



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

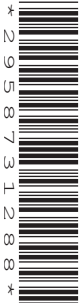
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CHEMISTRY

5070/41

Paper 4 Alternative to Practical

October/November 2010

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 a soft pencil for any diagrams, graphs or rough working.

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

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

Write your answers in the spaces provided in the Question Paper.

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.

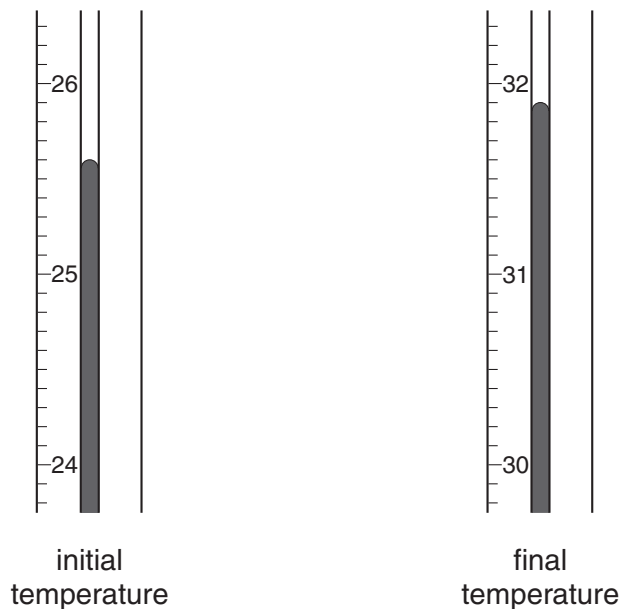
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This document consists of **16** printed pages.



- 1 A 100 cm³ beaker was half-filled with water and a clean piece of sodium was carefully added. The diagrams below show parts of the thermometer stem giving the temperature of the water both before and after the addition of sodium.



- (a) Complete the following table and calculate the rise in temperature.

| | |
|-------------------------------------|--|
| final temperature of the water/°C | |
| initial temperature of the water/°C | |
| rise in temperature/°C | |

[2]

- (b) What type of reaction does this temperature change indicate?

..... [1]

- (c) A gas was produced in the reaction.

Name and describe a positive test for this gas.

name

test [2]

(d) (i) Name the resulting solution after the sodium had reacted with the water.

..... [1]

A few drops of litmus solution were added to the solution.

(ii) What was the colour of the resulting solution?

..... [1]

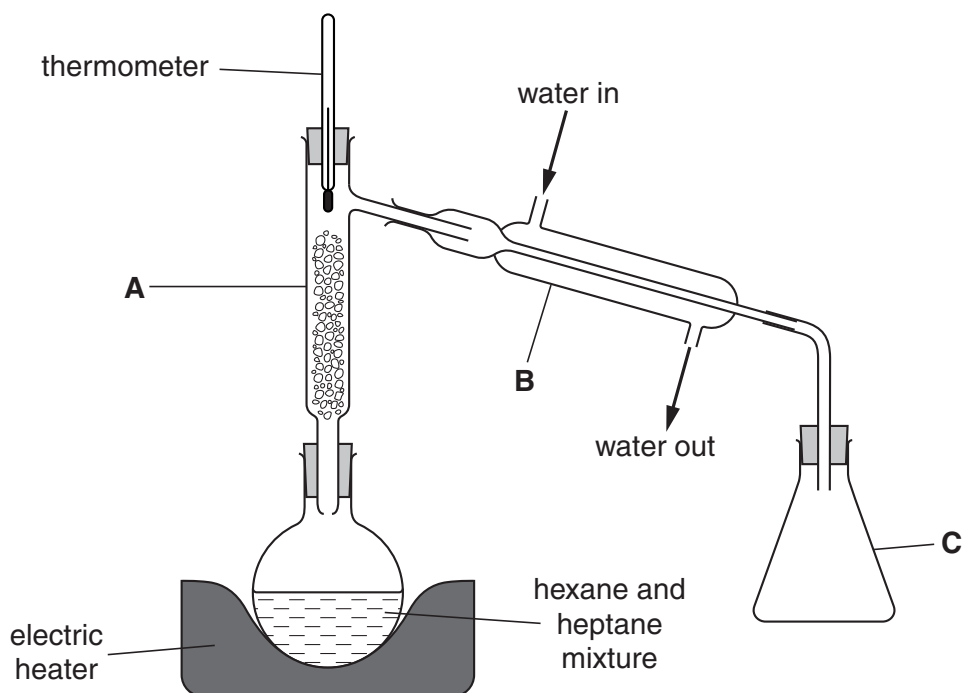
(e) State **two** other observations that can be made when sodium reacts with water.

