Section A

These questions are about the task, the investigation of a hair bleach.

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

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

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1 (a) Consider your results from Task 1. State **one** observation which enabled you to confirm that solution **A** contained an oxidising agent.

1 (b) State what you can deduce about solution **A** from your observations in Test 2.

2 In a further test, when solution **A** was added to iron(II) chloride solution, the mixture changed colour from green to yellow. When sodium hydroxide solution was added to this mixture, a precipitate was formed. Identify this precipitate and state its colour.

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

4 Half-equations for the redox reactions occurring in the reaction between hydrogen peroxide and potassium manganate(VII) are shown below.

$$H_2O_2 \longrightarrow O_2 + 2H^+ + 2e^-$$

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

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

5 The concentration of the potassium manganate(VII) solution used was 0.0200 mol dm^{-3}.
Use your answers from Questions **3** and **4** to calculate the amount, in moles, of hydrogen peroxide in 25.0 cm^3 of the hair bleach solution provided for Task 2. Show your working.

6 Use your answer from Question **5** to calculate the concentration, in mol dm^{-3}, of hydrogen peroxide in the hair bleach solution provided for Task 2. Give your answer to the appropriate precision.

7 Hydrogen peroxide is sold commercially as an aqueous solution containing approximately 60 g dm^{-3} of hydrogen peroxide.

7 (a) Use data from the Periodic Table to calculate the M_r of hydrogen peroxide. Give your answer to the appropriate precision.

7 (b) Calculate the concentration, in mol dm^{-3}, of a solution containing 60.0 g dm^{-3} of hydrogen peroxide.

7 (c) The concentration of hydrogen peroxide in a hair bleach is 0.050 mol dm^{-3}. Use your answer from Question **7 (b)** to calculate the dilution factor needed to make the commercial hydrogen peroxide solution suitable for use in this hair bleach. Show your working.

Section B

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

Introduction

Hydrogen peroxide is a powerful oxidising agent. Acidified hydrogen peroxide reacts with iodide ions to form iodine according to the following equation.

$$H_2O_2(aq) + 2H^+(aq) + 2I^-(aq) \longrightarrow I_2(aq) + 2H_2O(l)$$

The **initial rate** of this reaction is investigated by measuring the time taken to produce sufficient iodine to give a blue colour with starch solution.

A series of experiments was carried out, in which the concentration of iodide ions was varied, while keeping the concentrations of all of the other reagents the same. In each experiment the time taken (t) for the reaction mixture to turn blue was recorded.

The initial rate of the reaction can be represented as $(\frac{1}{t})$, and the initial concentration of iodide ions can be represented by the volume of potassium iodide solution used.

A graph of $\log_{10}(\frac{1}{t})$ on the y-axis against $\log_{10}$ (volume of KI(aq)) is a straight line. The gradient of this straight line is equal to the order of the reaction with respect to iodide ions.

The results obtained are given in the table below. The time taken for each mixture to turn blue was recorded on a stopclock graduated in seconds.

Expt.	Volume of KI(aq) / cm^3	$\log_{10}$ (volume of KI(aq))	Time / s	$\log_{10}(\frac{1}{t})$
1	5	0.70	71	–1.85
2	8	0.90	46	–1.66
3	10	1.00	37	–1.57
4	15	1.18	25	–1.40
5	20	1.30	19	–1.28
6	25	1.40	14	–1.15

8 Use the results given in the table to plot a graph of $\log_{10}(\frac{1}{t})$ on the y-axis against $\log_{10}$ (volume of KI(aq)).

Draw a straight line of best fit on the graph, ignoring any anomalous points.

9 Determine the gradient of the line you have drawn. Give your answer to two decimal places. Show your working.

Turn over ▶

10 Deduce the order of reaction with respect to iodide ions.

11 A student carried out the experiment using a flask on the laboratory bench. The student recorded the time taken for the reaction mixture to turn blue. State **one** way this method could be improved, other than by repeating the experiment or by improving the precision of time or volume measurements. Explain why the accuracy of the experiment would be improved.

12 Pure hydrogen peroxide is a colourless liquid with a boiling point of 150 ºC. Hydrogen peroxide was originally produced commercially in a two-stage process. In the first stage barium was heated in air to form barium peroxide. In the second stage barium peroxide was added to aqueous nitric acid. The equations for the reactions are shown below.

