



**Cambridge International Examinations**  
Cambridge International General Certificate of Secondary Education

CANDIDATE  
NAME

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**CO-ORDINATED SCIENCES**

**0654/51**

Paper 5 Practical Test

**May/June 2014**

**2 hours**

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions.

**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.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

Notes for Use in Qualitative Analysis for this paper are printed on page 16.

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.

For Examiner's Use	
<b>1</b>	
<b>2</b>	
<b>3</b>	
<b>Total</b>	

This document consists of **14** printed pages and **2** blank pages.

1 You will be investigating the vitamin C content of a fruit juice.

DCPIP is a dark blue chemical that is decolourised by vitamin C. A solution containing a higher concentration of vitamin C will take fewer drops to decolourise DCPIP.

You are provided with a set of different concentrations of vitamin C and a fruit juice of an unknown vitamin C concentration.

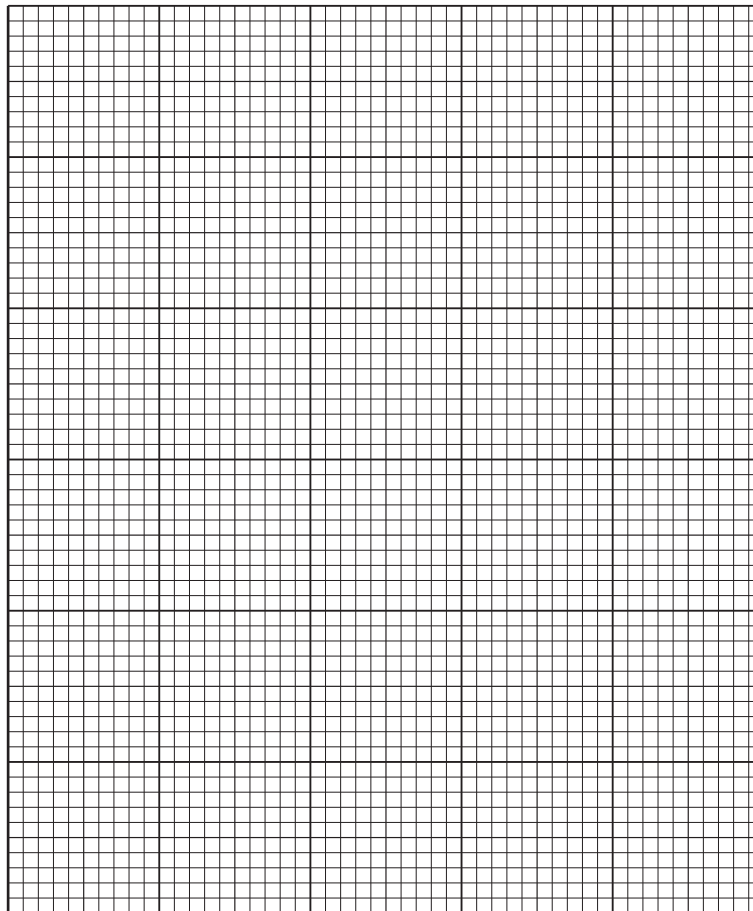
- (a)
- Using a dropping pipette, place **two** drops of DCPIP into each of five wells of a white spotting tile.
  - Start with the 1.00% solution of vitamin C. Use a clean dropping pipette to carefully add drops to one of the wells with the DCPIP and count how many drops are needed to decolourise it. **Immediately** record your result in Table 1.1.
  - Repeat with the other solutions of different concentrations of vitamin C and then the fruit juice, using a clean dropping pipette each time.
  - If a solution of vitamin C does not decolourise, stop when the well is full, record the number of drops and write maximum next to it.
  - You should ignore any colour changes seen 5 minutes after adding the vitamin C to the DCPIP.

**Table 1.1**

concentration of vitamin C (%)	number of drops needed to decolourise DCPIP
1.00	
0.75	
0.50	
0.25	
fruit juice	

[4]

- (b) Plot a graph on the grid below of the number of drops needed to decolourise DCPIP against vitamin C concentration. Draw the best fit straight line.



vitamin C concentration (%)

[3]

- (c) Use your graph to estimate the vitamin C concentration of the fruit juice and mark on the graph how you worked this out.

vitamin C concentration = ..... % [2]

- (d) A student suggested that drops of distilled water are added to two drops of DCPIP in another well.

Give a reason why this further test should be used.

.....  
..... [1]

(e) Identify **one** inaccuracy of this experimental method and suggest an improvement to reduce this inaccuracy.

inaccuracy .....

.....

improvement .....

..... [2]

(f) Outline a way of improving the reliability of this experiment.