1.

2. [2]

[Total: 9]

- 2 A student separated hexane, C_6H_{14} , (b.p. $69^\circ C$) and heptane, C_7H_{16} , (b.p. $98^\circ C$) using the apparatus shown below.



- (a) Identify **two** errors in the student's apparatus.

1. [1]
2. [2]

The errors were then corrected and the separation started.

- (b) (i) Name apparatus **A**.

..... [1]

- (ii) What is the purpose of apparatus **A**?

..... [1]

- (iii) Name apparatus **B**.

..... [1]

- (iv) What is the purpose of apparatus **B**?

..... [1]

- (c) (i) What was the reading on the thermometer when the first few drops of liquid appeared in **C**?

..... °C [1]

- (ii) Name this liquid.

..... [1]

- (iii) How did the student know when all of this liquid had distilled over?

..... [1]

- (d) Why was an electric heater rather than a flame used to heat the mixture?

..... [1]

- (e) The original mixture of 100g of hexane, C_6H_{14} , and heptane, C_7H_{16} , contained 40g of hexane.

Calculate the amount, in moles, of both hexane and heptane and hence the percentage by moles of hexane in the mixture.

[A_r : C,12; H,1]

moles of hexane

moles of heptane [1]

percentage by moles of hexane [1]

[Total: 12]

In questions 3 to 7 inclusive, place a tick (✓) in the box against the best answer.

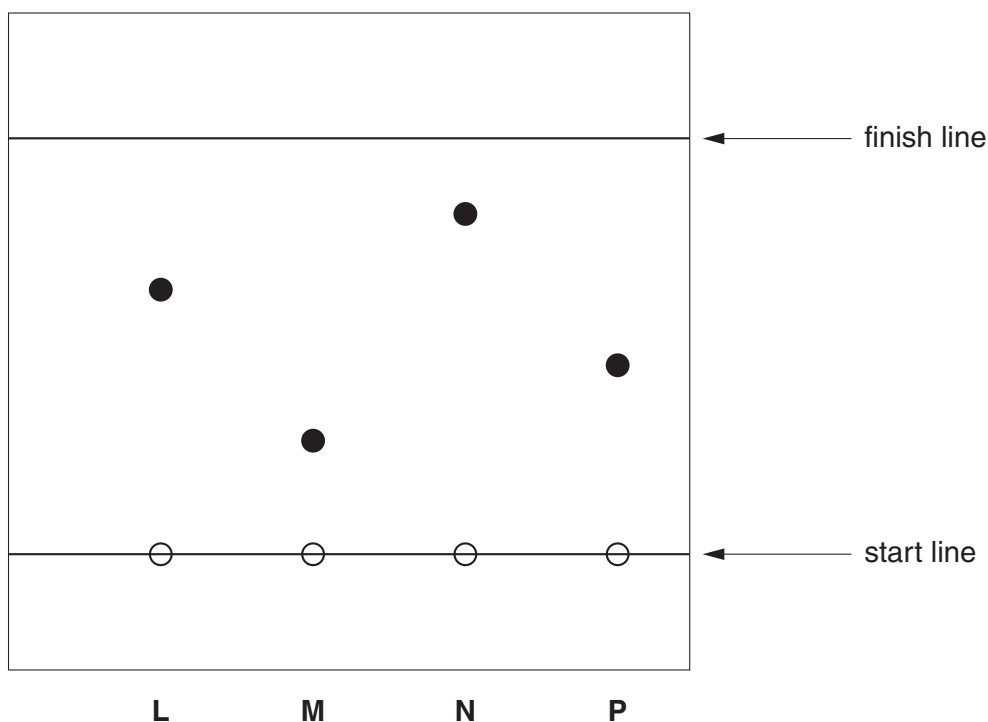
- 3 Water containing a little dilute sulfuric acid was electrolysed, using carbon electrodes.

