

CARIBBEAN EXAMINATIONS COUNCIL

CARIBBEAN SECONDARY EDUCATION CERTIFICATE®
EXAMINATION

11 JANUARY 2018 (a.m.)



J1801212020

FILL IN ALL THE INFORMATION REQUESTED CLEARLY IN CAPITAL LETTERS.

TEST CODE

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SUBJECT CHEMISTRY – Paper 02

PROFICIENCY GENERAL

REGISTRATION NUMBER

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SCHOOL/CENTRE NUMBER

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NAME OF SCHOOL/CENTRE

NAME OF SCHOOL/CENTRE

CANDIDATE'S FULL NAME (FIRST, MIDDLE, LAST)

CANDIDATE'S FULL NAME (FIRST, MIDDLE, LAST)

DATE OF BIRTH

D	D	M	M	Y	Y	Y	Y
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SIGNATURE _____



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JANUARY 2018

CARIBBEAN EXAMINATIONS COUNCIL

CARIBBEAN SECONDARY EDUCATION CERTIFICATE®
EXAMINATION

CHEMISTRY

Paper 02 – General Proficiency

2 hours and 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in TWO sections.
2. Answer ALL questions.
3. Write your answers in the spaces provided in this booklet.
4. Do NOT write in the margins.
5. Where appropriate, ALL WORKING MUST BE SHOWN in this booklet.
6. You may use a silent, non-programmable calculator to answer questions.
7. If you need to rewrite any answer and there is not enough space to do so on the original page, you must use the extra lined page(s) provided at the back of this booklet. **Remember to draw a line through your original answer.**
8. **If you use the extra page(s) you MUST write the question number clearly in the box provided at the top of the extra page(s) and, where relevant, include the question part beside the answer.**

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.



SECTION A

Answer ALL questions in this section.

Write your responses in the spaces provided in this booklet.

Do NOT spend more than 30 minutes on Question 1.

1. (a) Deneil is provided with two solutions, M and N. Solution M is aqueous hydrochloric acid containing 3.6 g dm^{-3} . Solution N is an aqueous sodium hydroxide solution which has been prepared by using a certain mass of sodium hydroxide in 1 dm^3 of solution.

Deneil is asked to titrate solution M against 25.0 cm^3 of solution N in order to determine the concentration of sodium hydroxide.

Figure 1 shows the burette volume readings Deneil obtained before (initial) and after (final) EACH of three titrations.

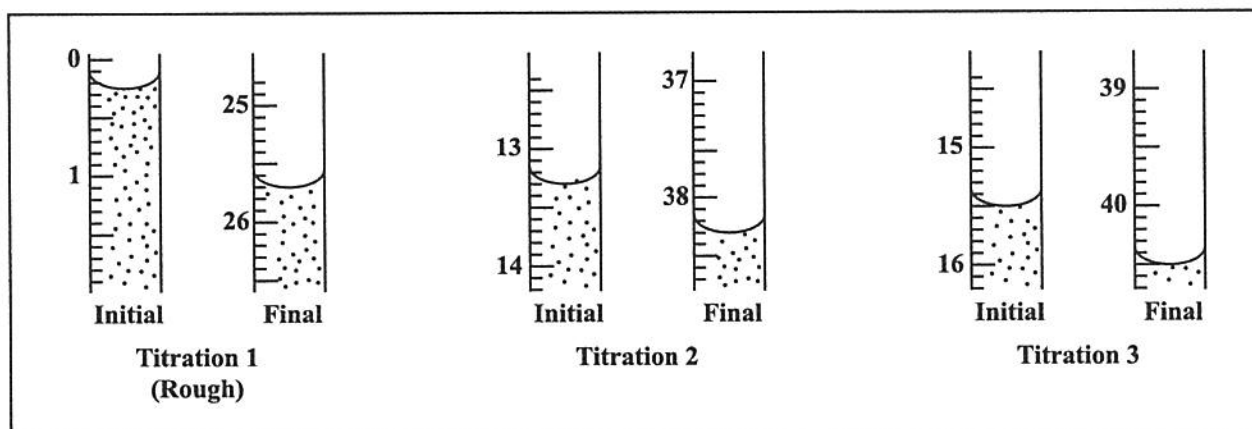


Figure 1. Burette readings

- (i) Complete Table 1 by recording the titration results obtained from the experiment in Figure 1.

TABLE 1: TITRATION OF SOLUTION M (HCl) WITH SOLUTION N (NaOH)

Burette Readings (cm^3)	Titration 1 (Rough)	Titration 2	Titration 3
Final volume			
Initial volume			
Volume of solution M used			

(9 marks)

GO ON TO THE NEXT PAGE



- (ii) Calculate the average volume of solution **M** used in the titration.

