Cambridge Assessment International Education

Cambridge O Level

CANDIDATE NAME									
CENTRE NUMBER						CANDIDATE NUMBER				

3293867256

CHEMISTRY **5070/41**

Paper 4 Alternative to Practical **October/November 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.

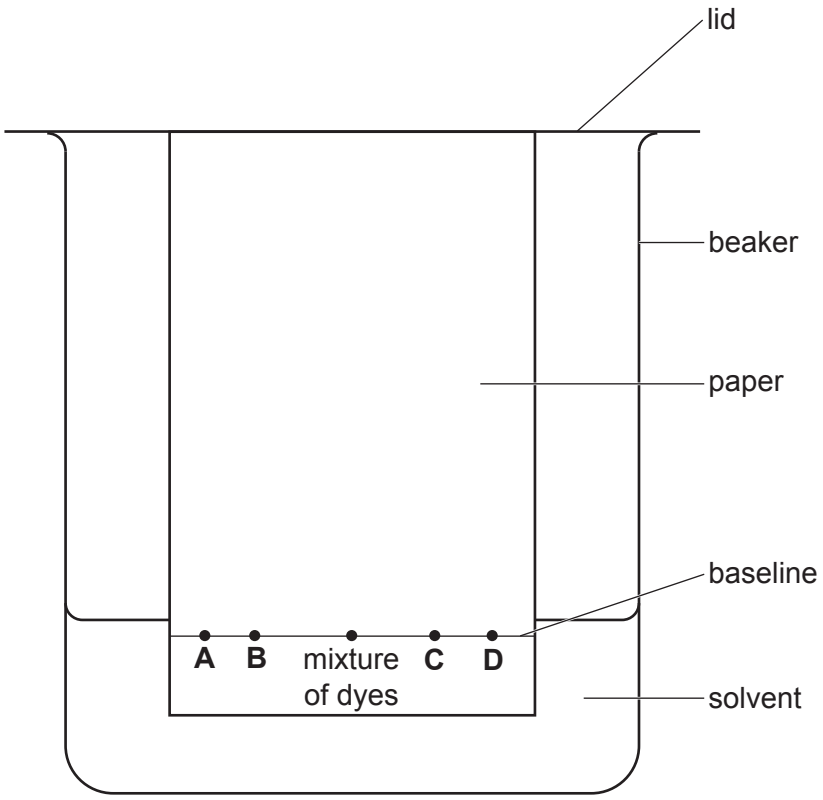
DC (PQ/FC) 184038/3
© UCLES 2020

[Turn over

1 A student wants to separate a mixture of dyes so that the dyes in the mixture can be identified.

The apparatus the student uses is shown.

The student also tests dyes **A**, **B**, **C** and **D**.



(a) Name the process the student uses to separate the mixture of dyes.

..... [1]

(b) The apparatus shown in the diagram is set up incorrectly. Explain why.

..... [1]

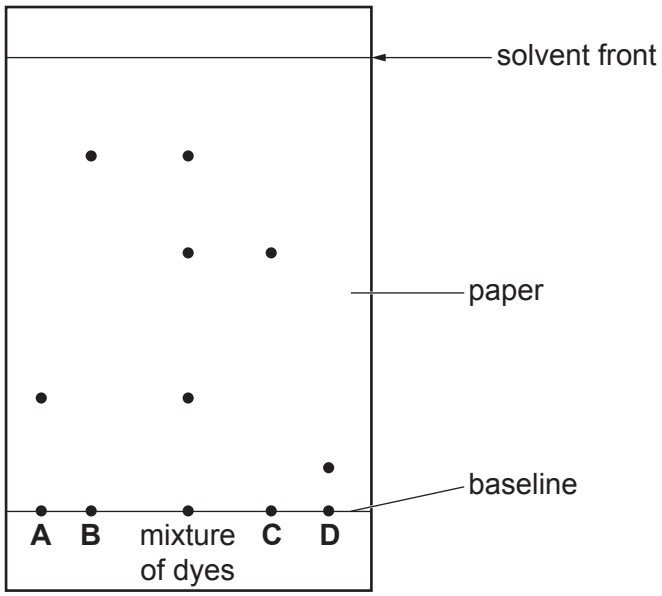
© UCLES 2020

The apparatus is then set up correctly.

The solvent travels up the paper.

The paper is removed and then dried.

The result is shown in the diagram.



(c) Which of the dyes **A**, **B**, **C** and **D** are present in the mixture of dyes?

..... [1]

(d) The student identifies the dyes in the mixture of dyes using R_f values.

(i) Measure the distance between:

- the baseline and the solvent front ..... cm
- the baseline and the position of **A** ..... cm.

