



Rewarding Learning

General Certificate of Secondary Education  
2012

Centre Number

71

Candidate Number

## Science: Chemistry

Paper 2  
Higher Tier

[G1404]



FRIDAY 22 JUNE, AFTERNOON

### TIME

2 hours.

### INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Write your answers in the spaces provided in this question paper.

Answer **all seven** questions.

### INFORMATION FOR CANDIDATES

The total mark for this paper is 160.

Quality of written communication will be assessed in question 7(c).

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

A Data Leaflet which includes a Periodic Table of the Elements is provided.

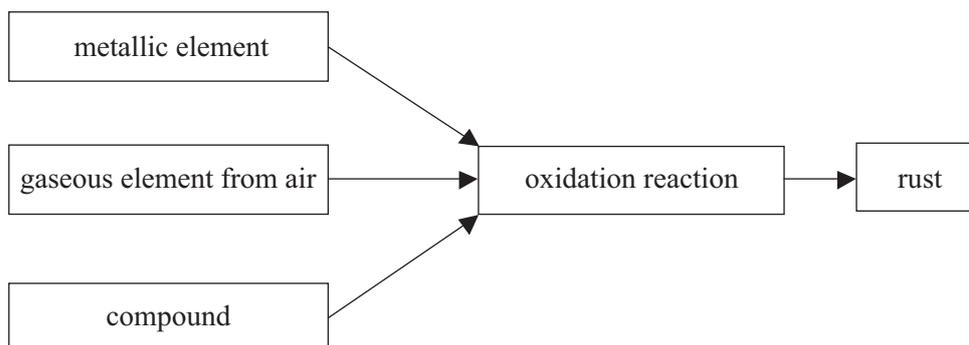
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use only

Question Number	Marks
1	
2	
3	
4	
5	
6	
7	

Total  
Marks



- 1 (a) The formation of rust is described as an oxidation reaction. The flow chart below shows the formation of rust during which a metallic element reacts with a gaseous element from the air and a compound.



- (i) Name the metallic element which reacts to form rust.

\_\_\_\_\_ [1]

- (ii) Name the gaseous element from the air which is required for the formation of rust.

\_\_\_\_\_ [1]

- (iii) Name the compound which is required for the formation of rust.

\_\_\_\_\_ [1]

- (iv) Explain what is meant by oxidation.

\_\_\_\_\_

\_\_\_\_\_ [1]

- (v) Describe the appearance of rust.

\_\_\_\_\_

\_\_\_\_\_ [2]

Examiner Only	
Marks	Remark

- (b) The reaction of chlorine with hydrogen may be described as both an exothermic reaction and as a reduction.



- (i) Write a balanced symbol equation for the reaction of chlorine with hydrogen.

\_\_\_\_\_ [3]

- (ii) Explain why chlorine is described as being reduced in this reaction.

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_ [2]

- (iii) Describe the colour of the reactants in this reaction.

chlorine \_\_\_\_\_

hydrogen \_\_\_\_\_ [2]

- (iv) What is meant by the term exothermic?

\_\_\_\_\_  
 \_\_\_\_\_ [1]

- (c) Copper(II) carbonate breaks down on heating in an endothermic reaction.

- (i) What term is used to describe a reaction in which a substance breaks down on heating?

\_\_\_\_\_ [2]

- (ii) Write a balanced symbol equation for the reaction which occurs when copper(II) carbonate is heated.

\_\_\_\_\_ [2]

Examiner Only	
Marks	Remark

- (iii) State the colour change observed when copper(II) carbonate is heated.

\_\_\_\_\_ [2]  
\_\_\_\_\_

- (d) Magnesium reacts with copper(II) sulphate solution. The reaction is described as a redox reaction as both oxidation and reduction are occurring. The balanced symbol equation and ionic equation for the reaction are given below.

Balanced Symbol Equation:  $\text{Mg} + \text{CuSO}_4 \rightarrow \text{Cu} + \text{MgSO}_4$

Ionic Equation:  $\text{Mg} + \text{Cu}^{2+} \rightarrow \text{Cu} + \text{Mg}^{2+}$

- (i) In this reaction, which ion does not undergo any change?

