OXFORD
INTERNATIONAL
AQA EXAMINATIONS

INTERNATIONAL GCSE

COMBINED SCIENCE DOUBLE AWARD

9204/CE CHEMISTRY – PAPER 2 – EXTENSION PAPER

Specimen Material 1 hour 45 minutes

Materials

For this paper you must have:

- a ruler with millimetre measurements
- a calculator
- the Periodic table (enclosed).

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the bottom of this page.
- Answer **all** questions.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 100.

Please write clearly, in block capitals, to allow character computer recognition.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

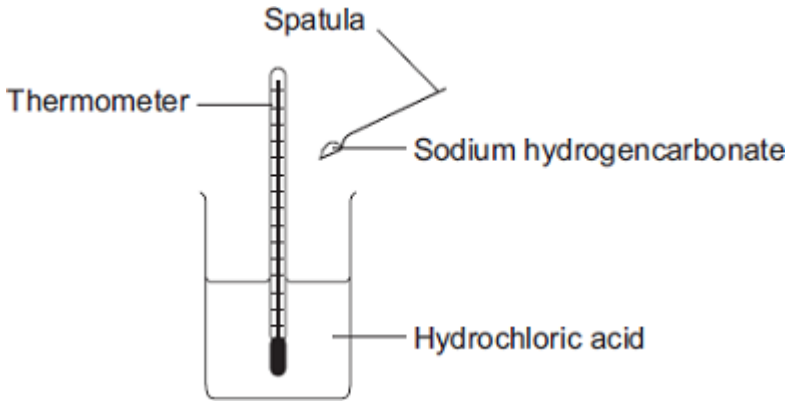
Surname

Forename(s)

Candidate signature _____

Answer **all** questions in the spaces provided.

1 Some students did an experiment to find the temperature change when hydrochloric acid reacts with sodium hydrogencarbonate.



The results are in the table.

Number of spatula measures of sodium hydrogencarbonate	Start temperature in °C	Final temperature in °C	Change in temperature in °C
2	20	16	4
4	20	14	6
6	19	11	8
8	20	10	10
10	19	9	10
12	20	10	10

0 1 . 1 Describe the trends shown in the students' results.

[3 marks]

0 1 . 2 State **one** variable that must be kept the same for the investigation.

[1 mark]

0 1 . 3 State the type of energy transfer for this reaction.

[1 mark]

Sodium hydrogencarbonate is used as baking powder for making cakes.

When the cake mixture is baked the sodium hydrogencarbonate decomposes.

The equation for the reaction is:

$$2\,NaHCO_3(s) \xrightarrow{\text{Heat}} Na_2CO_3(s) + H_2O(g) + CO_2(g)$$

0 1 . 4 The cake mixture rises when baked.

Use the equation to suggest why.

[1 mark]

Question 1 continues on the next page

0 1 . 5 The same reaction can be reversed to produce sodium hydrogencarbonate from sodium carbonate.

$$Na_2CO_3 + H_2O + CO_2 \longrightarrow 2NaHCO_3$$

Do the reactants need to be heated?

Give a reason for your answer.

[1 mark]

0 1 . 6 Calculate the relative formula mass of sodium hydrogencarbonate ($NaHCO_3$).

Relative atomic masses (A_r): H=1; C=12; O=16; Na=23

[2 marks]