.....

.....

..... [2]

(g) Vitamin C is an important component of our diet. What are the consequences of a diet that lacks vitamin C?

.....

..... [1]

- 2 You are going to investigate some reactions of sodium hydrogencarbonate,  $\text{NaHCO}_3$  and sodium carbonate,  $\text{Na}_2\text{CO}_3$ . In parts (b) and (c) you will carry out the same tests on these two substances. Be careful that you do not confuse the two white powders.

- (a) Remove the stopper from the hard glass test-tube which is one-quarter full of **sodium hydrogencarbonate** and attach a delivery tube.

One-quarter fill a test-tube with limewater and place the other end of the delivery tube into the limewater. See Fig. 2.1.

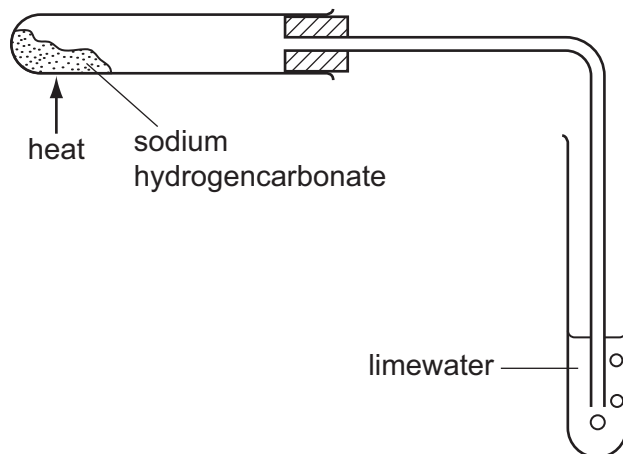


Fig. 2.1

Heat the hard glass test-tube containing the solid for at least two minutes after the limewater has returned to a colourless solution.

**Immediately remove the delivery tube from the limewater, to avoid suck back.**

Record your observations including what happened to the solid and to the limewater.

**Keep the solid contents of the hard glass test-tube for (d)(ii).**

observations .....

.....

..... [2]

- (b) Place one spatula load of **sodium hydrogencarbonate** into a clean test-tube and add distilled water until three-quarters full. Place the stopper in the test-tube and shake until the solid is dissolved.

Use this sodium hydrogencarbonate solution for tests (b)(i) to (b)(iv).

- (i) Place  $1\text{ cm}^3$  of sodium hydrogencarbonate solution into a clean test-tube and add a few drops of Universal (full range) Indicator solution.

Record the colour change.

colour change ..... to ..... [1]

- (ii) Place another  $1\text{ cm}^3$  of sodium hydrogencarbonate solution into a clean test-tube and add an equal volume of dilute hydrochloric acid.

Record your observations.

observations .....  
 ..... [1]

- (iii) Place  $2\text{ cm}^3$  of sodium hydrogencarbonate solution into a clean test-tube and add an equal volume of sodium hydroxide solution.

Record your observations.

observations .....  
 ..... [1]

- (iv) Place another  $2\text{ cm}^3$  of sodium hydrogencarbonate solution into a clean test-tube and add an equal volume of copper sulfate solution.

Record your observations.

observations .....  
 ..... [1]

- (c) Thoroughly wash out the test-tubes used in (b)(i) to (iv).  
**Do NOT wash out the hard glass test-tube from (a) which is needed for (d)(ii).**

Place one spatula load of **sodium carbonate** into a clean test-tube and add distilled water, until three-quarters full. Place the stopper in the test-tube and shake until the solid is dissolved. It does not matter if a small amount of solid will not dissolve.

Use this sodium carbonate solution for tests (c)(i) to (c)(iv).

- (i) Place  $1\text{ cm}^3$  of sodium carbonate solution into a clean test-tube and add a few drops of Universal (full range) Indicator solution.

Record the colour change.

colour change ..... to ..... [1]

- (ii) Place another  $1\text{ cm}^3$  of sodium carbonate solution into a clean test-tube and add an equal volume of dilute hydrochloric acid.

Record your observations.

observations .....  
 ..... [1]

- (iii) Place  $2\text{ cm}^3$  of sodium carbonate solution into a clean test-tube and add an equal volume of sodium hydroxide solution.

Record your observations.

observations .....  
 ..... [1]

- (iv) Place another  $2\text{ cm}^3$  of sodium carbonate solution into a clean test-tube and add an equal volume of copper sulfate solution.