\_\_\_\_\_ [1]

- (ii) What is oxidised in this reaction?

\_\_\_\_\_ [1]

- (iii) Write a half equation for the oxidation process occurring in this reaction.

\_\_\_\_\_ [3]

- (iv) Explain why copper ions are described as being reduced in this reaction.

\_\_\_\_\_ [2]  
\_\_\_\_\_

Examiner Only	
Marks	Remark

- 2 Pharmaceutical drugs are manufactured and analysed in a specialised chemistry laboratory.



*Í 'Dt cpf 'Z'Rkewt gu"TVj kpmazem*

- (a) Amyl nitrite is a drug commonly used to treat patients with heart disease.

A sample of amyl nitrite was analysed and found to contain four elements in the following proportions: 72.0 g of carbon, 13.2 g of hydrogen, 16.8 g of nitrogen and 38.4 g of oxygen.

Determine the empirical formula of amyl nitrite.

(Relative atomic masses: H = 1; C = 12; N = 14; O = 16)

Empirical formula \_\_\_\_\_ [5]

Examiner Only

Marks	Remark

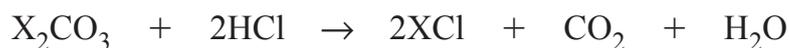
- (b) The pharmaceutical drug Eskalith is made from another carbon containing compound. The formula of this compound may be written as  $X_2CO_3$ . To determine the identity of X in this compound, a titration was carried out.

3.70 g of solid  $X_2CO_3$  were dissolved in  $1000\text{ cm}^3$  of deionised water and mixed thoroughly.  $25.0\text{ cm}^3$  of this solution were placed in a conical flask with a few drops of methyl orange indicator.  $20.0\text{ cm}^3$  of  $0.125\text{ mol/dm}^3$  hydrochloric acid were required to reach the end-point.

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

moles \_\_\_\_\_ [2]

The balanced symbol equation for the reaction is:



- (ii) Use the balanced symbol equation to determine the number of moles of  $X_2CO_3$  present in  $25.0\text{ cm}^3$  of the solution in the conical flask.

moles \_\_\_\_\_ [2]

- (iii) Calculate the number of moles of  $X_2CO_3$  present in  $1000\text{ cm}^3$  of solution.

moles \_\_\_\_\_ [2]

Examiner Only	
Marks	Remark



- (c) Nitrous oxide ( $\text{N}_2\text{O}$ ), also known as laughing gas, is commonly used as an anaesthetic in dentistry. Nitrous oxide may be produced by heating a sample of ammonium nitrate,  $\text{NH}_4\text{NO}_3$ . The equation for this reaction is given below.



Calculate the volume of nitrous oxide in  $\text{dm}^3$  which can be produced when 2 kg of ammonium nitrate are fully decomposed on heating. (Relative atomic masses: H = 1; N = 14; O = 16; 1 mole of any gas occupies a volume of  $24 \text{ dm}^3$  at room temperature and pressure.)

volume of  $\text{N}_2\text{O}$  \_\_\_\_\_  $\text{dm}^3$  [6]

Examiner Only	
Marks	Remark



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- 3 (a) Acids, bases, alkalis and salts are used in many commonly available household products such as those shown below. One substance found in each is stated.

ÀVj g'hqmqy kpi 'lo ci gu'j cxg'dggp'tgo qxgf 'htqo 'vj ku'r ci g'f wg'vq"  
 eqr {tki j v'kuwgu<"  
 ""

ÉC"dcì "qh'Dcvj 'Et {ucnu'eqpvcłkpi "o ci pgukwo "ej rtkf g0"  
 ÉC"dqwg"qh'O km'qh'O ci pguk'ns wkf "eqpvcłkpi "o ci pgukwo 'j {ftqzkf g0"  
 ÉC"ecp"qh'O t'O wuerg"Qxgp'Ergcpgt"eqpvcłkpi "uqf kwo 'j {ftqzkf g0"  
 ÉC"dcì "qh'O quunkrgt"( 'Ncy p"Vqple"eqpvcłkpi "l kpe"uwr j cvg0"

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" " "

- (i) Classify each substance as an acid, base, alkali or salt by placing a tick (✓) in the correct column in the table below. Choose the most common classification for each substance. You may find your Data Leaflet useful in answering this question.

