Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

2650599050

CHEMISTRY **5070/41**

Paper 4 Alternative to Practical **May/June 2020**

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 60.
- The number of marks for each question or part question is shown in brackets [ ].

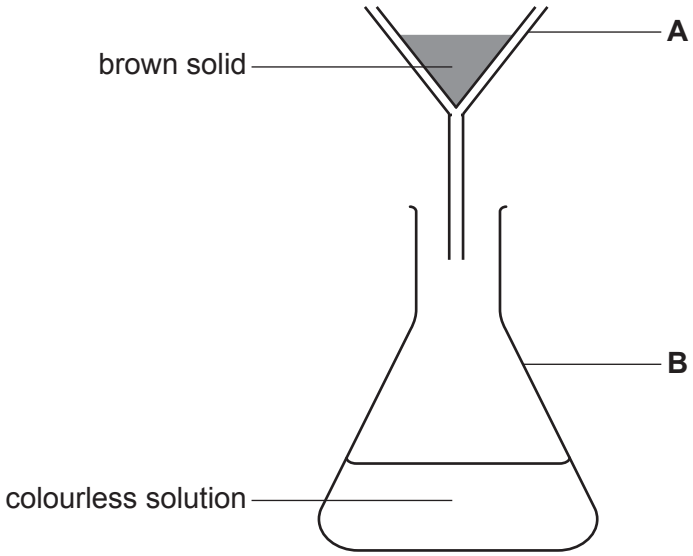
This document has **16** pages. Blank pages are indicated.

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1 A student investigates a sample of rock salt.

The student:

- grinds the rock salt into a powder
- places the powder into a beaker and adds water to it
- stirs the mixture
- pours the mixture through the apparatus shown.



(a) (i) Name apparatus **A**. ..... [1]

(ii) Name apparatus **B**. ..... [1]

(iii) A brown solid remains in apparatus **A**. A colourless solution is collected in apparatus **B**.

Name the process used to separate the solid from the colourless solution.

..... [1]

(b) The colourless solution contains two different cations. One cation is sodium.

The student adds dilute nitric acid and aqueous sodium sulfate to the colourless solution.

A white precipitate is formed.

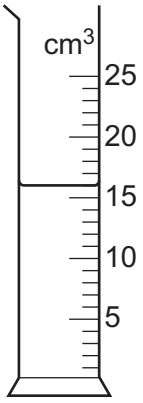
Name the other cation in the colourless solution.

..... [1]

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(c) A student investigates the effect of adding different masses of rock salt on the temperature of a mixture of ice and water.

The diagram shows the volume of water the student uses in the investigation.



State the volume of water the student uses. .....cm^3 [1]

(d) The student:

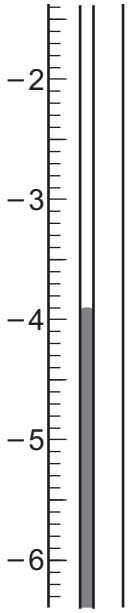
- places the water in a beaker
- adds ice
- stirs the mixture
- measures the lowest temperature of the mixture
- repeats the experiment four times.

In each of the repeated experiments a different mass of rock salt is added to the mixture.

(i) State a variable that needs to be kept constant in each experiment.

..... [1]

(ii) The diagram shows part of the thermometer the student uses to measure the lowest temperature reached when 1.0 g of rock salt is added.



[1]

Record this temperature in the table of results.