Record your observations.

observations .....  
 ..... [1]

- (d) (i) Look at your results for (b) and (c) and suggest which **two** tests could be used to distinguish between sodium hydrogencarbonate and sodium carbonate.

test 1 .....

test 2 ..... [1]

- (ii) Now dissolve a spatula load of the solid remaining in the hard glass test-tube from (a) in distilled water in a clean test-tube.

Use portions of this solution to carry out the two tests you have chosen in (d)(i).

Record your observations below.

observation for test 1 .....

observation for test 2 ..... [2]

- (iii) By using your observations in (a) and by comparing your observations in (d)(ii) with your observations in (b) and (c), state what the products of heating sodium hydrogencarbonate are.

.....

..... [2]



**Please turn over for Question 3.**

- 3 You are going to find the density of plasticine (modelling clay) by two different methods and then you will compare your answers.

### Method 1

- (a) You are provided with a beaker of water, a measuring cylinder, some plasticine and a length of thread.

Break the plasticine into two pieces of about the same size. Choose **one** of the pieces, and keep the other piece for use in part (b)(i).

- (i) Use the balance provided to find the mass,  $m_1$  of your chosen piece of plasticine to the nearest 0.1 g.

$$m_1 = \dots\dots\dots \text{g} \quad [1]$$

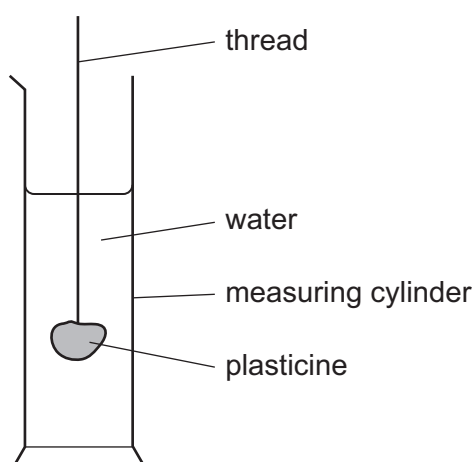


Fig. 3.1

- (ii) Pour approximately  $50 \text{ cm}^3$  of water from the beaker into the measuring cylinder.

Record the volume,  $V_1$  of water in the measuring cylinder.

$$V_1 = \dots\dots\dots \text{cm}^3 \quad [1]$$

- (iii) Use the thread to lower your weighed piece of plasticine into the measuring cylinder until it is completely immersed.

Record the new volume,  $V_2$ .

$$V_2 = \dots\dots\dots \text{cm}^3 \quad [1]$$

- (iv) Calculate the volume,  $V_3$  of your chosen piece of plasticine.

$$V_3 = \dots\dots\dots \text{cm}^3 \quad [1]$$

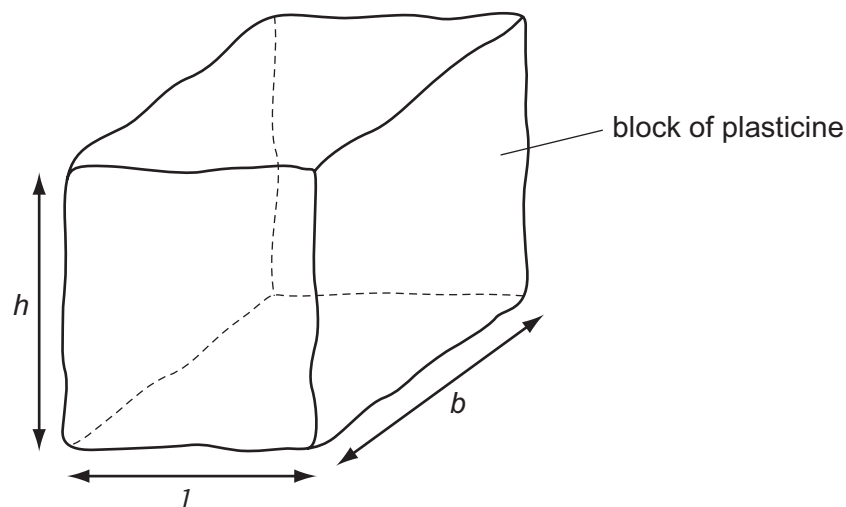
(v) Calculate the density,  $d$  of the plasticine using the equation:

$$d = \frac{m_1}{V_3}$$

$$d = \dots\dots\dots \text{g/cm}^3 \quad [1]$$

### Method 2

(b)



**Fig. 3.2**

- (i) Pour the water from the measuring cylinder back into the beaker, remove the plasticine from the measuring cylinder and dry the plasticine with the paper towels. Using **both** pieces of plasticine, mould them together into a shape that approximates to a cube, as shown in Fig. 3.2.

