Cambridge O Level

Cambridge International Examinations
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

7522989051

CHEMISTRY **5070/42**

Paper 4 Alternative to Practical **May/June 2018**

1 hour

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
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.
Write your answers in the spaces provided in the Question Paper.
Electronic calculators may be used.

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.

This document consists of **15** printed pages and **1** blank page.

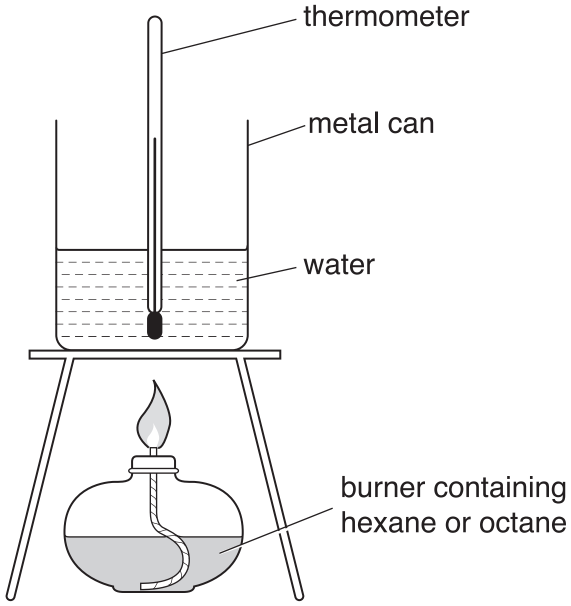
DC (SR/SW) 146475/3

CAMBRIDGE
International Examinations

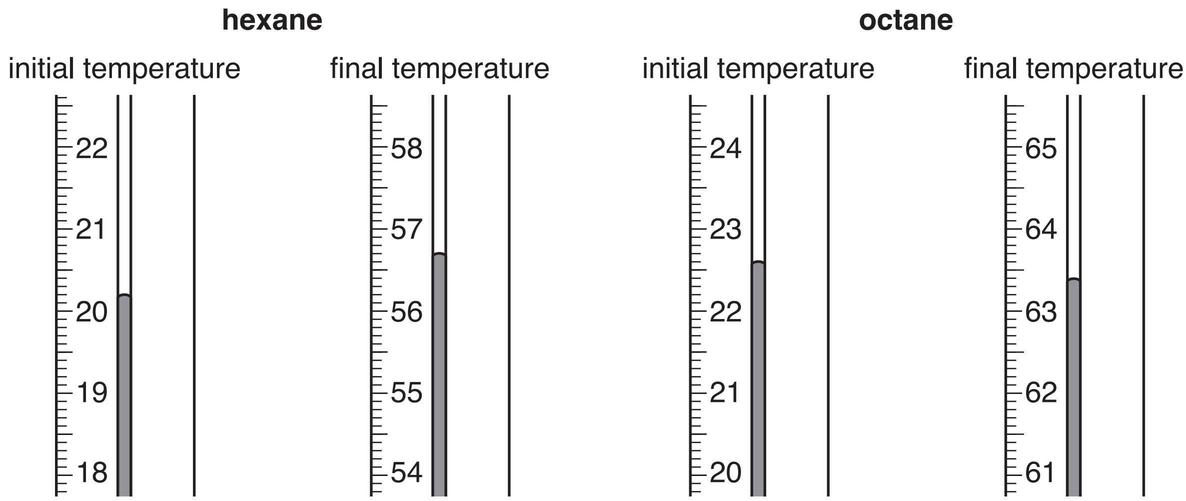
[Turn over

1 A student investigates two fuels: hexane and octane.

The student burns the fuels using the apparatus shown. A fixed volume of water is heated for five minutes in each experiment.



The diagrams show parts of the thermometer stem with the initial and final temperatures.



(a) Read the initial and final temperatures from the thermometer stems and record them in the table.

Complete the table by calculating the temperature changes.

fuel	initial temperature / °C	final temperature / °C	temperature change / °C
hexane			
octane			

[2]

(b) The student compares the temperature changes from the experiment with correct values found in a data book.

The student's experimental values are **lower** than the correct values.

Suggest a reason, other than student error, to explain why they are lower.

....

.... [1]

(c) Look at the data in the table in **(a)**.

(i) Which fuel releases more energy in the investigation?

Explain your answer.

fuel ....

explanation ....

....
[1]

(ii) What conclusion can be made from the temperature changes about the type of reaction that occurs?

....