[1]

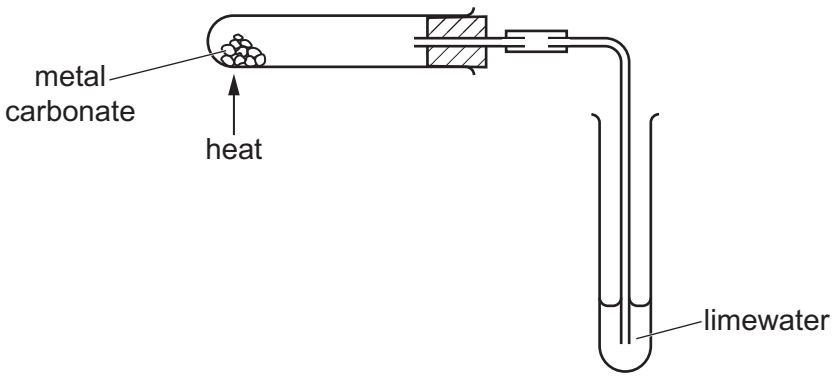
(ii) Calculate the R_f value of **A**.

R_f value of **A** ..... [1]

[Total: 5]

2 When metal carbonates are heated they decompose and give off a gas that turns limewater milky.

A student investigates the rate of decomposition of four metal carbonates using the apparatus shown.



The student:

- separately heats each of the metal carbonates with a Bunsen burner
- measures the time taken for the limewater to turn milky.

The results are shown in the table.

metal carbonate	time taken for limewater to turn milky / s
calcium carbonate	500
lead(II) carbonate	120
magnesium carbonate	300
zinc carbonate	205

(a) Name the gas that turns limewater milky.

..... [1]

© UCLES 2020

(b) The amount of heat supplied by the Bunsen burner must be controlled in each experiment.

(i) Suggest **two** ways in which the heat supplied by the Bunsen burner is kept constant.

1 .....

2 .....
[2]

(ii) Suggest **two other** variables that must be controlled.

1 .....

2 .....
[2]

(c) Which metal carbonate is the **slowest** to decompose?

..... [1]

(d) Suggest how the investigation can be improved to make the results more reliable.

.....

.....

..... [2]

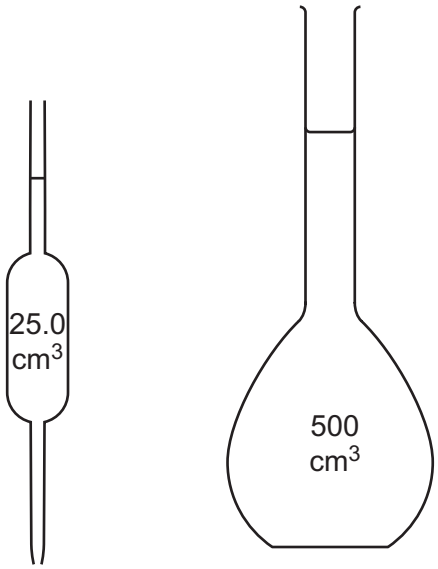
[Total: 8]

3 A student is provided with dilute sulfuric acid labelled **L**.

The student determines the concentration of **L** by titration.

The student uses apparatus **A** to measure and transfer 25.0 cm^3 of **L** into apparatus **B**.

The diagrams show apparatus **A** and **B**.



A **B**

(a) (i) Name apparatus **A**.

..... [1]

(ii) Name the other piece of apparatus that should be used with **A** to measure 25.0 cm^3 of **L**.

..... [1]

(iii) Why is apparatus **A** used instead of a measuring cylinder?

..... [1]

(b) The student makes up the 25.0 cm^3 sample of **L** to 500 cm^3 with distilled water in apparatus **B**. This is solution **M**.

Name apparatus **B**.

..... [1]

The student transfers 25.0 cm^3 of **M** into a conical flask and adds two drops of methyl orange indicator.

Solution **R** is 0.100 mol / dm^3 aqueous sodium hydroxide, NaOH(aq).

R is put into a burette and run into the conical flask until the indicator changes colour and the end-point is reached.

© UCLES 2020

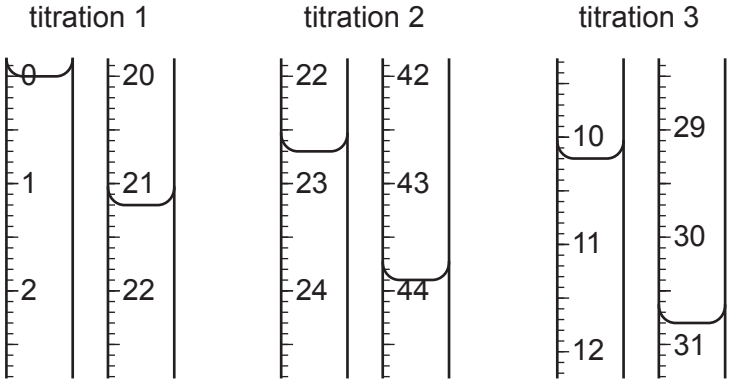
(c) Which liquid is used to wash out the burette **immediately** before it is filled with **R**?

