



Cambridge International Examinations

Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	
CHEMISTRY			9701/34
Paper 3 Advance	ced Practical Skills 2	Oct	ober/November 2014
Candidates answer on the Question Paper.			2 hours

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.

Give details of the practical session and laboratory where appropriate, in the boxes provided.

As listed in the Confidential Instructions

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer all questions.

Additional Materials:

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

Use of a Data Booklet is unnecessary.

Qualitative Analysis Notes are printed on pages 10 and 11.

At the end of the examination, fasten all your work securely together. The number of marks is given in brackets [] at the end of each question or part question.

	Session
	Laboratory
1	

For Examiner's Use	
1	
2	
3	
Total	

This document consists of 11 printed pages and 1 blank page.



1 Hydrogen peroxide, H₂O₂, is used in hair bleach and for skin therapies. In this experiment you will determine the concentration of a solution of hydrogen peroxide by titration with acidified potassium manganate(VII).

FB 1 is 0.0250 mol dm⁻³ potassium manganate(VII), KMnO₄.

FB 2 is dilute sulfuric acid, H₂SO₄.

FB 3 is aqueous hydrogen peroxide, H₂O₂.

(a) Method

Dilution of FB 3

- Pipette 25.0 cm³ of FB 3 into the volumetric (graduated) flask.
- Make the solution up to the mark using distilled water.
- Shake the flask thoroughly.
- This diluted solution of hydrogen peroxide is FB 4.

Titration

- Fill the burette with **FB 1**.
- Pipette **10.0 cm³** of **FB 4** into a conical flask.
- Use a measuring cylinder to add 25 cm³ of **FB 2** into the same flask.
- Add **FB 1** until a permanent pale pink colour is seen.
- Perform a **rough** titration and record your burette readings in the space below.

The rough titre is cm ³	The	rough	titre	is		cm ³
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- Carry out as many accurate titrations as you think necessary to obtain consistent results.
- Make sure any recorded results show the precision of your practical work.
- Record in a suitable form below all of your burette readings and the volume of **FB 1** added in each accurate titration.

Keep solution FB 2 for use in Question 3 and solution FB 3 for use in Questions 2 and 3.

I II III IV V VI VII

[7]

(b) From your accurate titration results, obtain a suitable value for the volume of FB 1 to be used

		your calculations. ow clearly how you have obtained this value.
		10.0 cm ³ of FB 4 required cm ³ of FB 1 . [1]
(c)	Ca	Iculations
		ow your working and appropriate significant figures in the final answer to each step of your culations.
	(i)	Calculate the number of moles of potassium manganate (VII) present in the volume calculated in (b).
		moles of $KMnO_4 = \dots mol$
	(ii)	Complete the equation below for the reaction of potassium manganate (VII) with hydrogen peroxide. State symbols are not required.
		KMnO ₄ + $5H_2O_2$ + $3H_2SO_4$ \rightarrow K_2SO_4 + $2MnSO_4$ + H_2O + $5O_2$
	(iii)	Use your answers to (i) and (ii) to calculate the number of moles of hydrogen peroxide used in each titration.
		moles of $H_2O_2 = \dots mol$
	(iv)	Calculate the concentration of H ₂ O ₂ in FB 4 , in mol dm ⁻³ .
		concentration of H_2O_2 in FB 4 = mol dm ⁻³
	(v)	Calculate the concentration of H ₂ O ₂ in FB 3 , in mol dm ⁻³ .
		concentration of H_2O_2 in FB 3 = mol dm ⁻³ [5]
		[Total: 13]

2 In this experiment you will determine the enthalpy change, ΔH , for the catalytic decomposition of hydrogen peroxide into water and oxygen.

$$H_2O_2(aq) \rightarrow H_2O(1) + \frac{1}{2}O_2(g)$$

FB 3 is aqueous hydrogen peroxide, H₂O₂.

FB 5 is manganese(IV) oxide, MnO₂, the catalyst for the decomposition.

(a) Method

Read through the method before starting any practical work and prepare a table for your results in the space below.