.... [1]

[Total: 5]

2 A chemist plans an experiment to determine the concentration of acid in the juice of a lemon.

Making the solution

- Squeeze the juice out of a lemon.
- Using a measuring cylinder, transfer 10 cm^3 of the lemon juice into a 100 cm^3 volumetric flask.
- Make up to the 100 cm^3 mark with distilled water.
- Mix the solution thoroughly.

Titration

- Transfer 25.0 cm^3 of the diluted lemon juice into a conical flask.
- Add a few drops of a suitable indicator.
- Add 0.0500 mol / dm^3 sodium hydroxide, **R**, until the end-point is reached.
- Repeat the titration two more times.

(a) In the titration, state the name of the apparatus used to:

(i) transfer 25.0 cm^3 of the diluted lemon juice into the conical flask

.... [1]

(ii) add **R** to the diluted lemon juice in the conical flask.

.... [1]

(b) The results of the titrations are recorded in the table.

titration number	1	2	3
final reading / cm^3	15.6	30.8	45.8
initial reading / cm^3	0.0	15.6	30.8
volume of **R** used / cm^3			
best titration results (✓)			

(i) Complete the table by calculating the volumes of **R** used.

[1]

(ii) Tick (✓) the best titration results and explain why you have selected these values.

....

....

.... [1]

(iii) Use these best titration results to calculate the average volume of **R** used.

average volume of **R** used .... cm^3

[1]

(c) **R** is 0.0500 mol / dm^3 sodium hydroxide, NaOH.

Calculate the number of moles of NaOH present in the average volume of **R** used.

.... moles [1]

(d) The acid in lemon juice is represented by the formula H**A**.

The equation for the reaction of H**A** with NaOH is shown.

$$NaOH + H\mathbf{A} \rightarrow Na\mathbf{A} + H_2O$$

Calculate the number of moles of H**A** that react with the NaOH in the average volume of **R** used.

.... moles [1]

(e) 25.0 cm^3 of diluted lemon juice is used in each titration.

Calculate the concentration, in mol / dm^3, of H**A** in the diluted lemon juice.

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

(f) **(i)** At the start of the experiment, distilled water was added to 10 cm^3 of lemon juice to make 100 cm^3 of diluted lemon juice.

Calculate the concentration, in mol / dm^3, of H**A** in the original lemon juice.

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

(ii) The actual concentration of acid in the lemon juice is different from your answer in **(f)(i)**.

Suggest the most likely source of error in the method for making the solution described at the start of the question.

....

.... [1]

[Total: 10]

3 Calcium carbonate reacts with dilute hydrochloric acid to form carbon dioxide gas.

Describe an experiment to follow the rate of reaction between calcium carbonate and 25 cm^3 0.10 mol / dm^3 hydrochloric acid at room temperature.

Your method must include the collection of carbon dioxide gas.

You are provided with:

- 2 g of small pieces of calcium carbonate (an excess)
- 25 cm^3 0.10 mol / dm^3 hydrochloric acid
- the apparatus normally found in a school laboratory.

Your answer should include:

- a method
- the measurements you need to make during your experiment
- how you will process your results.

You may use a labelled diagram to help explain the method.

....

....

....

....

....

....

....

....

....

.... [6]

4 Two solids, **L** and **M**, are mixed together.

L is soluble in water. **M** is insoluble in water.

(a) How can **M** be separated from **L**?

....

....

.... [2]

(b) Two samples of a solution of **L** are put into separate test-tubes.

- Aqueous sodium hydroxide is added to the first test-tube and the mixture is warmed. A gas is produced which turns damp red litmus paper blue.
- Dilute nitric acid and aqueous barium nitrate are added to the second test-tube. A white precipitate is formed.

Name both ions present in **L**.

.... and .... [2]

(c) **(i)** A sample of the insoluble solid, **M**, is put into another test tube.

Dilute hydrochloric acid is added to this test-tube. Carbon dioxide gas is produced.

Give a test and observation to identify carbon dioxide gas.

....

.... [2]

(ii) Name the negative ion in **M**.

.... [1]

(d) Solid **M** reacts with dilute hydrochloric acid to form a solution.

Describe a test and observations to show that this solution contains calcium ions.

test ....

....

observations ....