Measure the length  $l$ , breadth  $b$ , and height  $h$ , of the cube to the nearest 0.1 cm and record your results below.

$$l = \dots\dots\dots \text{cm}$$

$$b = \dots\dots\dots \text{cm}$$

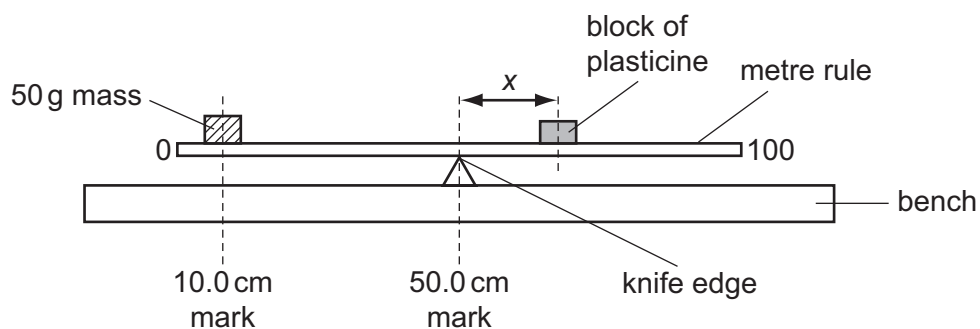
$$h = \dots\dots\dots \text{cm} \quad [2]$$

- (ii) Calculate the volume,  $V_4$  of your cube by using the equation:

$$V_4 = l \times b \times h$$

$$V_4 = \dots\dots\dots \text{cm}^3 \quad [1]$$

A 50 g mass has been secured to the metre rule. Its position is fixed with its centre over the 10.0 cm mark. Do not attempt to move the mass during the experiment.



**Fig. 3.3**

- (iii) Place the knife edge directly under the 50.0 cm mark, as shown in Fig. 3.3.

Take the cube of plasticine and place it on the metre rule.

Adjust its position until the rule is just balanced.

Measure, to the nearest 0.1 cm, the distance,  $x$  from the centre of the cube to the 50.0 cm mark on the rule.

Record the distance  $x$ .

$$x = \dots\dots\dots \text{ cm} \quad [2]$$

- (iv) Calculate the mass,  $m_2$  of the cube of plasticine using the equation:

$$m_2 = \frac{2000}{x}$$

$$m_2 = \dots\dots\dots \text{ g} \quad [1]$$

- (v) Calculate the density,  $d$  of the plasticine to an appropriate number of significant figures using the equation:

$$d = \frac{m_2}{V_4}$$

$$d = \dots\dots\dots \text{ g/cm}^3 \quad [2]$$

(c) Compare your results for the two methods of determining the density of the plasticine given in (a)(v) and (b)(v).

Suggest **two** reasons why the values you have obtained may not be the same.

reason 1 .....

.....

reason 2 .....

..... [2]





## NOTES FOR USE IN QUALITATIVE ANALYSIS

## Test for anions

<i>anion</i>	<i>test</i>	<i>test result</i>
carbonate ( $\text{CO}_3^{2-}$ )	add dilute acid	effervescence, carbon dioxide produced
chloride ( $\text{Cl}^-$ ) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
nitrate ( $\text{NO}_3^-$ ) [in solution]	add aqueous sodium hydroxide then aluminium foil; warm carefully	ammonia produced
sulfate ( $\text{SO}_4^{2-}$ ) [in solution]	acidify then add aqueous barium chloride <i>or</i> aqueous barium nitrate	white ppt.

## Test for aqueous cations

<i>cation</i>	<i>effect of aqueous sodium hydroxide</i>	<i>effect of aqueous ammonia</i>
ammonium ( $\text{NH}_4^+$ )	ammonia produced on warming	-
copper(II) ( $\text{Cu}^{2+}$ )	light blue ppt., insoluble in excess	light blue ppt., soluble in excess giving a dark blue solution
iron(II) ( $\text{Fe}^{2+}$ )	green ppt., insoluble in excess	green ppt., insoluble in excess
iron(III) ( $\text{Fe}^{3+}$ )	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc ( $\text{Zn}^{2+}$ )	white ppt., soluble in excess giving a colourless solution	white ppt., soluble in excess giving a colourless solution

## Test for gases

<i>gas</i>	<i>test and test results</i>
ammonia ( $\text{NH}_3$ )	turns damp red litmus paper blue
carbon dioxide ( $\text{CO}_2$ )	turns limewater milky
chlorine ( $\text{Cl}_2$ )	bleaches damp litmus paper
hydrogen ( $\text{H}_2$ )	"pops" with a lighted splint
oxygen ( $\text{O}_2$ )	relights a glowing splint

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