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(1 mark)

- (iii) Calculate the concentration of hydrochloric acid in solution **M**, in mol dm⁻³.
(Relative atomic mass: H = 1; Cl = 35.5)

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(2 marks)

- (iv) Calculate the number of moles of hydrochloric acid used in the titration.

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(1 mark)

- (v) Write a balanced equation for the reaction between the hydrochloric acid and sodium hydroxide solutions.

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(1 mark)



- (vi) Determine the number of moles of sodium hydroxide in the 25 cm³ of solution used.

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(2 marks)

- (vii) Calculate the concentration of sodium hydroxide, in g dm⁻³.
(Molar mass of sodium hydroxide = 40 g mol⁻¹)

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(2 marks)



NOTHING HAS BEEN OMITTED.



- (b) Deneil also conducted an experiment to determine the effect of temperature on stearic acid. Stearic acid is an organic acid that exists as a 'molecular solid' with a melting point less than 100 °C. Table 2 shows the data she collected.

TABLE 2: RESULTS OF EXPERIMENT

Time (min)	0	1.5	2.0	2.5	3.0	5.0	7.0
Temperature (°C)	19	40	48	53	55	55	55

- (i) Identify the forces that exist in a 'molecular solid'.

.....

 (1 mark)

- (ii) Sodium chloride, another solid, has a higher melting and boiling point than stearic acid. Explain why this is so.

.....

 (2 marks)

- (iii) Using the axes provided in Figure 2 on page 9, plot a graph of temperature against time from the information in Table 2. One point has already been plotted. Draw the best fit curve through your points. (4 marks)