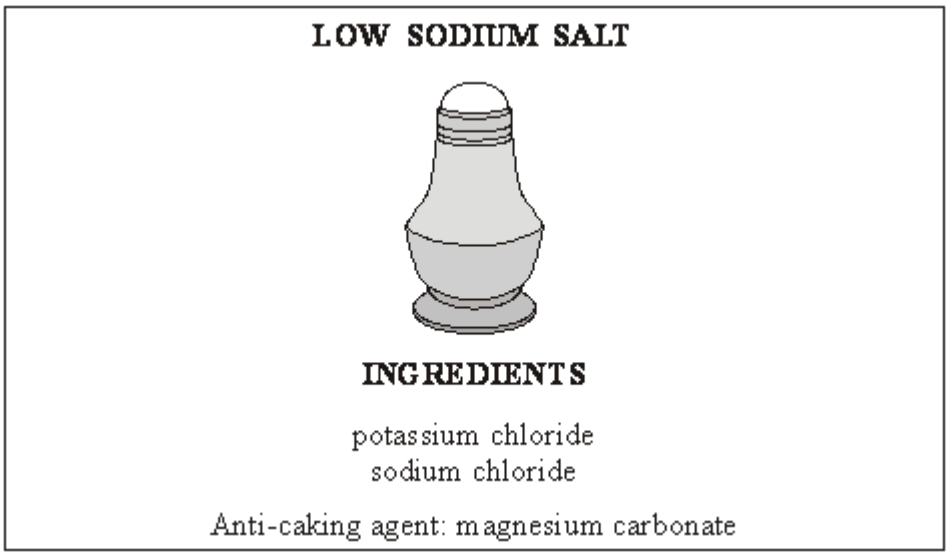
Relative formula mass (M_r)= _____

0 1 . 7 Calculate the percentage by mass of carbon in sodium hydrogencarbonate.

[1 mark]

Percentage of carbon = _____ %

2 The label is from a packet of Low Sodium Salt.



A student tested some Low Sodium Salt to show that it contains carbonate ions and chloride ions.

0 2 . 1 Describe how you would test for carbonate ions.

Describe what you would see.

[2 marks]

0 2 . 2 Flame tests can be used to identify potassium ions and sodium ions.

Suggest why it is difficult to identify **both** of these ions in Low Sodium Salt using a flame test.

[1 mark]

Read the following information and then answer the questions.

Salt – friend or foe?

Sodium chloride (salt) is an essential mineral for our health. It is used to flavour and preserve foods.

Too much sodium in our diet may increase the risk of high blood pressure and heart disease.

Heart disease is a major cause of death in many countries. Some people also claim that too much sodium is poisonous and can cause cancer, while others say that more evidence is needed.

Many processed foods contain salt, so it is easy to exceed the recommended daily upper limit of about 5 g of salt per person. A 'healthier' amount should be about 3 g. Many people consume over 10 g of salt each day.

One way to reduce sodium in our diet is to use Low Sodium Salt. This has two thirds of the sodium chloride replaced by potassium chloride.

0 2 . 3 Suggest why removing all sodium chloride from food would be impractical.

[1 mark]

_____

_____

0 2 . 4 Describe the advantages and disadvantages of reducing the amount of sodium chloride in foods.

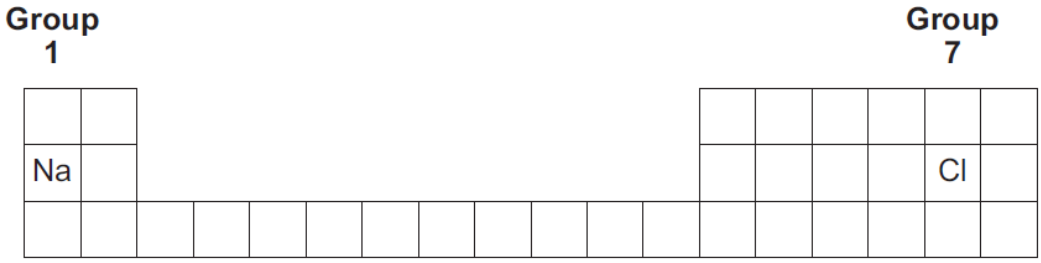
[6 marks]

Turn over for the next question

3 This question is about sodium and chlorine.

0 3 . 1 **Figure 1** shows part of the periodic table.

Figure 1



Complete the sentences.

[2 marks]

The elements in Group 1 are called the _____ .

The elements in Group 7 are called the _____ .

0 3 . 2 Sodium chloride (NaCl) is an ionic compound.

Describe, in terms of electrons, how atoms of sodium and chlorine form ions.

You should give the charge on the sodium ion and the charge on the chloride ion.

[4 marks]

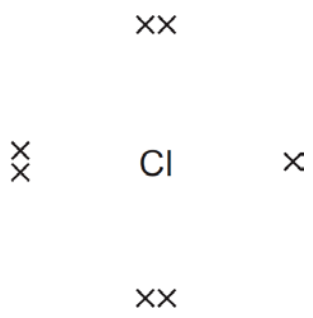
0 3 . 3 Two chlorine atoms bond to form a chlorine molecule (Cl_2).

