Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

0749229451

CHEMISTRY **5070/41**

Paper 4 Alternative to Practical **May/June 2023**

1 hour

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [ ].
- Notes for use in qualitative analysis are provided in the question paper.

This document has **12** pages.

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1 A student uses chromatography to separate the dyes in a food colouring.

Fig. 1.1 shows the apparatus the student uses.

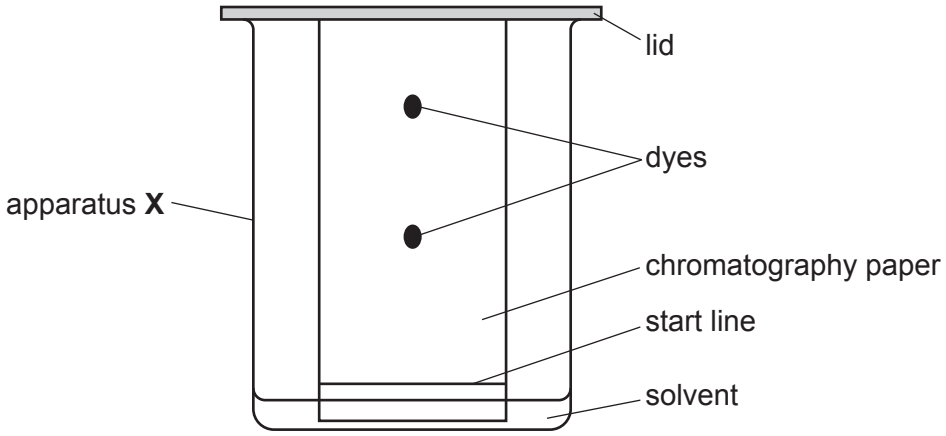


Fig. 1.1

(a) Name apparatus **X**.

..... [1]

(b) State why it is important to have a lid on **X**.

.....

..... [1]

(c) State why the start line is:

- above the level of the solvent
- drawn in pencil.

above the level of the solvent .....

.....

drawn in pencil .....

.....

[2]

(d) The R_f value of one of the dyes in the food colouring is 0.60.

In the separation this dye travels 5.7 cm.

Calculate the distance travelled by the solvent during the separation.

distance travelled by solvent ..... cm [2]

[Total: 6]

2 White vinegar is a colourless solution containing ethanoic acid.

A student titrates 0.400 mol / dm^3 aqueous sodium hydroxide with two samples of vinegar, **A** and **B**.

The student does four titrations, two with **A** and two with **B**.

The student:

Step 1. uses a volumetric pipette to add 25.0 cm^3 of 0.400 mol / dm^3 sodium hydroxide to a conical flask
Step 2. adds five drops of an indicator to the conical flask
Step 3. adds **A** from a burette while swirling the contents of the flask, adding drop by drop near the end-point, until the solution just changes colour
Step 4. empties the conical flask and rinses it with distilled water
Step 5. repeats steps 1 to 4
Step 6. repeats steps 1 to 5 using **B** instead of **A**.

(a) (i) Fig. 2.1 shows the burette readings for the two titrations with vinegar **A**.

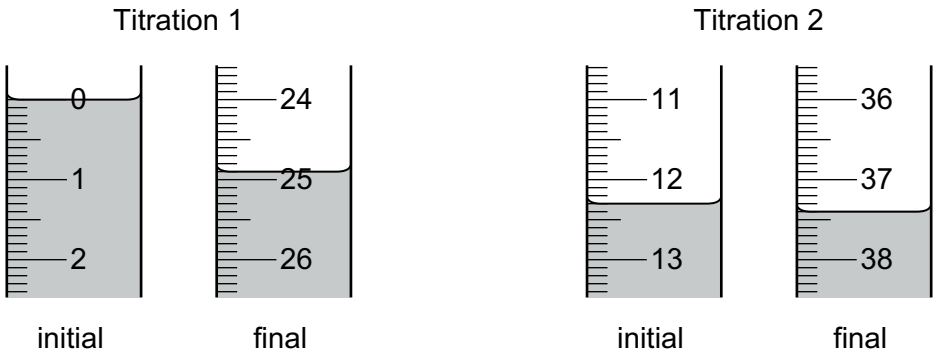


Fig. 2.1

Record the burette readings in Table 2.1.

Complete Table 2.1 with the volume used in each titration.

Table 2.1

	Titration 1	Titration 2
final burette reading / cm^3		
initial burette reading / cm^3		
volume of **A** used / cm^3		

[3]

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(ii) Fig. 2.2 shows the burette readings for one of the titrations with vinegar **B**.

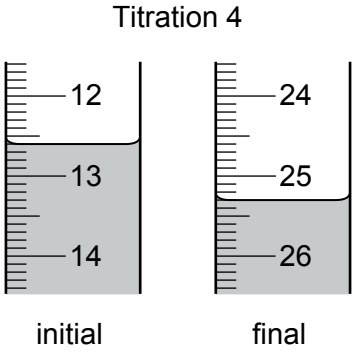


Fig. 2.2

Record the burette readings for Titration 4 in Table 2.2.