..... [1]

(d) What is the colour change of the methyl orange indicator at the end-point?

The colour changes from ..... to ..... [1]

(e) The student does three titrations. The diagrams show parts of the burette with the liquid levels at the beginning and end of each titration.



(i) Use the diagrams to complete the table.

titration number	1	2	3
final burette reading / cm^3			
initial burette reading / cm^3			
volume of **R** / cm^3			
best titration results (✓)			

Summary

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

Use the ticked values to calculate the average volume of **R**.

..... cm^3 [4]

(ii) Why was it unnecessary for the student to do a third titration?

..... [1]

(f) Solution **R** is 0.100 mol / dm^3 aqueous sodium hydroxide, NaOH(aq).

Calculate the number of moles of NaOH in the average volume of 0.100 mol / dm^3 NaOH used in the titration. Give your answer to **three** significant figures.

..... mol [1]

(g) Dilute sulfuric acid reacts with aqueous sodium hydroxide as shown.

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

Calculate the number of moles of H_2SO_4 in 25.0 cm^3 of **M**.

..... mol [1]

(h) Calculate the number of moles of H_2SO_4 in 500 cm^3 of **M**.

..... mol [1]

(i) Calculate the number of moles of H_2SO_4 in 25.0 cm^3 of **L**.

..... mol [1]

(j) Calculate the concentration of H_2SO_4 in **L**.

..... mol / dm^3 [1]

© UCLES 2020

(k) Between each titration the student washes the conical flask with water and dries it.

(i) A second student repeats the experiment but uses **L** instead of water to wash the conical flask and does not dry the flask.

State **and** explain whether the second student's titration volume of NaOH(aq) would be smaller, larger or unchanged compared with the first student's titration volume of NaOH(aq).

.....

.....

..... [2]

(ii) A third student repeats the experiment, washes the conical flask out with water but does not dry it before each titration.

State **and** explain whether the third student's titration volume of NaOH(aq) would be smaller, larger or unchanged compared with the first student's titration volume of NaOH(aq).

.....

.....

..... [2]

[Total: 20]

4 A student wants to electroplate a metallic spoon with a layer of copper.

Plan how the student does the experiment.

You should:

- state what needs to be done to the spoon before electrolysis
- include a labelled diagram of the apparatus
- give the names of the substances used.

.....

.....

.....

.....

.....

.....

.....

..... [5]

© UCLES 2020

5 Compound **Q** contains two cations and one anion. The following table shows the tests a student does on compound **Q**.

Complete the table.

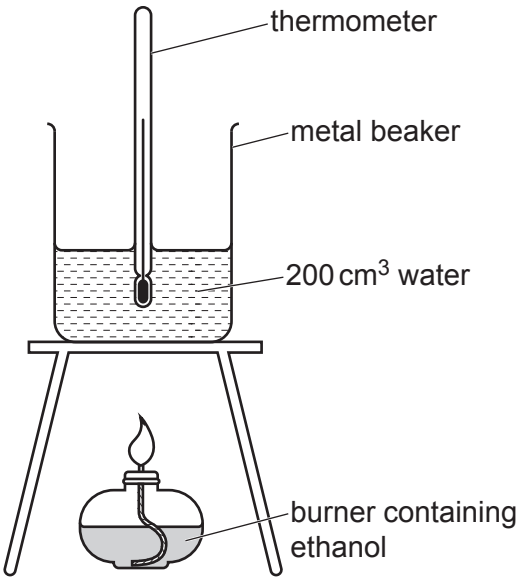
Identify any gases that are formed in the tests.

test	observation	conclusion
(a) **Q** is dissolved in water. The solution is divided into two portions for tests **(b)** and **(c)**.	A coloured solution is formed.	.... [1]
(b) **(i)** To the first portion, aqueous sodium hydroxide is added until a change is seen.	....	**Q** contains Cr^{3+} or Fe^{2+} ions. [1]
(ii) An excess of aqueous sodium hydroxide is added to the mixture from **(b)(i)**.	....	**Q** contains Fe^{2+} ions. [1]
(iii) The mixture from **(b)(ii)** is warmed and the gas formed is tested with damp red litmus paper.	The gas turns damp red litmus paper blue.	.... [2]
(c)	....	**Q** contains SO_4^{2-} ions. [3]

[Total: 8]

6 A student investigates the amount of heat released when ethanol burns.

The diagram shows the apparatus the student uses.



(a) The student burns a known mass of ethanol.

The heat released is used to heat 200 cm^3 of water.

The student determines the temperature rise of the water while the ethanol is burning.

(i) In the first experiment the student burns 1.0 g of ethanol and the temperature rises by 20 °C.