Total 25 marks



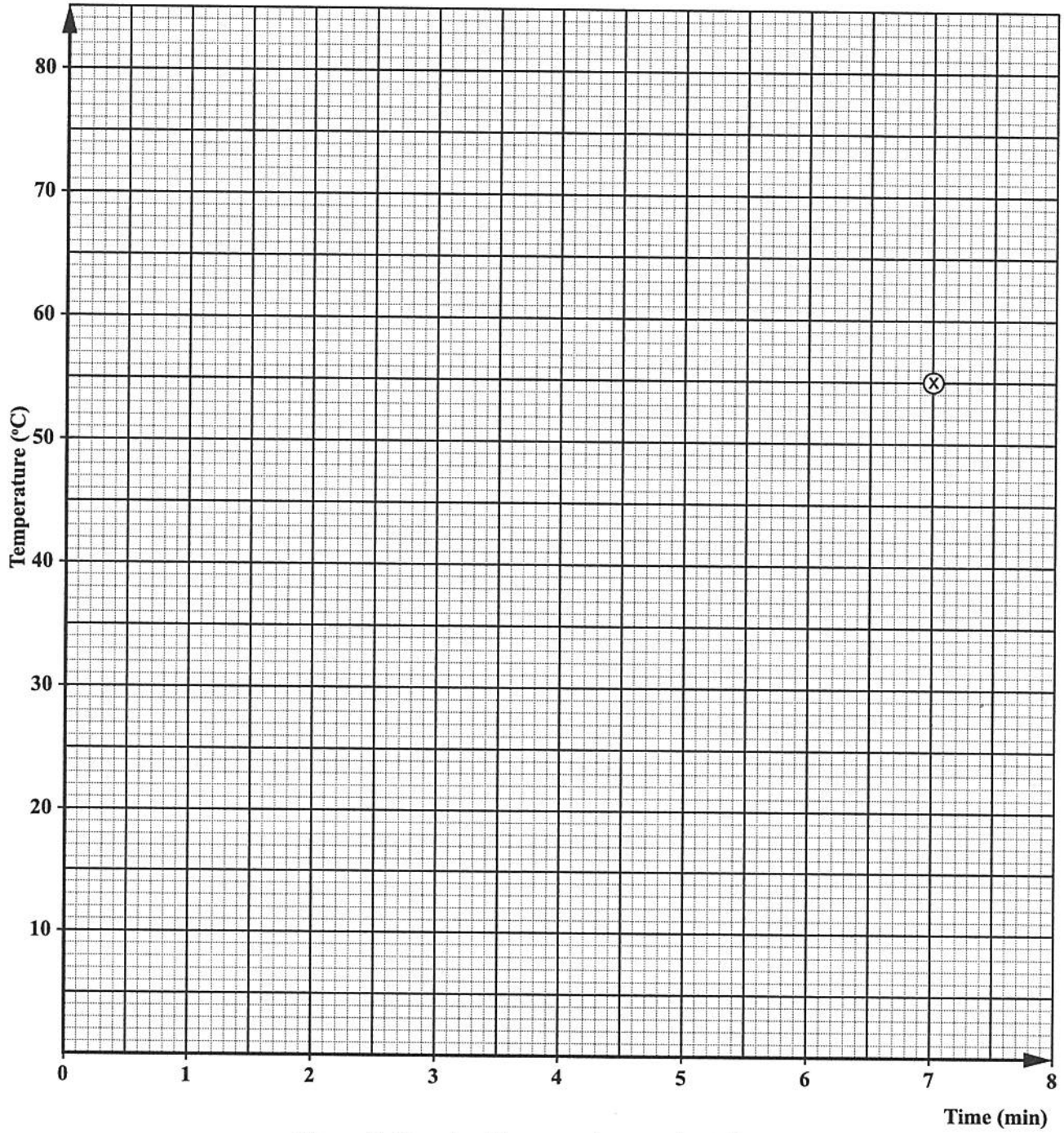


Figure 2. Graph of temperature against time

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2. (a) Phosphoric acid, H_3PO_4 , is a common additive in most soft drinks. It can react with sodium hydroxide, an alkali, to form both normal and acid salts.

- (i) Define the terms 'acid' and 'alkali'.

Acid

.....
.....
(1 mark)

Alkali

.....
.....
(1 mark)

- (ii) Define the terms 'acid salts' and 'normal salts'.

Acid salts

.....
.....
(1 mark)

Normal salts

.....
.....
(1 mark)

- (iii) State the molecular formula for the normal salt formed from the reaction between phosphoric acid and sodium hydroxide.

.....
(1 mark)

- (iv) Write a balanced equation to show the formation of the normal salt stated in (a) (iii).

.....
.....
(2 marks)

GO ON TO THE NEXT PAGE



- (v) State the molecular formula for an acid salt formed from the reaction between phosphoric acid and sodium hydroxide.

.....
(1 mark)

- (vi) Write a balanced equation to show the formation of the acid salt stated in (a) (v).

.....
.....
(2 marks)

- (b) A solution of 0.05 M phosphoric acid has a pH of 4, and a solution of 0.05 M sulfuric acid has a pH of 1.

Which of the two acids is stronger?

.....
(1 mark)

- (c) Jeffrey complains of pains due to excess stomach acid after consuming too much orange juice.

- (i) Name TWO acids present in orange juice.

.....
(2 marks)

- (ii) State the type of chemical reaction that takes place in the treatment of excess stomach acid.

.....
(1 mark)

- (iii) Hence, name ONE substance that can be used to treat excess stomach acid.

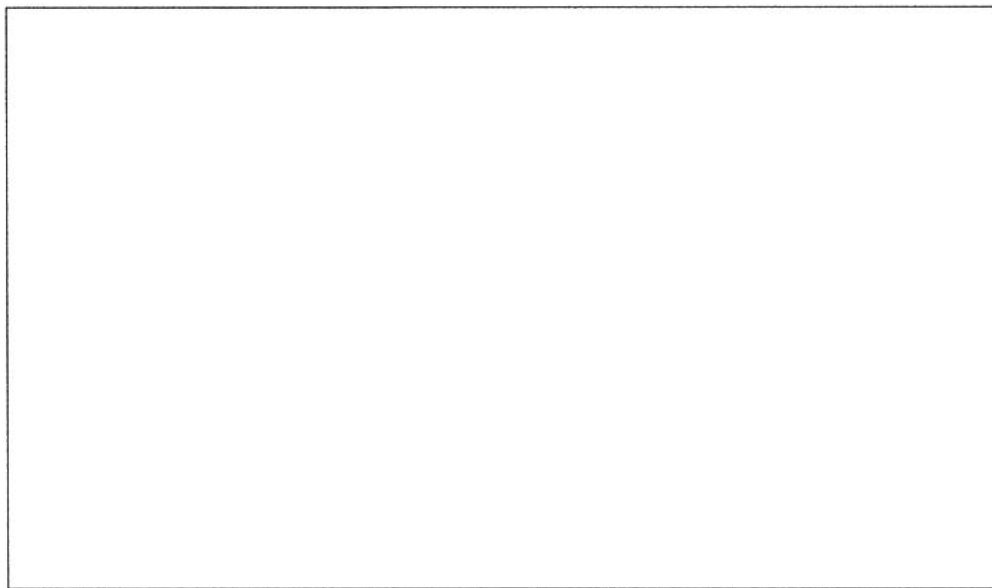
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(1 mark)

Total 15 marks



3. (a) Ethene undergoes a halogenation reaction to form 1,2-dichloroethane.