Figure 2 shows the electrons in the outer energy level of one chlorine atom.

Complete **Figure 2** to show a chlorine molecule.

[2 marks]

Figure 2



0 3 . 4 Sodium reacts with water to produce sodium hydroxide and hydrogen.

Complete and balance the chemical equation for the reaction.

[2 marks]

$$Na + H_2O \longrightarrow$$

0 3 . 5 Complete **Table 1** to show the pH of pure water and of sodium hydroxide solution.

[2 marks]

Table 1

Substance	**pH**
Pure water	
Sodium hydroxide solution	

Turn over for the next question

4 A student investigated displacement reactions of metals.

The student measured the temperature change when different metals react with copper sulfate solution.

He used the following method:

- put 50 cm^3 of copper sulfate solution into a polystyrene cup
- measure the temperature of the solution
- calculate the mass of 0.050 mol of the metal
- add this mass of metal to the solution and stir the mixture
- measure the temperature of the mixture after one minute

0 4 . 1 Name a suitable piece of apparatus the student could use to measure 50 cm^3 of copper sulfate solution.

[1 mark]

_____

0 4 . 2 Calculate the mass of 0.050 mol of zinc.

Relative atomic mass (A_r): Zn = 65

[2 marks]

_____

_____

Mass = _____ g

0 4 . 3 Give a reason why the student used a polystyrene cup instead of a glass beaker.

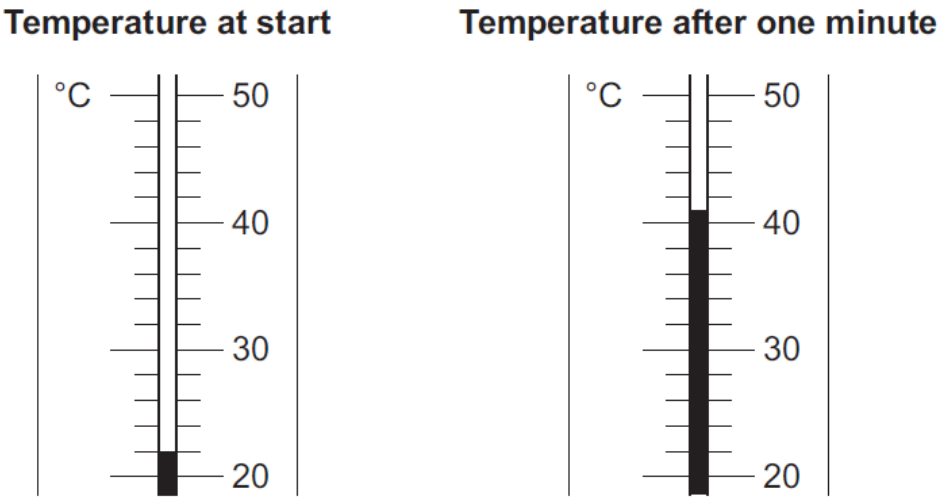
[1 mark]

_____

_____

0 4 . 4 **Figure 3** shows the readings on the thermometer in one of the experiments.

Figure 3



Write down the temperature at the start and after one minute.

[2 marks]

Temperature at the start = _____ °C

Temperature after one minute = _____ °C

0 4 . 5 Use your answers from part 04.4 to calculate the temperature increase.

[1 mark]

_____

_____

Temperature increase = _____ °C

Question 4 continues on the next page

The student did the experiment three times for each metal.

Table 2 shows the student's results.

Table 2

Metal	Temperature increase in °C			
	Experiment 1	Experiment 2	Experiment 3	Mean
Zinc	10	24	28	
Iron	19	17	18	18
Magnesium	61	63	59	

0 4 . 6 Calculate the mean temperature increase for zinc and for magnesium.

You should take account of any anomalous results

[2 marks]

Zinc

Mean temperature increase = _____ °C

Magnesium

Mean temperature increase = _____ °C

0 4 . 7 Which metal has the most precise results?

Give a reason for your answer.

[2 marks]

Metal

Reason

0 4 . 8 Use the results in **Table 2** to put the metals copper, iron, magnesium and zinc in order of their reactivity.

Explain how you worked out the order of reactivity.

[4 marks]

Most reactive _____

_____

_____

Least reactive _____

Explanation _____

_____

_____

_____

_____

0 4 . 9 The student wanted to make sure his results were valid.