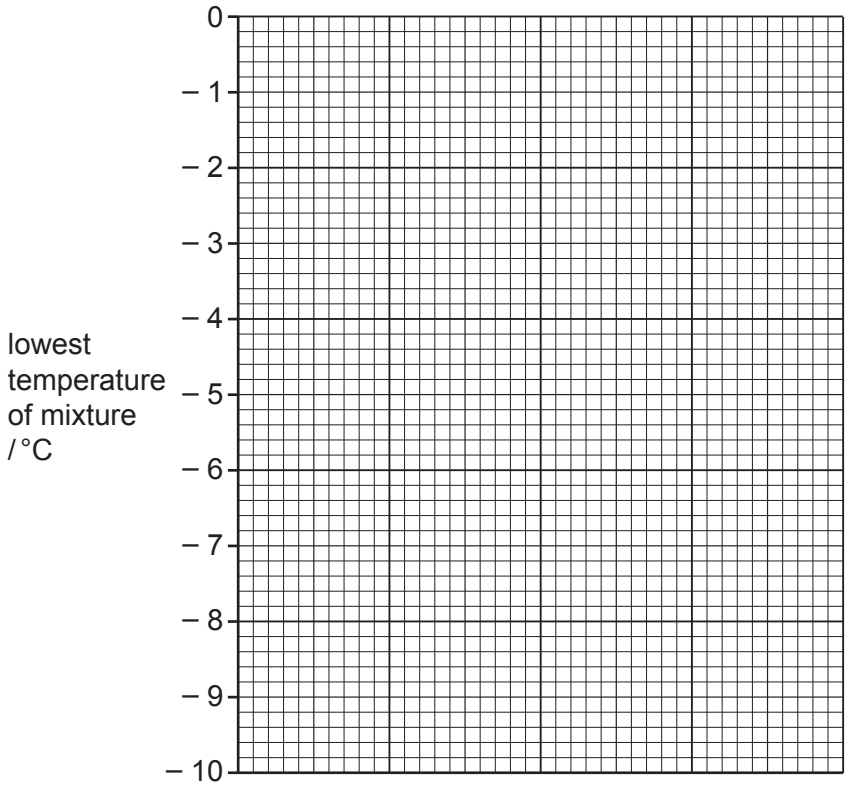
mass of rock salt added / g	lowest temperature of ice and salt mixture / °C
0.0	0.0
0.5	–1.9
1.0	
1.5	–5.8
2.0	–7.8

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(iii) Plot the results on the grid.

Include:

- a suitable scale for the *x*-axis
- a straight line of best fit.



[3]

(iv) Use your graph to find the lowest temperature when 1.4 g of rock salt is added.

.....°C [1]

(v) Deduce the relationship between the mass of rock salt added and the lowest temperature reached.

.....

..... [1]

[Total: 12]

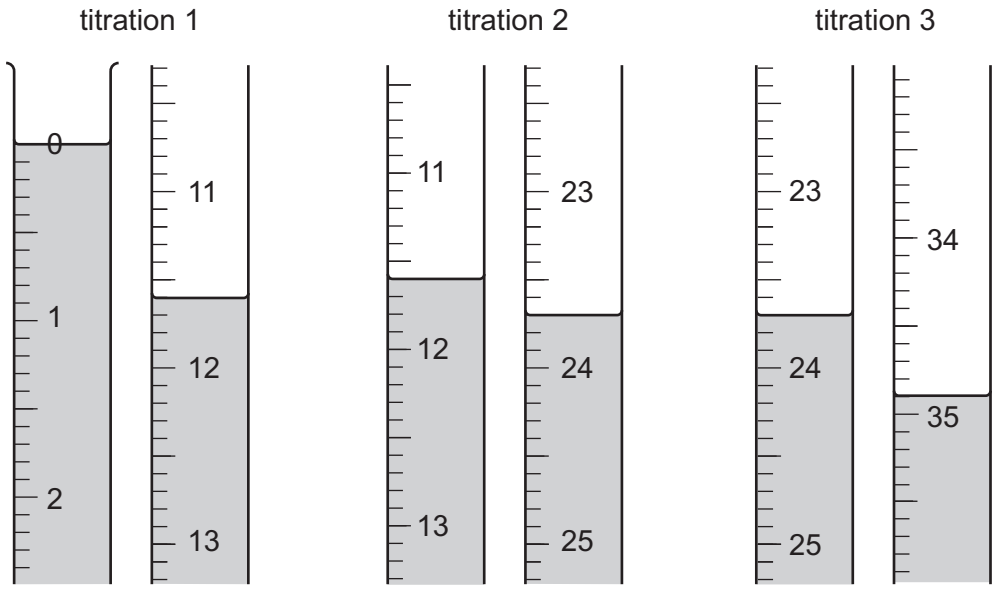
2 Limewater is a saturated solution of calcium hydroxide, $Ca(OH)_2$.

A student finds the mass of calcium hydroxide in 1.00 dm^3 of limewater.