Substance	acid	base	alkali	salt
magnesium chloride				
magnesium hydroxide				
sodium hydroxide				
zinc sulphate				

[4]

- (ii) Sodium hydroxide reacts with sulphuric acid. Write a balanced symbol equation for this reaction.

\_\_\_\_\_ [3]

- (iii) Name the salt produced when magnesium hydroxide reacts with nitric acid.

\_\_\_\_\_ [1]

Examiner Only

Marks Remark

(iv) Hydrated zinc sulphate has the formula  $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ . What is meant by the term hydrated?

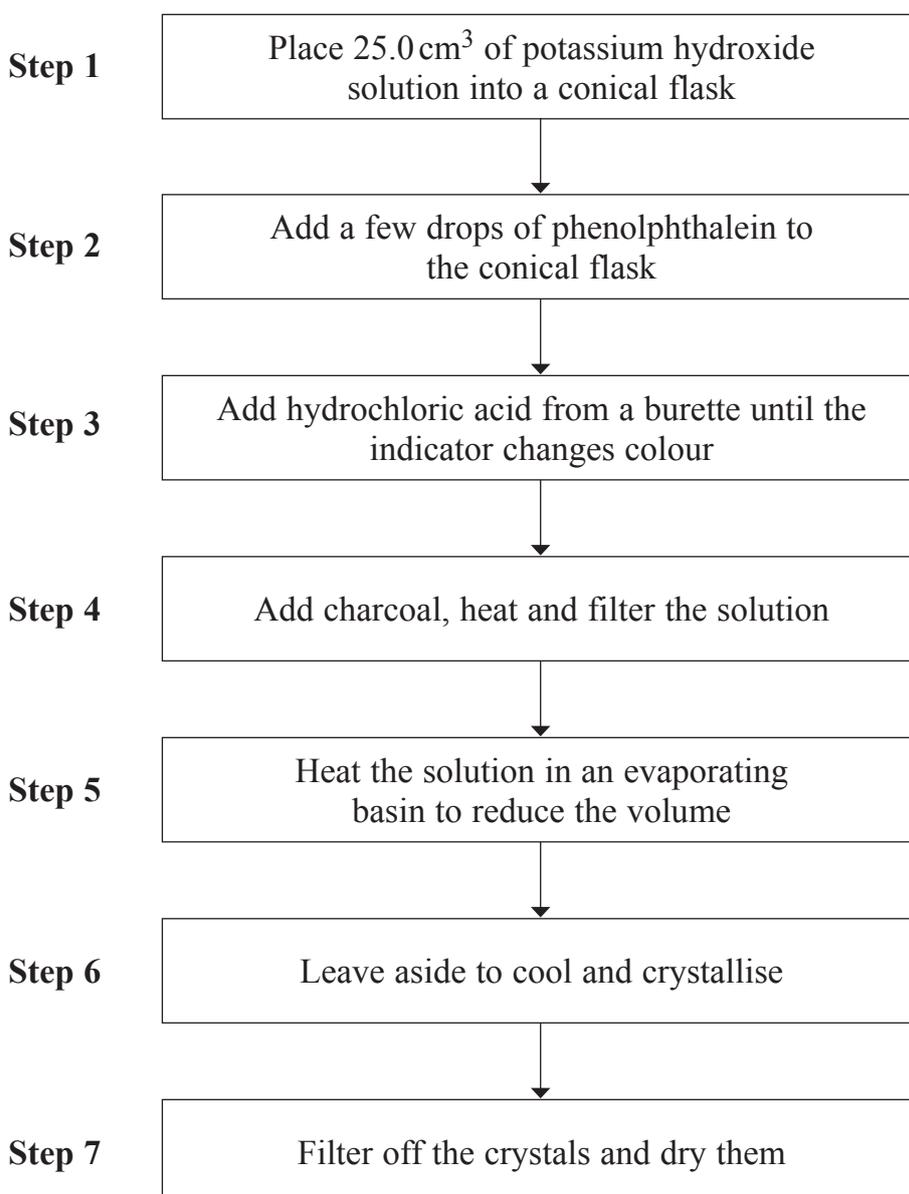
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[2]