Stage **1** $Ba(s) + O_2(g) \longrightarrow BaO_2(s)$

Stage **2** $BaO_2(s) + 2HNO_3(aq) \longrightarrow H_2O_2(aq) + Ba(NO_3)_2(aq)$

12 (a) Suggest **one** method of separating hydrogen peroxide from the reaction mixture in Stage **2**.

12 (b) Apart from cost, suggest **one** reason why nitric acid was eventually replaced by sulfuric acid in Stage **2**.

12 (c) Suggest **one** reason why infrared spectroscopy could **not** be used to indicate the presence of a small amount of water in hydrogen peroxide.

13 Hydrogen peroxide decomposes very slowly at room temperature. The equation for the reaction is shown below.

$$2H_2O_2 \longrightarrow 2H_2O + O_2$$

13 (a) Suggest **one** reason why hydrogen peroxide decomposes more quickly if it is **not** stored in brown glass bottles.

13 (b) Despite the corrosive nature of hydrogen peroxide, suggest **one** reason why a spillage of a dilute solution of hydrogen peroxide presents little long-term danger to the environment.

Turn over ▶

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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14 Ethanal is prepared by heating ethanol with potassium dichromate(VI) in the presence of sulfuric acid. **Figures 1** and **2** show two possible ways of heating this reaction mixture.

Figure 1

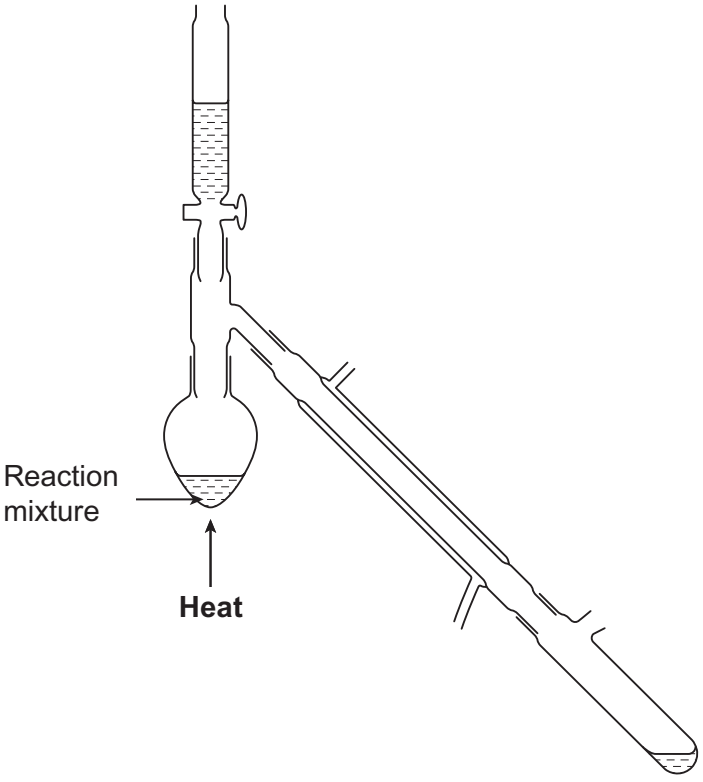
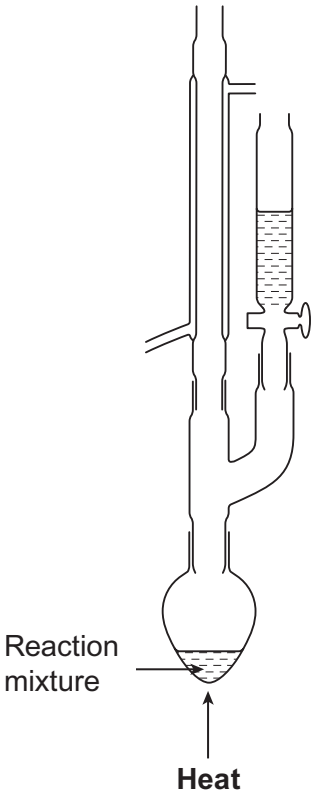


Figure 2



State which arrangement would **not** be suitable for the preparation of ethanal. Explain your answer.

15 Describe briefly how you would ensure that a reading from a pH meter is accurate.

16 Describe briefly how you could measure the melting point of aspirin.

END OF QUESTIONS