State all the measurements the student makes to obtain these values.

.....

..... [2]

(ii) Why is a metal beaker used instead of a glass beaker?

..... [1]

(iii) The student finds out that 1.0 g of ethanol should give a theoretical temperature rise of more than 20 °C.

Suggest **two** reasons why the temperature rise of the water was less than the theoretical value.

1 .....

2 .....
[2]

© UCLES 2020

(iv) Suggest **two** ways, using 1.0 g of ethanol and 200 cm^3 of water, in which the apparatus can be changed to produce a temperature rise of more than 20 °C.

1 .....

2 .....

[2]

(b) The relative formula mass of ethanol, C_2H_5OH, is 46.

Calculate the number of moles of ethanol in 1.0 g.

..... mol [1]

(c) The experiment is repeated using the same number of moles of different alcohols.

The temperature rises are shown in the table.

number of carbon atoms in each alcohol molecule	temperature rise / °C
2	20
3	32
4	43
5	55
6	66
7	78

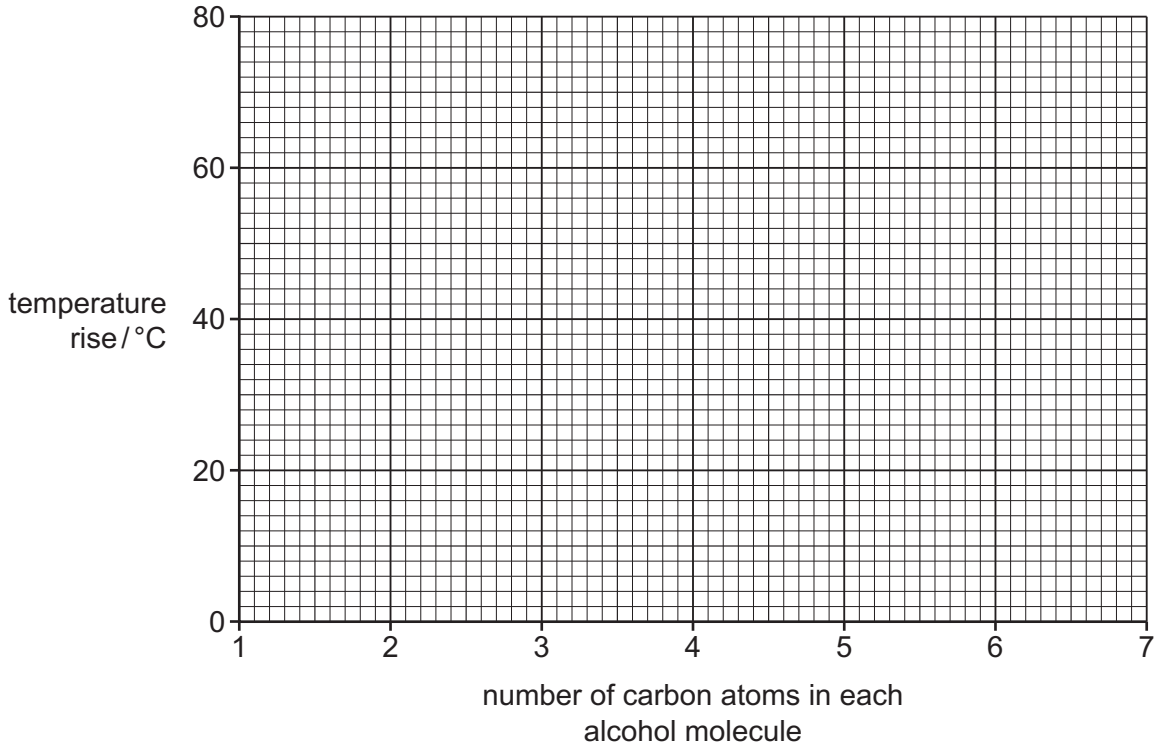
(i) What evidence in the table shows that all the reactions are exothermic?

..... [1]

(ii) Plot the data in the table on the grid.

Draw a straight line of best fit.

Extend your line to the left hand side of the grid.



[2]

© UCLES 2020

(d) The student repeats the experiment with methanol, CH_3OH.

The student uses the same number of moles of methanol as the other alcohols and the same volume of water.

Use your graph to predict the temperature rise for methanol.

..... °C [1]

(e) The student predicts that the temperature rise with another alcohol is 90 °C.

(i) The student uses an initial water temperature of 20 °C.

Explain why it is not possible to obtain a temperature rise of 90 °C.

..... [1]

(ii) The student wants to obtain a temperature rise of 90 °C with this alcohol and the same apparatus.

Suggest one way the student can obtain a temperature rise of 90 °C.

..... [1]

[Total: 14]

© UCLES 2020

BLANK PAGE

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of the Cambridge Assessment Group. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which itself is a department of the University of Cambridge.

© UCLES 2020