Calculate the volume of vinegar **B** added in Titrations 3 and 4.

Table 2.2

	Titration 3	Titration 4
final burette reading / cm^3	12.6	
initial burette reading / cm^3	0.1	
volume of **B** used / cm^3		

[1]

(b) Calculate the mean volume of **A** and of **B** needed to neutralise 25.0 cm^3 of 0.400 mol / dm^3 aqueous sodium hydroxide.

mean volume of **A** ..... cm^3

mean volume of **B** ..... cm^3

[1]

(c) Suggest why the titrations using **A** and **B** are repeated.

..... [1]

(d) The equation for the reaction between ethanoic acid and sodium hydroxide is shown.

$$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$$

The answer to **(b)** shows the mean volume of **B** used to neutralise 25.0 cm^3 of 0.400 mol/dm^3 aqueous sodium hydroxide.

Calculate the concentration of ethanoic acid in **B**.

Give your answer to an appropriate number of significant figures.

concentration ..... mol/dm^3 [2]

(e) Use your answer to **(d)** to calculate the mass of ethanoic acid in 500 cm^3 of **B**.

[M_r: ethanoic acid, 60]

mass ..... g [2]

(f) Use your answers to **(b)** and **(e)** to calculate the mass of ethanoic acid in 500 cm^3 of **A**.

mass ..... g [1]

(g) Suggest why the conical flask is rinsed with distilled water and **not** 0.400 mol/dm^3 aqueous sodium hydroxide between titrations.

.....

.....

..... [2]

(h) Some vinegars are brown rather than colourless.

Suggest why this titration method would **not** be suitable for finding the concentration of ethanoic acid in brown vinegar.

..... [1]

[Total: 14]

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3 A student investigates solution **W** and copper(II) carbonate.

(a) The tests the student does on **W** are shown in Table 3.1.

Some of the observations for these tests are also shown.

Table 3.1

	tests on solution **W**	observations
1	Add aqueous sodium hydroxide to **W**.	solution remains colourless
2	Add dilute nitric acid, then add aqueous barium nitrate to **W**.	white precipitate
3	Add dilute hydrochloric acid, then add aqueous silver nitrate to **W**.	white precipitate
4	Flame test on **W**.	no colour is observed

(i) The student correctly concludes that ammonia is formed in test 1.

Describe what else the student must have done to reach this conclusion.

.....

.....

..... [3]

(ii) State why the student cannot identify the anion in **W** from the observation in test 3.

..... [1]

(iii) State how the tests and observations show that **W** does **not** contain sodium ions.

..... [1]

(iv) Identify the cation and anion in **W**.

cation ..... anion ..... [2]

(b) The student adds dilute hydrochloric acid to copper(II) carbonate.

A gas and a solution are produced.

(i) State the observation that confirms the production of a gas.

..... [1]

(ii) Describe how to do a flame test to confirm the presence of copper(II) ions in the solution.

.....

.....

.....

..... [3]

(iii) Describe one **other** method the student could use to confirm that the solution contains copper(II) ions.

.....

.....

.....

..... [3]

[Total: 14]

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4 Baking powder is used to make cakes rise. When water is added to baking powder, carbon dioxide gas is released.

The longer the baking powder is stored, the less carbon dioxide it releases when water is added.

Plan an investigation to show which of two different samples of baking powder has been stored for longer.

Your plan should include the use of common laboratory apparatus, the two samples of baking powder and water. No other chemicals should be used.

Your plan should include:
- the apparatus needed
- the method to use
- the measurements to take
- the variables to control
- how to use the results to determine which sample has been stored for longer.

You may draw a diagram to help you answer the question.

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[6]

Notes for use in qualitative analysis

Tests for anions

anion	test	test result
carbonate, CO_3^{2-}	add dilute acid, then test for carbon dioxide gas	effervescence, carbon dioxide produced
chloride, Cl^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
bromide, Br^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream ppt.
iodide, I^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate, NO_3^- [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate, SO_4^{2-} [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.
sulfite, SO_3^{2-}	add a small volume of acidified aqueous potassium manganate(VII)	the acidified aqueous potassium manganate(VII) changes colour from purple to colourless

Tests 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. or very slight white ppt.
chromium(III), Cr^{3+}	green ppt., soluble in excess	green ppt., insoluble in excess
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, ppt. turns brown near surface on standing	green ppt., insoluble in excess, ppt. turns brown near surface on standing
iron(III), Fe^{3+}	red-brown ppt., insoluble in excess	red-brown 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

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Tests 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
sulfur dioxide, SO_2	turns acidified aqueous potassium manganate(VII) from purple to colourless

Flame tests for metal ions

metal ion	flame colour
lithium, Li^+	red
sodium, Na^+	yellow
potassium, K^+	lilac
copper(II), Cu^{2+}	blue-green
calcium, Ca^{2+}	orange-red
barium, Ba^{2+}	light green

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