The student:

- measures 25.0 cm^3 of limewater into a flask using a 100 cm^3 measuring cylinder
- adds a few drops of methyl orange indicator to the flask
- places 0.100 mol / dm^3 hydrochloric acid in a burette and takes an initial reading
- runs hydrochloric acid from the burette into the flask until the mixture changes colour
- records the final reading
- repeats the experiment two times.

The initial and final readings for all titrations are shown in the diagrams.



(a) Use the information in the diagrams to complete the results table.

titration number	1	2	3
final reading / cm^3			
initial reading / cm^3			
volume used / cm^3			

[3]

(b) (i) The results are not consistent.

Identify the apparatus the student uses that is not accurate enough for titration.

..... [1]

(ii) Suggest a more accurate piece of apparatus the student can use.

..... [1]

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(iii) The student adds the hydrochloric acid drop by drop near the end-point of the titration.

Suggest why the hydrochloric acid is added drop by drop near the end-point.

.....

..... [1]

(c) The student repeats the whole experiment three more times using the more accurate apparatus.

The results are shown in the table.

titration number	1	2	3
final reading / cm^3	11.8	23.3	33.6
initial reading / cm^3	0.0	11.7	22.3
volume used / cm^3	11.8	11.6	11.3
best titration results (✓)			

(i) Tick (✓) the best titration results in the results table.

Use the ticked values to calculate the average volume of 0.100 mol / dm^3 HCl used.

average volume .....cm^3 [1]

(ii) Calculate the number of moles of HCl in the average volume of 0.100 mol / dm^3 HCl.

..... moles [1]

(iii) Calculate the number of moles of calcium hydroxide, $Ca(OH)_2$, in 25.0 cm^3 of limewater.

$$Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$$

..... moles [1]

(iv) Calculate the number of moles of $Ca(OH)_2$ in 1.00 dm^3 of limewater.

..... moles [1]

(v) Calculate the M_r of $Ca(OH)_2$.
[A_r: Ca, 40; H,1; O,16]

M_r = ... [1]

(vi) Calculate the mass of $Ca(OH)_2$ in 1.00 dm^3 of limewater. Give your answer to **two** significant figures.

.....g [1]

[Total: 12]

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3 Bromine, chlorine, fluorine and iodine are elements in Group VII of the Periodic Table.

Group VII elements react with compounds of Group VII elements in aqueous solution in displacement reactions. More reactive elements displace less reactive elements from their compounds. For example:

potassium iodide + fluorine → potassium fluoride + iodine

$$2KI + F_2 \rightarrow 2KF + I_2$$

You have access to:
- colourless aqueous solutions of potassium bromide, potassium chloride and potassium iodide
- aqueous solutions of bromine (orange), chlorine (yellow) and iodine (brown)
- the apparatus normally found in a school laboratory.

No other chemicals are available.

Plan experiments using these solutions to show that:
- chlorine is more reactive than bromine and iodine
- bromine is more reactive than iodine but less reactive than chlorine.

Your plan must include:
- what you need to do
- the observations you expect
- an explanation of how these observations show the order of reactivity of bromine, chlorine and iodine.

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[Total: 5]

4 Scientists analyse a sample of soil. They discover that the soil contains nitrate ions, carbonate ions and iron(III) ions.

(a) Complete the tables to show the observations of their tests.

Name any gases formed and state the tests used to identify them.

(i) Tests on a solid sample of soil.

ion	test	observations and conclusions
nitrate, NO_3^-	Add aqueous sodium hydroxide, then add aluminium foil and warm gently.	
carbonate, CO_3^{2-}	Add dilute hydrochloric acid.	

[6]

(ii) Tests on an aqueous solution made from soil.

ion	test	observations
iron(III), Fe^{3+}	Add aqueous sodium hydroxide.	
	Add excess aqueous sodium hydroxide.	

[2]

(b) The scientists also want to know the pH of the soil. They test the soil by shaking it with universal indicator solution then leaving it to stand.

They discover that the pH is 6.

State the colour of the universal indicator at pH 6.

..... [1]

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(c) The scientists believe that some fertiliser containing iodide ions has been added to the soil.