(i) Draw the FULLY DISPLAYED structure of ethene.



(2 marks)

(ii) Draw the FULLY DISPLAYED structure of the 1,2-dichloroethane.



(2 marks)

(iii) Is the halogenation of ethene an addition or substitution reaction?

.....
(1 mark)



(b) Dichloromethane can be obtained from methane. This reaction takes place in two steps.

(i) Write balanced chemical equations to show EACH step in the formation of dichloromethane.

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(4 marks)

(ii) Is the halogenation of methane an addition or substitution reaction?

.....

(1 mark)

GO ON TO THE NEXT PAGE



- (c) Ethene and propene are typical monomers which are used as starting materials for making polymers. In forming polymers, ethene and propene undergo addition polymerization.

(i) Define the term 'polymer.'

.....
.....
(1 mark)

(ii) Define what is meant by 'addition polymerization.'

.....
.....
(1 mark)

(iii) State ONE use of EACH of the following polymers:

Polyvinyl chloride

.....
(1 mark)

Teflon

.....
(1 mark)

Poly(ethene)

.....
(1 mark)

Total 15 marks



SECTION B

Answer ALL questions in this section.

Write your responses in the spaces provided in this booklet.

4. (a) When a reaction is accompanied by energy changes, it can be categorized as either endothermic or exothermic.

- (i) Distinguish between the terms 'endothermic' and 'exothermic.'

.....

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(2 marks)

- (ii) Generally, when chemical reactions take place, existing bonds are broken and new bonds are formed. Classify bond making AND bond breaking as either endothermic or exothermic processes.

Bond making

.....

(1 mark)

Bond breaking

.....

(1 mark)

GO ON TO THE NEXT PAGE



- (b) In an experiment, when 12.0 g of potassium nitrate, KNO_3 , is dissolved in 100 cm^3 of water, the temperature drops by 4.20 $^\circ\text{C}$.

- (i) Calculate the number of moles of KNO_3 used in the experiment.
(RMM: $\text{KNO}_3 = 101$)

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(1 mark)

- (ii) Calculate the heat change for the reaction.

Specific heat capacity of water = 4.2 $\text{J g}^{-1} ^\circ\text{C}^{-1}$;
Heat change = $m \times c \times \Delta T$; Density of water = 1 g cm^{-3}

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(2 marks)

- (iii) Calculate the enthalpy change for **1 mole** of potassium nitrate.

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(1 mark)



DO NOT WRITE IN THIS AREA

- (iv) List TWO pieces of apparatus necessary to conduct the experiment in a school laboratory. State how EACH piece of apparatus is used.

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(4 marks)

- (v) Draw a labelled energy profile diagram to represent the enthalpy change for the reaction. On your diagram, indicate the sign of ΔH for the reaction.

(3 marks)