.... [3]

[Total: 10]

5 Ammonia is produced by the reaction between nitrogen and hydrogen in the presence of a catalyst.

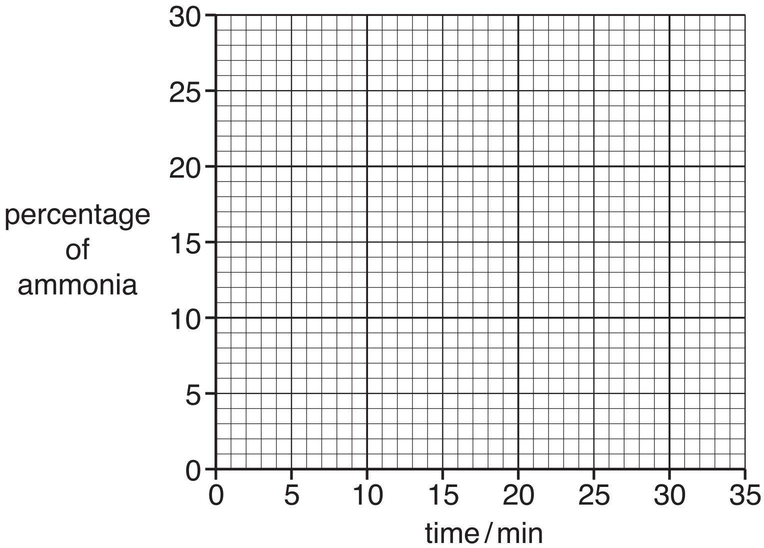
Nitrogen is mixed with hydrogen and a sample of the reaction mixture is removed every five minutes.

A student determines the percentage of ammonia in each sample.

The results are shown in the table.

time / min	percentage of ammonia
0	0
5	10
10	18
15	15
20	24
25	25
30	25

(a) **(i)** Plot the results on the grid and draw a smooth curve of best fit.



[2]

(ii) The student believes that one of the data points is anomalous. Circle the anomalous point on the graph.

[1]

(iii) Use your graph to deduce the correct percentage of ammonia corresponding to the point circled in **(a)(ii)**.

.... %
[1]

(b) The student decides to repeat the whole experiment.

Why is this a good idea?

....

.... [1]

(c) Suggest why a catalyst is used in the experiment.

....

.... [1]

(d) The reaction between nitrogen and ammonia is reversible and reaches dynamic equilibrium.

Use your **graph** to suggest the time when dynamic equilibrium is first reached.

.... [1]

[Total: 7]

6 **X** is a colourless solution of an oxidising agent.

Y is a colourless solution of a reducing agent.

Z is a metal between iron and calcium in the reactivity series.

(a) Tests are carried out on substances **X**, **Y** and **Z**. Complete the table.

substance	test	observation
X	To 1 cm depth of aqueous potassium iodide in a test-tube, **X** is added until no further change occurs.	
Y	To 1 cm depth of acidified potassium manganate(VII) in a test-tube, **Y** is added until no further change occurs.	
Z	A piece of **Z** is added to an excess of dilute hydrochloric acid in a test-tube.	

[5]

(b) **(i)** Name the gas produced by the reaction of **Z** with dilute hydrochloric acid.

.... [1]

(ii) Give a test and observation to identify this gas.

....

.... [2]

[Total: 8]

7 **(a)** A student makes an aqueous solution of potassium nitrate. She reacts dilute nitric acid with an aqueous solution of a salt.