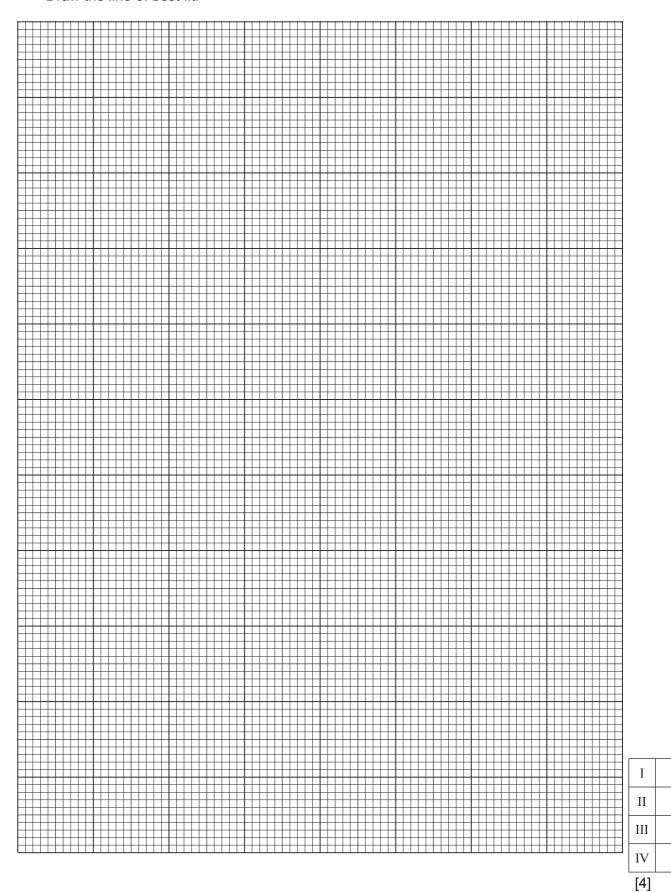
- For the **first** experiment, support the plastic cup inside the 250 cm³ beaker.
- Use a measuring cylinder to transfer 40 cm³ of distilled water into the plastic cup.
- Use a measuring cylinder to add 10 cm³ of **FB 3** into the plastic cup.
- Measure and record the initial temperature of the mixture.
- Add a heaped spatula measure of **FB 5** to the mixture in the plastic cup.
- Stir constantly until the maximum temperature is reached and record this temperature.
- Calculate and record the temperature rise.
- Wash and wipe out your plastic cup and rinse the thermometer, ready for the second experiment.
- For the **second** experiment, support the plastic cup inside the 250 cm³ beaker.
- Use a measuring cylinder to transfer 30 cm³ of distilled water into the plastic cup.
- Use a measuring cylinder to add 20 cm³ of **FB 3** into the plastic cup.
- Measure and record the initial temperature of the mixture.
- Add a heaped spatula measure of **FB 5** to the mixture in the plastic cup.
- Stir constantly until the maximum temperature is reached and record this temperature.
- Calculate and record the temperature rise.
- Wash and wipe out your plastic cup and rinse the thermometer, ready for the third experiment.
- Carry out the third experiment in a similar way.
- Transfer 20 cm³ of distilled water into the plastic cup.
- Add 30 cm³ of **FB 3** into the plastic cup.
- Measure and record the initial temperature of the mixture.
- Add a heaped spatula measure of **FB 5** to the mixture in the plastic cup.
- Record the maximum temperature, then calculate and record the temperature rise.
- For the **fourth** experiment, use 10 cm³ of distilled water and 40 cm³ of **FB 3**.

I II III IV V

[5]

(b) Using the grid below, plot a graph of the temperature rise (*y*-axis) against the volume of **FB 3** (*x*-axis).

Draw the line of best fit.



(c)	Calcul	lation
-----	--------	--------

	(i)	Use your graph to calculate the average temperature rise for each 1.0 cm³ of FB 3 used. Show your working clearly on the graph.
		average temperature rise =°C
	(ii)	Calculate the energy released for each 1.0 cm³ of FB 3 used. (Assume that 4.2 J are needed to raise the temperature of 1.0 cm³ of solution by 1.0 °C.)
		energy released = J
(iii)	Use your answer to 1(c)(v) to calculate the number of moles of hydrogen peroxide in 1.0 cm ³ of FB 3 .
		(If you were unable to calculate the concentration of $\rm H_2O_2$ in FB 3 , assume that it was 1.72 mol dm ⁻³ . Note: this is not the correct value.)
		number of moles of $H_2O_2 = \dots mol$
(iv)	Calculate the enthalpy change, in kJ mol ⁻¹ , for the reaction below.
		$H_2O_2(aq) \rightarrow H_2O(I) + \frac{1}{2}O_2(g)$
		enthalpy change = kJ mol ⁻¹ (sign) (value)
		(sign) (value) [4]
(d)		ich one of the four experiments that you carried out is likely to be the least accurate? plain your choice.
		[1]
		[Total: 14]

3 Qualitative Analysis

At each stage of any test you are to record details of the following.

- colour changes seen
- the formation of any precipitate
- the solubility of such precipitates in an excess of the reagent added

Where gases are released they should be identified by a test, **described in the appropriate place in your observations**.

You should indicate clearly at what stage in a test a change occurs.

No additional tests for ions present should be attempted.

If any solution is warmed, a boiling tube MUST be used.

Rinse and reuse test-tubes and boiling tubes where possible.

Where reagents are selected for use in a test, the name or correct formula of the element or compound must be given.

(0)	Vou will	oorn/	out further	ovnorimente	with	001100110	hydrogon	norovido	ED	2
(a)	YOU WIII	carry	out juitiner	experiments	witti	adueous	nvaroaen	peroxide.	ГВ	J .

FB 2 is dilute sulfuric acid, H₂SO₄.