The variables he controlled were the volume of copper sulfate solution, the number of moles of metal and the time when the temperature was measured.

The metal was in excess.

Suggest one other control variable.

Explain how the temperature change would be affected if this variable was **not** controlled.

[3 marks]

Control variable _____

Explanation _____

_____

_____

_____

_____

_____

5 This question is about rates of reaction.

Dilute hydrochloric acid reacts with sodium thiosulfate solution.

$$2HCl + Na_2S_2O_3 \longrightarrow 2NaCl + S + SO_2 + H_2O$$

0 5 . 1 The reaction produces a precipitate.

What is the name of the precipitate?

Tick **one** box.

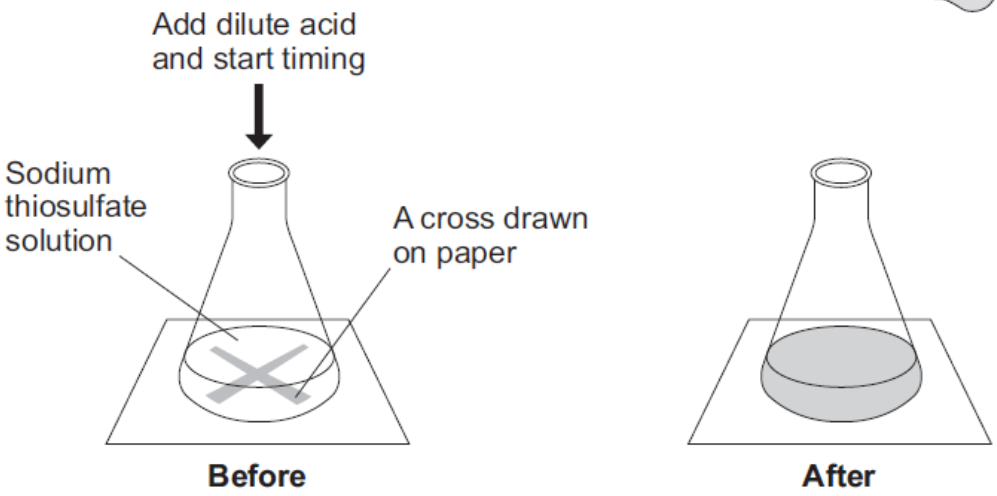
[1 mark]

- Sodium chloride ☐
- Sulfur ☐
- Sulfur dioxide ☐
- Water ☐

A student investigated how the rate of a reaction changes with temperature.

The student used the following method:

- put 50 cm^3 of sodium thiosulfate solution into a conical flask
- heat the sodium thiosulfate solution to the required reaction temperature
- put the flask on a cross drawn on a piece of paper
- add 10 cm^3 of dilute hydrochloric acid and start a stopclock
- stop the stopclock when the cross can no longer be seen.



0 5 . 2 Why can the student no longer see the cross?

[1 mark]

Question 5 continues on the next page

0 5 . 3 The student's results are shown in **Table 3**.

Table 3

Temperature in °C	Time in seconds
20	155
30	78
40	65
50	19
60	10

Plot the results on the grid in **Figure 4**, choosing appropriate scales.

Draw a best-fit smooth curve.

[4 marks]

Figure 4

0 5 . 4 Draw a ring around the anomalous point on the graph.

[1 mark]

0 5 . 5 There was a systematic error in the student's method on page 15.

Explain why the error in the method made the temperatures recorded in **Table 3** inaccurate.

Suggest an improvement to the method that would make the recorded temperatures more accurate.