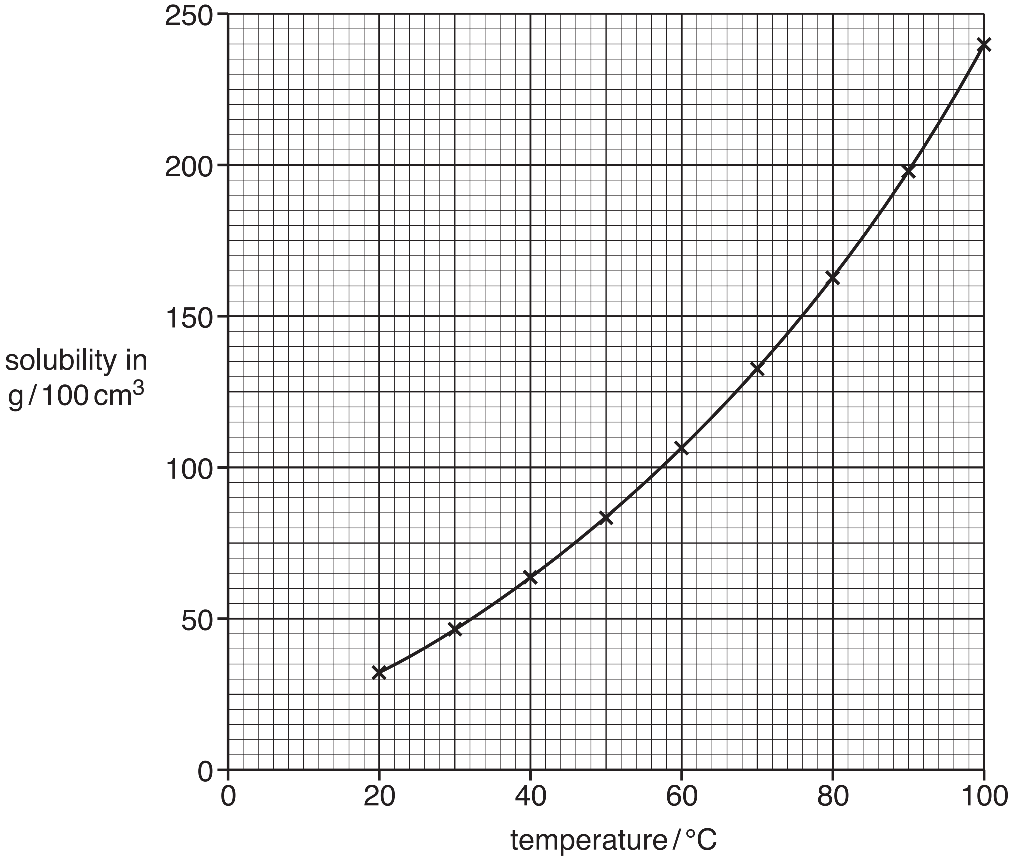
Name a salt that she could use.

.... [1]

(b) The student investigates the mass of potassium nitrate that dissolves in 100 cm^3 of water at different temperatures. This is its solubility.

The graph shows the student's results.

On the grid, extend the graph to 0 °C.



[1]

(c) Using the graph, deduce the temperature at which the solubility is 180 g / 100 cm^3.

.... °C [1]

(d) Using the graph, deduce:

(i) the mass of potassium nitrate dissolved in 100 cm^3 of water at 90 °C

.... g [1]

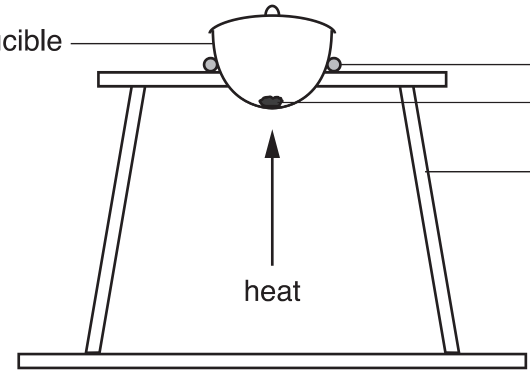
(ii) the mass of potassium nitrate that crystallises when this solution is cooled from 90 °C to 20 °C.

.... g [2]

[Total: 6]

8 A scientist needs to identify the metal ion in a metal carbonate, **M**CO_3.

MCO_3 is heated in a crucible for three minutes. The **M**CO_3 decomposes to form the solid metal oxide, **M**O, and carbon dioxide gas.



(a) Give **two** reasons why it is important that a lid is placed loosely on the crucible.

1 ....

2 ....
[2]

(b) Complete the table of results.

mass of crucible and lid / g	mass of crucible, lid and **M**CO_3 before heating / g	mass of crucible, lid and contents after heating / g	mass of **M**CO_3 before heating / g	mass of carbon dioxide gas formed / g
10.1	12.6	11.7		

[2]

(c) The crucible is heated for another three minutes. The mass of the crucible, lid and contents is 11.5 g.

Explain why this is different from the value in the table.

....

....

.... [1]

(d) The total mass of carbon dioxide, CO_2, formed is 1.1 g.

Calculate the number of moles of CO_2 formed.

[M_r: CO_2, 44]

.... moles [1]

(e) The equation for the decomposition of the metal carbonate is shown.

$$\mathbf{M}CO_3 \rightarrow \mathbf{M}O + CO_2$$

Using the equation and your answers to **(b)** and **(d)**, calculate the relative formula mass of **M**CO_3.

relative formula mass .... [1]

(f) Calculate the relative atomic mass, A_r, of metal **M**.

[A_r: C, 12; O, 16]

A_r of metal **M** .... [1]

[Total: 8]

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