(b) A pure, dry sample of potassium chloride can be prepared by the reaction of potassium hydroxide solution with hydrochloric acid.

The flow chart below explains how this is carried out.



Examiner Only

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Remark



(c) The presence of anions in salts can be determined by mixing two solutions and observing the formation of a precipitate and its colour.

(i) What is an anion?

\_\_\_\_\_ [1]

(ii) What is meant by the term precipitate?

\_\_\_\_\_  
\_\_\_\_\_ [2]

(iii) Name the solution which is used to test for the presence of sulphate ions.

\_\_\_\_\_ [1]

(iv) Potassium iodide solution was mixed with silver nitrate solution and a precipitate formed. State the colour of the precipitate.

\_\_\_\_\_ [1]

Examiner Only	
Marks	Remark

4 Aluminium is the most abundant metal in the Earth's crust. Aluminium ore is first purified to give aluminium oxide and the metal is then extracted from the aluminium oxide by electrolysis.

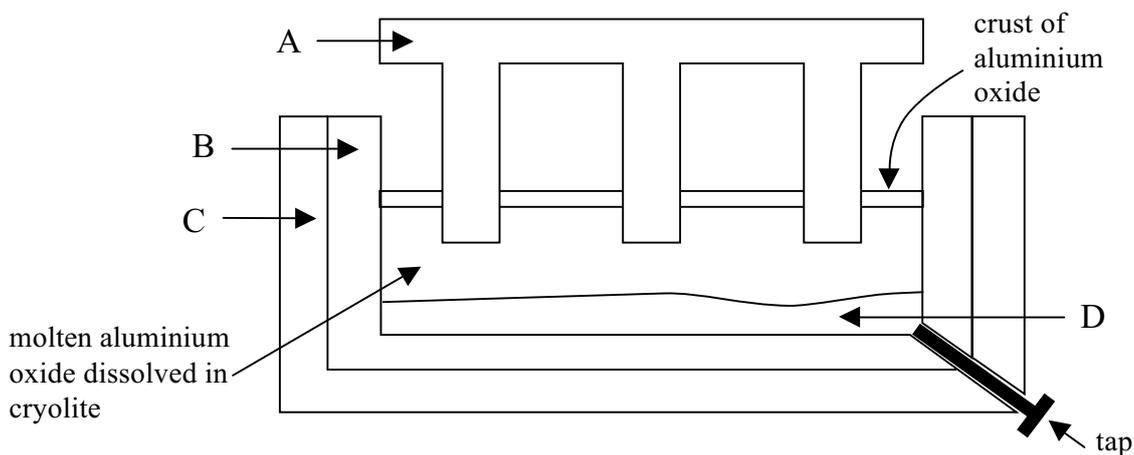
(a) What is meant by the term electrolysis?

\_\_\_\_\_ [2]

(b) Name the ore from which aluminium is extracted.

\_\_\_\_\_ [1]

(c) The electrolysis of the purified ore is carried out in the Hall-Héroult cell. The diagram below shows the cell used.



(i) Name parts A, B and C, and substance D.

A \_\_\_\_\_

B \_\_\_\_\_

C \_\_\_\_\_

D \_\_\_\_\_ [4]

(ii) Explain why the aluminium oxide will only conduct electricity when molten.

\_\_\_\_\_ [2]

Examiner Only	
Marks	Remark



5 The earth is a rich source of many raw materials. Some of these raw materials, including lignite, are extracted by open-cast mining.