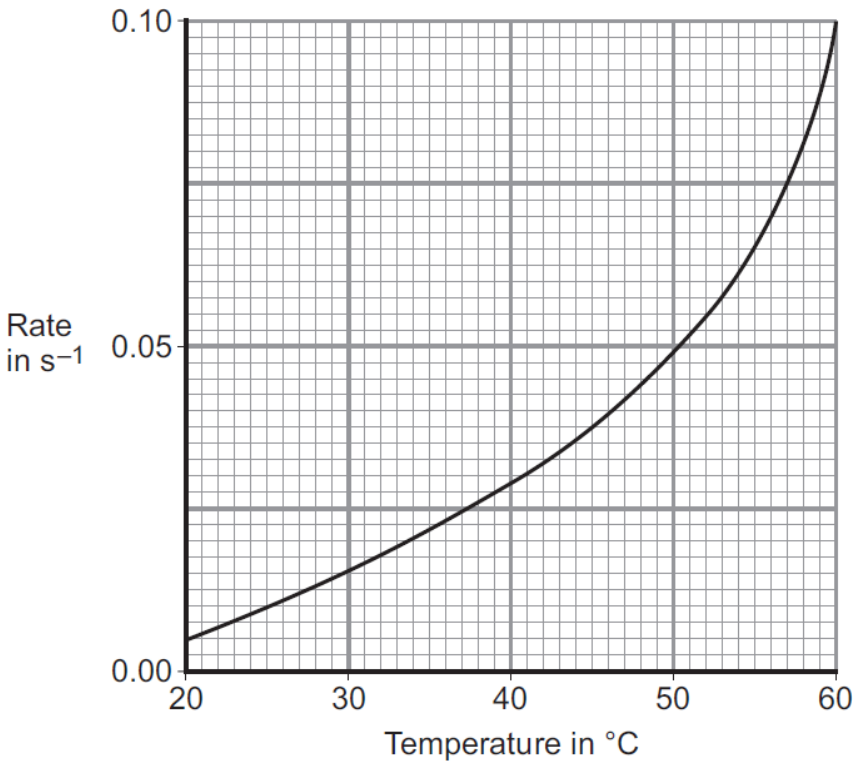
[3 marks]

The student calculated the rate of each reaction by calculating 1/time.

She plotted a graph showing the rate of the reaction and the temperature.

Figure 5 shows the best-fit graph she drew.

Figure 5



0 5 . 6 How does the graph in **Figure 5** show that the reaction is faster at higher temperatures?

[1 mark]

0 5 . 7 Explain, in terms of particles, why the reaction is faster at higher temperatures.

[3 marks]

0 5 . 8 The student said that the graph in **Figure 5** shows that rate is directly proportional to temperature.

Give a reason why the student was not correct.

[1 mark]

Turn over for the next question

6 Oil rigs are used to drill for crude oil.

0 6 . 1 Name **two** elements found in steel.

Why is steel described as an alloy.

[3 marks]

0 6 . 2 Drill heads also contain diamonds.

Describe, as fully as you can, the structure and bonding in diamond.

[4 marks]

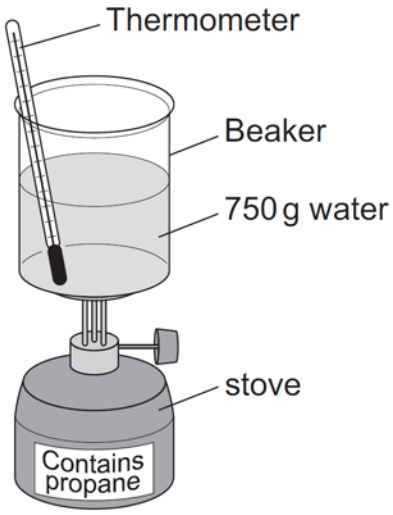
0 6 . 3 Polymers are produced from crude oil.

Describe the structure and bonding in a thermosoftening polymer and explain why thermosoftening polymers melt when heated.

[4 marks]

Turn over for the next question

7 A portable stove uses propane gas.



A student did an experiment to find the energy released when propane is burned.

The student:

- put 750 g water into a beaker
- measured the temperature of the water, which was 17 °C
- heated the water by burning propane
- measured the temperature of the water again, which was then 64 °C.

The student calculated the energy released using the equation.

$$Q = m \times 4.2 \times \Delta T$$

Where:
Q = energy released (J)
m = mass of water (g)
ΔT = temperature change (°C)

0 7 . 1 Use the student's results to calculate the energy released in joules (J).

[3 marks]

Energy released = _____ J

0 7 . 2 To find how much propane had been used the student weighed the portable stove before and after the experiment.

The mass of the camping stove decreased by 6.0 g.

Using this information and your answer to part 07.1**,** calculate the energy in kJ released when 1 mole of propane burns.

Relative formula mass (M_r) of propane = 44

[2 marks]

Energy released = _____ kJ

0 7 . 3 The student's method does **not** give accurate results.