If 20 cm³ of hydrogen was given off at the cathode, what volume of oxygen would be given off at the anode?

- (a) 10 cm³
- (b) 20 cm³
- (c) 30 cm³
- (d) 40 cm³

[Total: 1]

- 4 The diagram below shows the result of a chromatography experiment on substances L, M, N and P.



Which substance has a R_f value of 0.64?

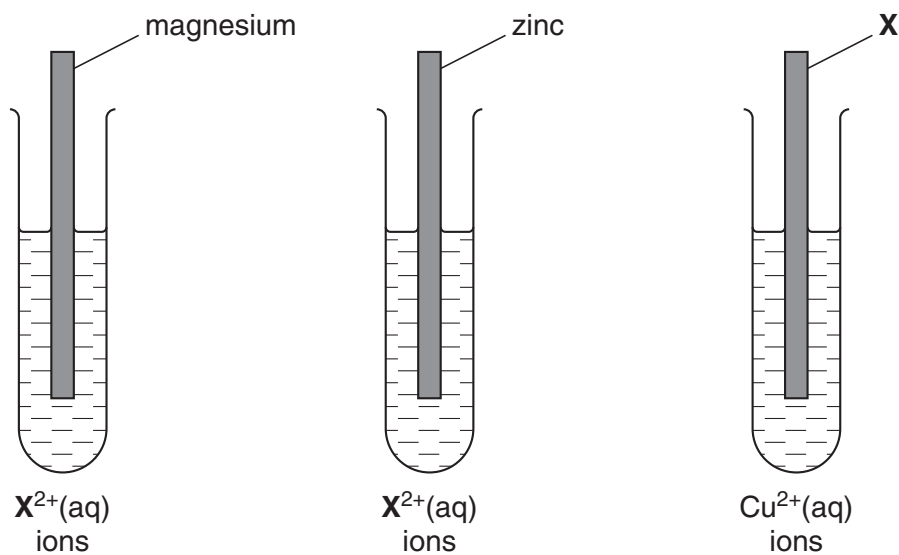
- (a) L
- (b) M
- (c) N
- (d) P

[Total: 1]

5 A student did an experiment to compare the reactivities of three different metals.

Three test-tubes were arranged as in the diagrams below.

There was a deposit formed in all three tubes.



X could be

- (a) calcium
- (b) iron
- (c) silver
- (d) sodium

[Total: 1]

- 6 A compound, **P**, contains 40.0% carbon, 6.7% hydrogen and 53.3% oxygen.

What is its empirical formula?

[A_r : C,12; H,1; O,16]

- (a) CHO
- (b) C₂H₂O
- (c) CH₂O
- (d) CHO₂

[Total: 1]

- 7 Which of the following statements, involving aqueous ethanoic acid, is **not** correct?

- (a) On addition of orange coloured potassium dichromate(VI),
a green solution is formed.
- (b) Effervescence occurs on addition of aqueous sodium carbonate.
- (c) Reaction with zinc produces hydrogen.
- (d) It reacts with ethanol to produce a sweet smelling compound.

[Total: 1]

8 The formula for hydrated iron(II) sulfate crystals is $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$.

A student determined the value of x using aqueous 0.0200 mol/dm^3 potassium manganate(VII), **G**.

Potassium manganate(VII), which is purple, oxidises the iron(II) ions to iron(III) ions.

A sample of iron(II) sulfate crystals was added to a previously weighed container, which was then reweighed.

| | | |
|------------------------------|---|---------|
| Mass of container + crystals | = | 11.22 g |
| Mass of container | = | 4.98 g |

(a) Calculate the mass of iron(II) sulfate used in the experiment.