Describe how the scientists could test the solution made from the soil for the presence of iodide ions and the result of the test if iodide ions are present.

test:

.....

.....

.....

.....

result:

.....

.....

.....

.....

[3]

[Total: 12]

5 Leaves of plants contain a number of different coloured pigments.

Four students want to extract and analyse some of these coloured pigments.

The leaves are chopped up and ground using a mortar and pestle and then mixed with ethanol.



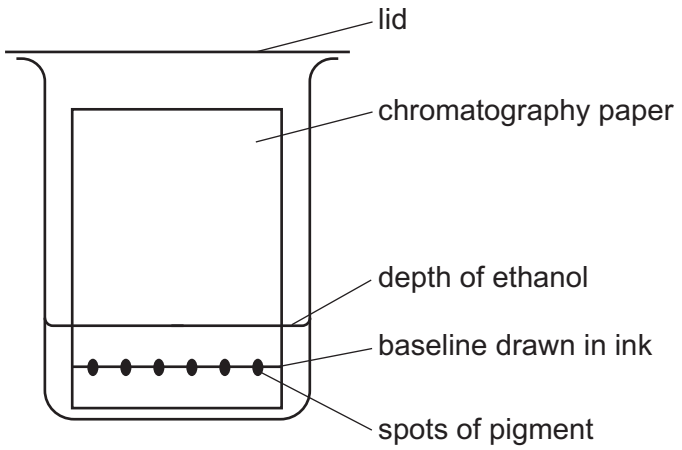
The pigments are separated using paper chromatography.

(a) (i) Suggest a reason for cutting and grinding the leaves.

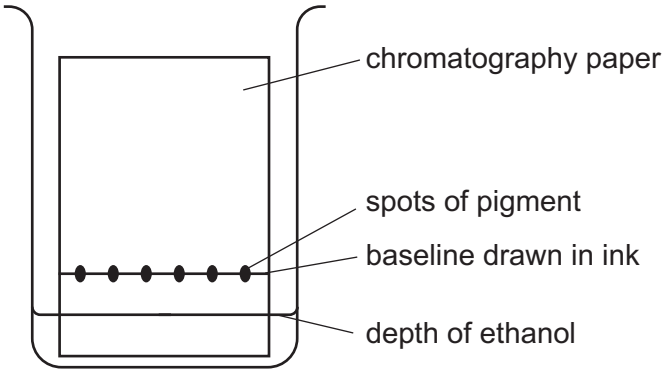
..... [1]

(ii) Four students do the paper chromatography separation.

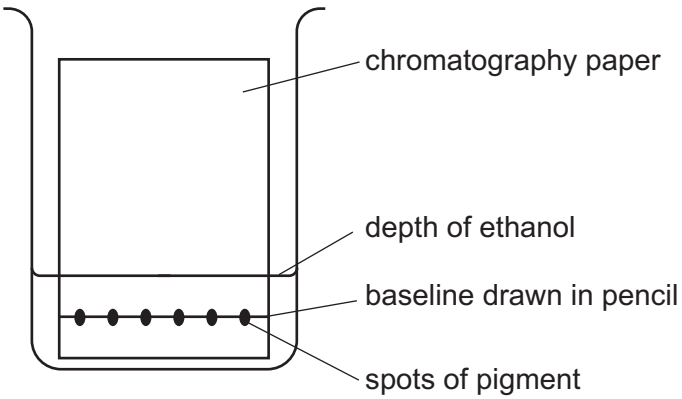
The diagrams show four sets of apparatus used by the students. Three of the students make mistakes in setting up the apparatus.



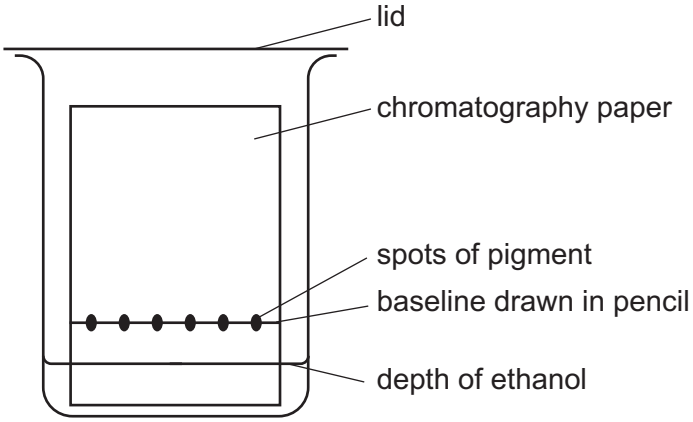
A



B



C



D

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Which diagram, **A**, **B**, **C**, or **D**, shows the correct set-up of the apparatus?