FB 3 is aqueous hydrogen peroxide, H₂O₂.

FB 6 is a solution containing two cations and one anion.

FB 7 is a solution containing one cation and one anion.

(i)	To a 1cm depth of FB 6 in a boiling tube, add aqueous sodium hydroxide until it is in excess. Then heat the tube, gently and with care. Keep the mixture for test (ii). Record your observations. Identify the cations in FB 6 .
	observations
	FB 6: cations are and
(ii)	To the mixture obtained from (i) add a 1 cm depth of FB 3 . Shake the tube. Record your observations.
	observations
	What type of reaction has taken place? Explain your answer.

(iii) To a 1 cm depth of FB 3 in a test-tube, add an equal volume of sulfuric acid, FB 2.

()	Then add a 1 cm depth of FB 7 , followed by a few drops of starch solution. Record all your observations. Draw what conclusions you can about the ions in FB 7 . If no conclusion is possible, write 'not known'.	е
	observations	
	FB 7: cation anion	 ']

- (b) FB 7, FB 8 and FB 9 are aqueous solutions, each containing one cation and one anion. Note that FB 7 was also used in (a)(iii).
 - (i) Carry out the following tests in test-tubes.
 Use 1 cm depths of solutions.
 Complete the table by recording your observations.

40.04	observations		
test	FB 7	FB 8	FB 9
add a 2cm strip of magnesium ribbon			
FB 7			
FB 8			

(ii)	Suggest the identify of the cation in FB 9 . Explain your answer.
	cation
	explanation
(iii)	Give the ionic equation for the reaction between FB 7 and FB 9.
(iv)	From your observations, identify FB 8 .
	[6]

[Total: 13]

Qualitative Analysis Notes

Key: [ppt. = precipitate]

1 Reactions of aqueous cations

ion	reaction with		
	NaOH(aq)	NH ₃ (aq)	
aluminium, Al³+(aq)	white ppt. soluble in excess	white ppt. insoluble in excess	
ammonium, NH₄⁺(aq)	no ppt. ammonia produced on heating	_	
barium, Ba ²⁺ (aq)	no ppt. (if reagents are pure)	no ppt.	
calcium, Ca ²⁺ (aq)	white ppt. with high [Ca ²⁺ (aq)]	no ppt.	
chromium(III), Cr³+(aq)	grey-green ppt. soluble in excess giving dark green solution	grey-green ppt. insoluble in excess	
copper(II), Cu ²⁺ (aq)	pale blue ppt. insoluble in excess	blue ppt. soluble in excess giving dark blue solution	
iron(II), Fe²+(aq)	green ppt. turning brown on contact with air insoluble in excess	green ppt. turning brown on contact with air insoluble in excess	
iron(III), Fe³+(aq)	red-brown ppt. insoluble in excess	red-brown ppt. insoluble in excess	
magnesium, Mg²+(aq)	white ppt. insoluble in excess	white ppt. insoluble in excess	
manganese(II), Mn²+(aq)	off-white ppt. rapidly turning brown on contact with air insoluble in excess	off-white ppt. rapidly turning brown on contact with air insoluble in excess	
zinc, Zn²+(aq)	white ppt. soluble in excess	white ppt. soluble in excess	

2 Reactions of anions

ion	reaction
carbonate, CO ₃ ²⁻	CO ₂ liberated by dilute acids
chloride, C <i>l</i> ⁻ (aq)	gives white ppt. with Ag ⁺ (aq) (soluble in NH ₃ (aq))
bromide, Br ⁻ (aq)	gives cream ppt. with Ag ⁺ (aq) (partially soluble in NH ₃ (aq))
iodide, I ⁻ (aq)	gives yellow ppt. with Ag ⁺ (aq) (insoluble in NH ₃ (aq))
nitrate, NO ₃ -(aq)	NH ₃ liberated on heating with OH ⁻ (aq) and A <i>l</i> foil
nitrite, NO ₂ ⁻ (aq)	NH_3 liberated on heating with $OH^-(aq)$ and Al foil; NO liberated by dilute acids (colourless $NO \rightarrow$ (pale) brown NO_2 in air)
sulfate, SO ₄ ²⁻ (aq)	gives white ppt. with Ba ²⁺ (aq) (insoluble in excess dilute strong acids)
sulfite, SO ₃ ²⁻ (aq)	SO ₂ liberated with dilute acids; gives white ppt. with Ba ²⁺ (aq) (soluble in excess dilute strong acids)

3 Tests for gases

gas	test and test result
ammonia, NH ₃	turns damp red litmus paper blue
carbon dioxide, CO ₂	gives a white ppt. with limewater (ppt. dissolves with excess CO ₂)
chlorine, Cl ₂	bleaches damp litmus paper
hydrogen, H ₂	"pops" with a lighted splint
oxygen, O ₂	relights a glowing splint
sulfur dioxide, SO ₂	turns acidified aqueous potassium manganate(VII) from purple to colourless

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