..... g [1]

The sample was dissolved in 100 cm^3 of dilute sulfuric acid and the solution made up to 250 cm^3 with distilled water. This was **H**.

A 25.0 cm^3 sample of **H** was measured into a conical flask.

G was put into a burette and run into the conical flask containing **H**.

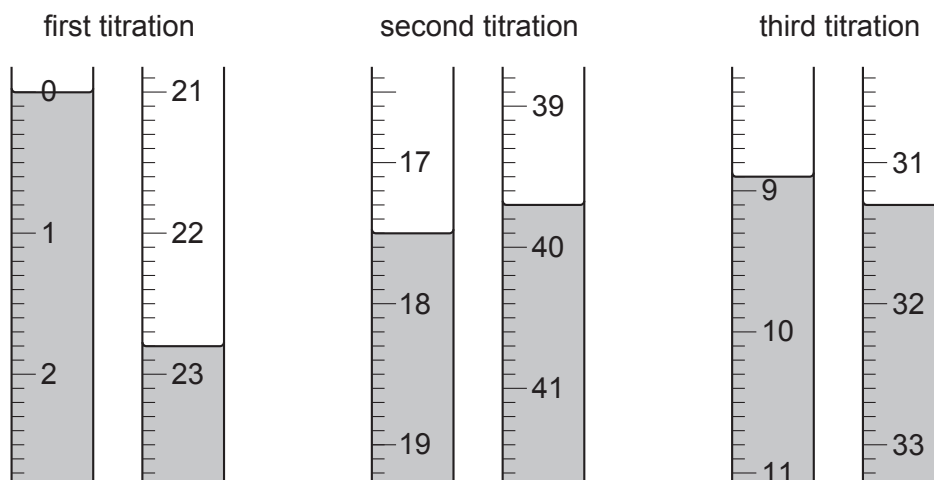
(b) What was the colour of the solution in the conical flask

(i) before **G** was added,

(ii) at the end-point?

[1]

Three titrations were done. The diagrams below show parts of the burette with the liquid levels at the beginning and end of each titration.



(c) Use these diagrams to complete the following table of results.

| | | | |
|---|---|---|---|
| titration number | 1 | 2 | 3 |
| final burette reading/cm ³ | | | |
| initial burette reading/cm ³ | | | |
| volume of G /cm ³ | | | |
| best titration results (✓) | | | |

Summary

Tick (✓) the best titration results.

Using these results, the average volume of **G** was cm³. [4]

(d) **G** is 0.0200 mol/dm³ potassium manganate(VII), KMnO₄.

Calculate how many moles of KMnO₄ were present in the average volume of **G**.

..... moles [1]

- (e) Five moles of FeSO_4 react with one mole of KMnO_4 .

Calculate how many moles of FeSO_4 were present in 25.0 cm^3 of **H**.

..... moles [1]

- (f) Calculate how many moles of FeSO_4 were present in 250 cm^3 of **H**.

..... moles [1]

- (g) Using your answer to (f), calculate the mass of FeSO_4 in the original sample of $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$.

[A_r : Fe,56; S,32; O,16]

..... g [1]

- (h) Using your answers to (a) and (g) calculate the mass of water in the sample of $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$.

..... g [1]

- (i) Using your answer to (h) calculate the number of moles of water in the sample of $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$.

[A_r : H,1; O,16]

..... moles [1]

(j) Using your answers to (f) and (i), calculate the value of x in $\text{FeSO}_4 \cdot x\text{H}_2\text{O}$.

..... [1]

(k) Write the formula for hydrated iron(II) sulfate crystals.

..... [1]

(l) Explain why the reaction between aqueous iron(II) sulfate and aqueous potassium manganate(VII) is an example of a **redox** reaction.

.....

.....

..... [2]

(m) Suggest why a similar titration cannot be used to find the value of x in $\text{FeCl}_3 \cdot x\text{H}_2\text{O}$.

.....