Total 15 marks

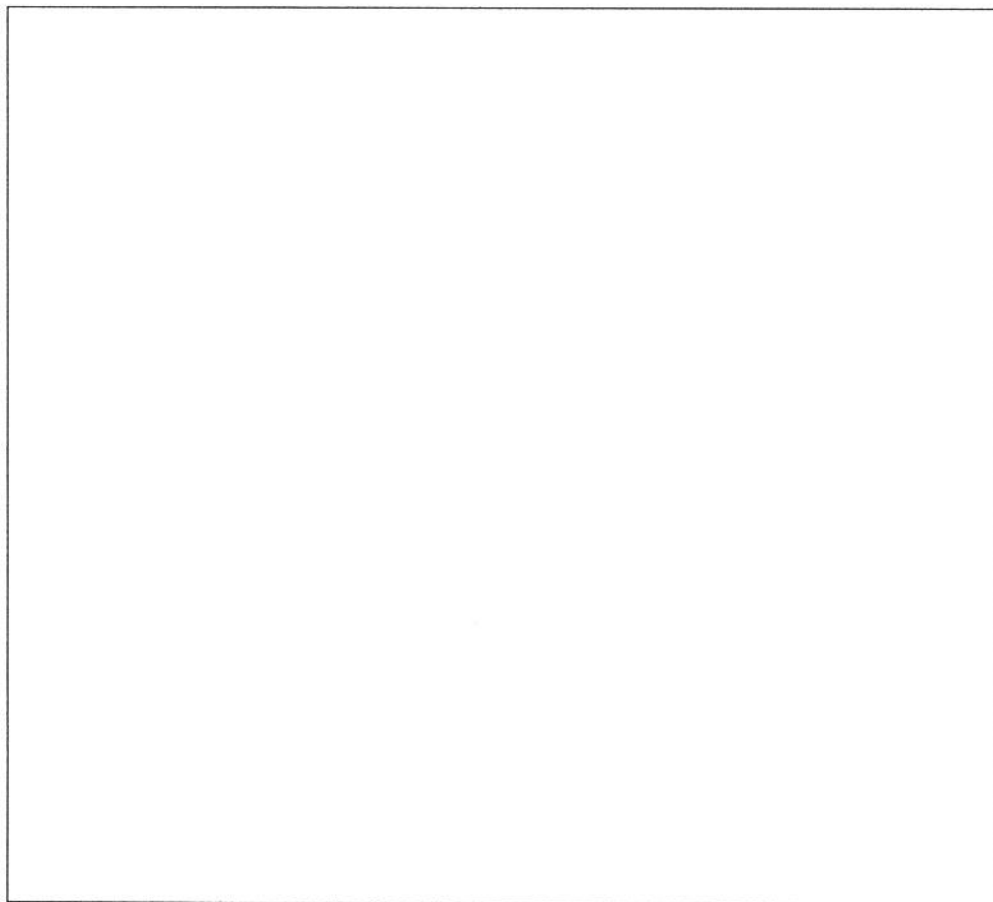


5. (a) The compound responsible for the odour of apples is ethyl pentanoate, $C_4H_9COOC_2H_5$.

(i) State the homologous series to which ethyl pentanoate belongs.

.....
(1 mark)

(ii) Draw the FULLY DISPLAYED structure of ethyl pentanoate and circle the functional group.



(3 marks)

(iii) Write the molecular formulae for the alcohol and carboxylic acid that will react to produce ethyl pentanoate.

.....
.....
(2 marks)



- (iv) Name the catalyst involved in the reaction between the alcohol and carboxylic acid stated in (c) (iii).

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(1 mark)

- (v) Explain why an ester has low solubility in water whereas a simple alcohol is very soluble in water.

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(2 marks)

- (b) State the reaction condition and reagent used for the alkaline hydrolysis of ethyl ethanoate. Hence, write a balanced chemical equation for this reaction.

Condition and Reagent:

Balanced chemical equation:

.....
(4 marks)

- (c) Commercial soaps are usually manufactured using natural esters. Name the process used to make soap and state ONE source of these natural esters.

Process:

Source:

(2 marks)

Total 15 marks

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6. (a) List FOUR unique properties of water as it relates to the human body.

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(4 marks)

- (b) Water exists in liquid, solid and gaseous states. Describe a laboratory test for water vapour.

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(2 marks)

- (c) In some Caribbean islands, calcium hydrogen carbonate causes temporary hardness in water. This can be treated by the use of washing soda (sodium carbonate).

Write a balanced chemical equation, including state symbols, to show the removal of temporary hardness from water using this treatment.

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(3 marks)



- (d) Pure water does not conduct electricity but can be acidified using dilute sulfuric acid for this to occur. Predict the ions that will migrate to the anode and cathode during the electrolysis of dilute sulfuric acid (acidified water). Write a balanced chemical equation, including state symbols, for the electrolysis of dilute sulfuric acid (acidified water).

Ions to anode:

.....

Ions to cathode:

.....

Balanced equation:

.....

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(6 marks)

Total 15 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.



EXTRA SPACE

If you use this extra page, you MUST write the question number clearly in the box provided.

Question No.

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01212020/JANUARY 2018



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CANDIDATE'S RECEIPT

INSTRUCTIONS TO CANDIDATE:

1. Fill in all the information requested clearly in capital letters.

TEST CODE:

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SUBJECT: CHEMISTRY – Paper 02

PROFICIENCY: GENERAL

REGISTRATION NUMBER:

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FULL NAME: _____
(BLOCK LETTERS)

Signature: _____

Date: _____

2. Ensure that this slip is detached by the Supervisor or Invigilator and given to you when you hand in this booklet.
3. Keep it in a safe place until you have received your results.

INSTRUCTION TO SUPERVISOR/INVIGILATOR:

Sign the declaration below, detach this slip and hand it to the candidate as his/her receipt for this booklet collected by you.

I hereby acknowledge receipt of the candidate's booklet for the examination stated above.

Signature: _____
Supervisor/Invigilator

Date: _____



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