(a) Lignite is a fossil fuel. Describe how lignite is formed.

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 [3]

(b) Large deposits of lignite have been located near Ballymoney, County Antrim. The advantages and disadvantages associated with mining this lignite were debated in the Northern Ireland Assembly in July 2007.

(i) State **two** advantages for the local community of setting up a lignite mine.

1. \_\_\_\_\_

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2. \_\_\_\_\_

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 [2]

(ii) State **two** disadvantages for the local community of setting up a lignite mine.

1. \_\_\_\_\_

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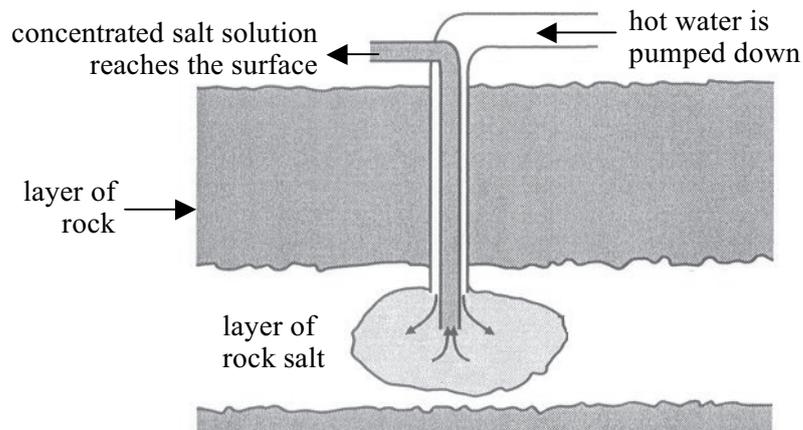
2. \_\_\_\_\_

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 [2]

Examiner Only	
Marks	Remark

- (c) Another method used to extract raw materials from the earth is solution mining. This method is used to extract sodium chloride from the earth.



- (i) On what physical property of sodium chloride does this process depend?

\_\_\_\_\_ [1]

- (ii) Suggest **one** reason why solution mining uses a lot of energy.

\_\_\_\_\_ [1]

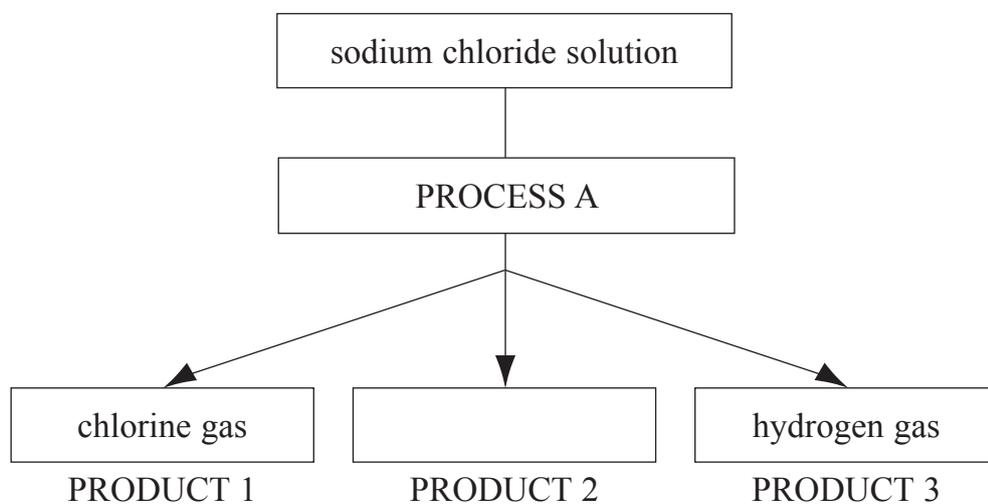
- (iii) Suggest **one** negative effect which solution mining has on the environment.

\_\_\_\_\_ [1]

Examiner Only

Marks Remark

- (d) The chlor-alkali industry uses a substantial percentage of the sodium chloride produced from solution mining. The main process involved is summarised in the diagram below.