..... [1]

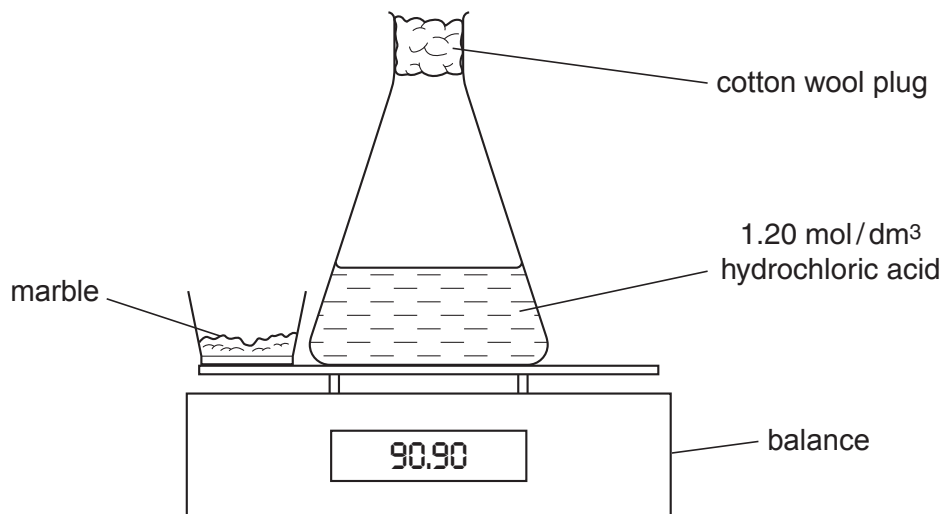
[Total: 17]

- 9 The following table shows the tests a student did on compound **P**. Complete the table by adding the conclusion for test **(a)**, the observations for **(b)(i)**, **(b)(ii)** and **(c)** and the test and observation for **(d)**.

| test | observations | conclusions |
|---|-----------------------------------|---|
| (a) P was dissolved in water and the resulting solution divided into three parts for tests (b) , (c) and (d) . | A colourless solution was formed. | |
| (b) (i) To the first part aqueous sodium hydroxide was added until a change was seen. (ii) An excess of aqueous sodium hydroxide was added to the mixture from (i) . | | P may contain Al^{3+} , Ca^{2+} or Zn^{2+} ions. P may contain Ca^{2+} ions. |
| (c) To the second part aqueous ammonia was added. | | The presence of Ca^{2+} ions was confirmed. |
| (d) | | P contains I^- ions. |

[Total: 7]

- 10 A student used the apparatus shown below to find the loss in mass during the reaction between 20.0 g of marble pieces (an excess) and 30.0 cm³ of 1.20 mol/dm³ hydrochloric acid (experiment 1).



The marble was added to the acid and the mass was recorded every 30 seconds.

- (a) Why did the mass of the flask and contents decrease during the reaction?

..... [1]

The experiment was repeated using the same mass of marble but finely powdered. The volume and concentration of the hydrochloric acid were the same (experiment 2).