However, this method is suitable for comparing the energy released by different fuels.

Suggest why.

[1 mark]

Question 7 continues on the next page

The student used bond energies to calculate the energy released when propane is burned.

The equation for the combustion of propane is:

$$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$$

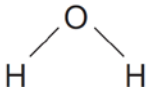
Some bond energies are given in **Table 4**.

Table 4

Bond	Bond energy in kJ per mole
C = O	803
O – H	464

The displayed structures of the products are:

carbon dioxide 

water 

0 7 . 4 Calculate the energy released by bond making when the products are formed.

[3 marks]

Energy released = _____ kJ per mole

0 7 . 5 The energy used for bond breaking of the reactants in the equation is 6481 kJ per mole.

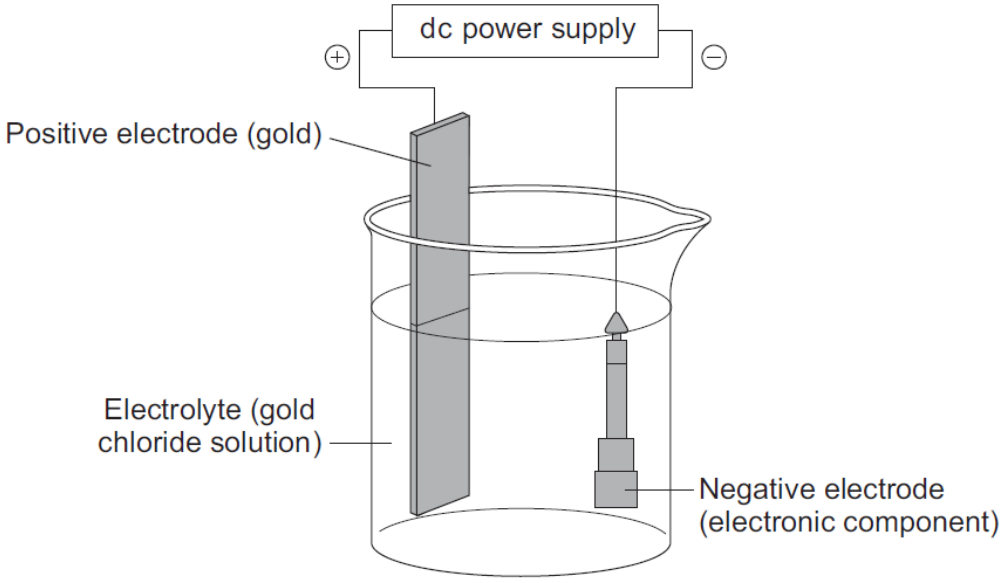
Calculate the overall energy change of this reaction.

[1 mark]

Overall energy change = _____ kJ per mole

Turn over for the next question

8 Some electronic components are electroplated with gold.



0 8 . 1 Gold chloride is an ionic compound.

Explain why the ionic compound used for the electrolyte must be in solution.

[2 marks]

At the positive electrode gold atoms (Au) change into gold ions (Au^{3+}).

0 8 . 2 Complete the half equation.

[1 mark]

$$Au \longrightarrow Au^{3+} + \_\_\_\_\_$$

0 8 . 3 Why is this an oxidation reaction?

[1 mark]

0 8 . 4 The electronic component to be electroplated by the gold is the negative electrode.

Explain why.

[2 marks]

0 8 . 5 The table shows properties of four metals.

	Relative hardness	**Relative electrical conductivity**	**Melting point in °C**	**Price in US$ per ton**
Copper	2.0	5.57	1083	5 400
Tin	1.0	1.00	232	20 000
Nickel	2.7	1.33	1453	11 000
Silver	1.7	5.89	962	600 000

Use the information in the table to decide which **one** of the metals you would use to electroplate electronic components.

Explain your choice.

[3 marks]

There are no questions printed on this page

9 Scientists found that a compound contained:

22.8% sodium; 21.8% boron; and 55.4% oxygen.

Use the percentages to calculate the empirical formula of the compound.

Relative atomic masses (A_r): B = 11; O = 16; Na = 23

To gain full marks you **must** show all your working.

[5 marks]

Empirical formula = _____

END OF QUESTIONS

There are no questions printed on this page