- (i) Name Process A.

\_\_\_\_\_ [1]

- (ii) Write the chemical formula for Product 2.

\_\_\_\_\_ [1]

- (iii) State **one** use of each of the gaseous products.

chlorine: \_\_\_\_\_

hydrogen: \_\_\_\_\_ [2]

Examiner Only	
Marks	Remark

- 6 On 14th April 2010 the volcano Eyjafjallajökull erupted in Iceland, creating an ash cloud which was dangerous for aircraft and led to the closure of many airports for about ten days.



Í 'Álqenr j qv"TVj kpmrqem

A large number of gases were released into the atmosphere from the volcano. These volcanic gases included carbon dioxide, hydrogen and hydrogen chloride.

- (a) Complete the table below to describe the tests used to identify each of these gases in the laboratory, and state the result of a positive test for each gas.

Gas	Test	Result of positive test	
carbon dioxide			[2]
hydrogen			[2]
hydrogen chloride			[4]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

(b) Sulphur dioxide is also emitted when a volcano erupts. It is a pollutant gas which reacts with water in the air to form acid rain.

(i) Write a balanced symbol equation for the reaction of sulphur dioxide with water.

\_\_\_\_\_ [2]

(ii) State **two** harmful effects of acid rain on the environment.

1. \_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_ [2]

(c) Volcanic ash contains many different minerals and can be used in cosmetics including skin scrubs. Some skin scrubs, such as the one shown below, contain sugar to give roughness.

:-Cp"lo ci g'qh'O CE"Xqreple'Cuj 'Gzhqncvqt"j cu'dggp'tgo qxgf  
htqo 'yj ku'r ci g'f wg'vq'eqr { tki j v'kuwgu0

(i) Describe the appearance of sugar.

\_\_\_\_\_ [2]

Examiner Only	
Marks	Remark

- (ii) State **three** observations you would make when concentrated sulphuric acid is added to sugar.

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 [3]

- (d) Iron compounds are added to many cosmetics to give colour. Iron compounds may contain the iron(II) ion or the iron(III) ion. The presence of these ions in solution may be detected by adding ammonia solution.

- (i) Complete the table to show what would be observed when ammonia solution is added to a solution of iron(II) ions and to a solution of iron(III) ions.

	<b>Result of a positive test when ammonia solution is added</b>
iron(II) ion	
iron(III) ion	

[4]

- (ii) Write an ionic equation for the reaction of iron(II) ions with ammonia solution.

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 [3]

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Marks Remark

7 Hydrogen peroxide,  $\text{H}_2\text{O}_2$ , decomposes very slowly to produce water and oxygen.

- (a) Draw a labelled diagram of the assembled apparatus used to carry out this reaction and measure the volume of oxygen produced every minute. Include all apparatus required.

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Marks	Remark

[4]

(b) The rate of decomposition of hydrogen peroxide may be increased by adding 1 g of manganese(IV) oxide (manganese dioxide) to the solution. The manganese(IV) oxide acts as a catalyst.

(i) Explain what you understand by the term catalyst.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ [3]

(ii) What mass of manganese(IV) oxide will be recovered at the end of the reaction?

\_\_\_\_\_ [1]

(iii) Catalysts are important in many industrial processes. Complete the table below.

Industrial Process	Catalyst used	Balanced symbol equation for the catalysed reaction	
The Haber Process	iron		[3]
The Contact Process		$2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$	[1]
Production of Nitric acid	platinum/ rhodium		[3]

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Marks Remark

- (c) Another method of increasing the rate of decomposition of hydrogen peroxide is to increase the temperature of the solution. Explain, in terms of particles, how increasing the temperature of the solution increases the rate of reaction.

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[3]

Quality of written communication

[2]

- (d) In the Haber Process, a pressure of 250 atmospheres is used even though a higher yield of ammonia can be obtained at a higher pressure. Suggest **two** reasons why a higher pressure is not used in the process.

1. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2. \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ [2]

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**THIS IS THE END OF THE QUESTION PAPER**

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