..... [1]

(iii) Describe **two** mistakes made by the students shown in the diagrams.

Explain why each mistake will prevent the chromatography from working correctly.

mistake 1:

.....

.....

explanation:

.....

.....

mistake 2:

.....

.....

explanation:

.....

.....

[4]

(iv) Chromatography often uses water in the beaker.

Suggest why ethanol is used instead of water in this experiment.

..... [1]

(v) What property of ethanol makes it hazardous to use in the laboratory?

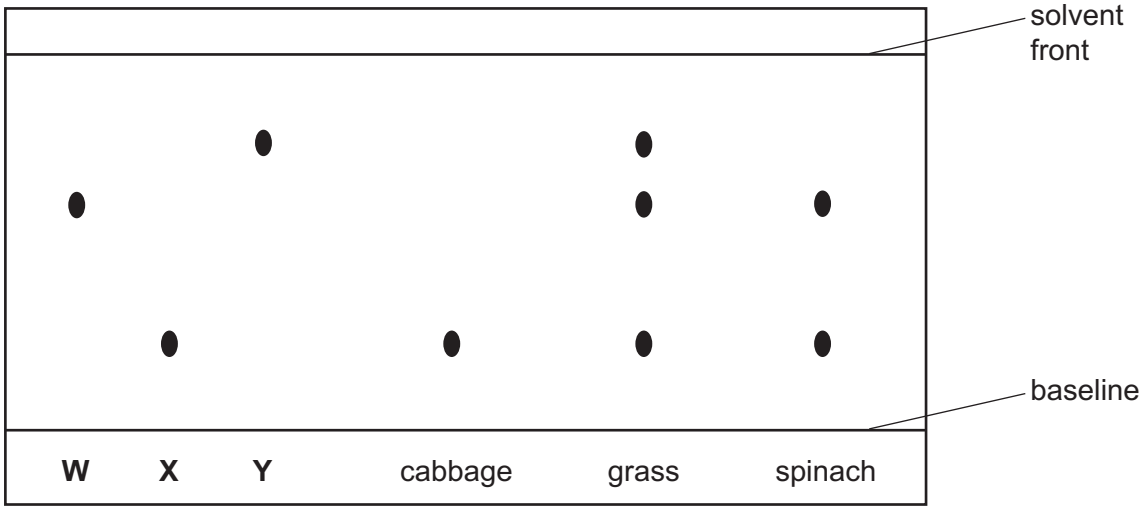
What safety precaution needs to be taken to avoid this hazard?

property: .....

precaution: .....

[2]

(b) The diagram shows the results for three known pigments, **W**, **X** and **Y**, and pigments from three plants.



(i) How many pigments are there in grass? Explain your answer.

.....

.....

..... [1]

(ii) Which pigment is in all of the plants?

..... [1]

(iii) Calculate the R_f value for pigment **W**.

.....

..... [2]

(iv) Which of the plants contain pigment **W**?

..... [1]

[Total: 14]

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6 A student investigates the reactivity series by putting pieces of metals into aqueous solutions.

The table shows the experiments.

metal	solution	observation
copper	magnesium sulfate	
copper	iron(II) sulfate	no change
magnesium	copper(II) sulfate	red / brown solid formed
magnesium	zinc sulfate	silver / grey solid formed
magnesium	iron(II) sulfate	
iron		red / brown solid formed
zinc	iron(II) sulfate	grey / black solid formed
zinc	magnesium sulfate	no change

(a) Complete the table. [3]

(b) Use the information in the table to arrange the **four** metals in order of reactivity starting with the most reactive first.

most reactive metal .....

.....

.....

least reactive metal .....

[2]

[Total: 5]

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