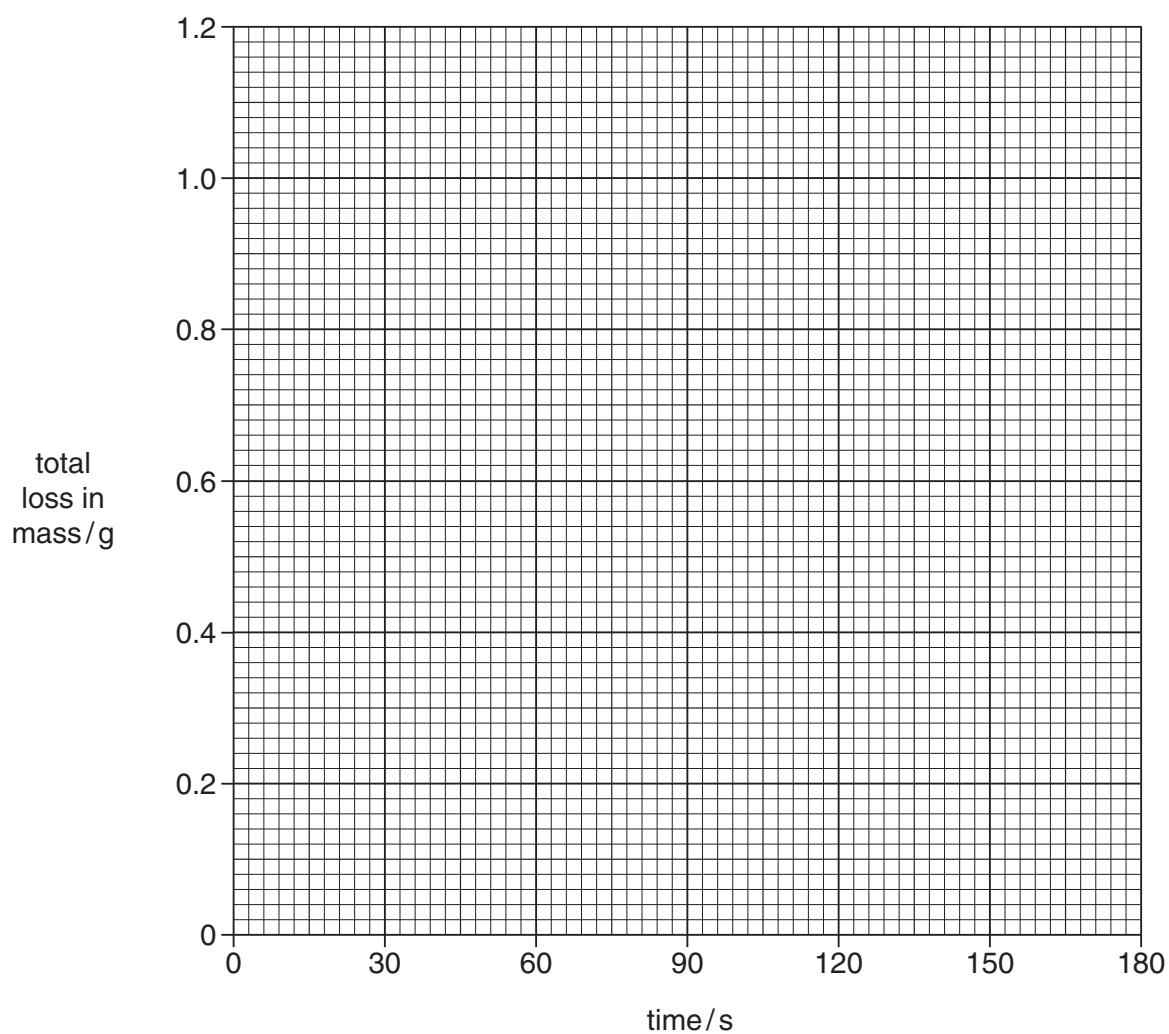
The results of the two experiments were recorded in the table below.

- (b) Complete the table by calculating the total loss in mass for both experiments.

| time/s | experiment 1 | | experiment 2 | |
|--------|--------------|----------------------|--------------|----------------------|
| | mass/g | total loss in mass/g | mass/g | total loss in mass/g |
| 0 | 90.90 | 0.00 | 90.90 | 0.00 |
| 30 | 90.62 | 0.28 | 90.42 | 0.48 |
| 60 | 90.42 | 0.48 | 90.23 | 0.67 |
| 90 | 90.27 | | 90.14 | |
| 120 | 90.17 | | 90.10 | |
| 150 | 90.10 | | 90.10 | |
| 180 | 90.10 | | 90.10 | |

[2]

- (c) Plot the points for each experiment on the grid. Join each set of points with a curve. Label the curves **1** (experiment 1) and **2** (experiment 2).



[3]

- (d) Why were the last two results in experiment 1, and the last three results in experiment 2 the same?

..... [1]

- (e) Using your graph

- (i) What was the total loss in mass in experiment 1 after 75 seconds?

..... g [1]

- (ii) What was the mass in experiment 2 after 45 seconds?

..... g [1]

- (f) Compare the two curves and deduce the effect of using powdered marble in experiment 2.

..... [1]

[Total: 10]