

**Paper Reference(s) 1CH0/1H**

**Pearson Edexcel Level 1/Level 2 GCSE (9–1)**

**Chemistry**

**Paper 1**

**Higher Tier**

**Thursday 16 May 2019 – Morning**

**Time: 1 hour 45 minutes plus your additional time allowance**

**INSTRUCTIONS TO CANDIDATES**

**Write your centre number, candidate number, surname, other names and your signature in the boxes below. Check that you have the correct question paper.**

<b>Centre No.</b>					
<b>Candidate No.</b>					
<b>Surname</b>					
<b>Other names</b>					
<b>Signature</b>					
<b>Paper Reference</b>	1	C	H	0	/ 1 H



- Use **BLACK** ink or ball-point pen.
- Answer **ALL** questions.
- Answer the questions in the spaces provided – there may be more space than you need.
- Any diagrams may **NOT** be accurately drawn, unless otherwise indicated.
- You must **SHOW ALL YOUR WORKING OUT** with **YOUR ANSWER CLEARLY IDENTIFIED** at the **END OF YOUR SOLUTION**.

## **MATERIALS REQUIRED FOR EXAMINATION**

**Calculator, ruler**

## **ITEMS INCLUDED WITH QUESTION PAPERS**

**Periodic Table**

## **INFORMATION FOR CANDIDATES**

- The total mark for this paper is 100.
- The marks for **EACH** question are shown in brackets – use this as a guide as to how much time to spend on each question.
- In questions marked with an **ASTERISK (\*)**, marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.
- Candidates may use a calculator.

**(Turn over)**

## **ADVICE TO CANDIDATES**

- **Read each question carefully before you start to answer it.**
- **Try to answer every question.**
- **Check your answers if you have time at the end.**

**Answer ALL questions. Write your answers in the spaces provided.**

**Some questions must be answered with a cross in a box ☐. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☐.**

**1 In a hydrogen-oxygen fuel cell, hydrogen and oxygen react at the electrodes.**

**(a) The overall reaction occurring in this fuel cell is a reaction of hydrogen with oxygen.**

**Write the balanced equation for this reaction.  
(2 marks)**

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**(Question continues on next page)**

**(Turn over)**

- (b) The electrodes of a fuel cell are in contact with water and air.

The electrodes are made of platinum rather than iron.

- (i) State why iron is not a suitable metal for the electrodes of the cell. (1 mark)

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(Question continues on next page)

**(ii) Platinum acts as a catalyst.**

**State, in terms of its position in the periodic table, why you would expect platinum to act as a catalyst. (1 mark)**

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**(Question continues on next page)**

**(c) Some metal objects are electroplated.**

**State TWO reasons for electroplating a metal object. (2 marks)**

**1** \_\_\_\_\_

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**2** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**(TOTAL FOR QUESTION 1 = 6 MARKS)**

\_\_\_\_\_

**(Questions continue on next page)**

**(Turn over)**

2 In Figure 1, the letters A, E, G, J, X and Z show the positions of six elements in the periodic table.

These letters are not the symbols of the atoms of these elements.

1	2	3	4	5	6	7	0	8
A								
J		E			G			
							X	

Figure 1

(Question continues on next page)

(Turn over)



**(a) Using the letters A, E, G, J, X and Z**

- (i) give the letters of the TWO elements that are non-metals (1 mark)**

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- (ii) give the letters of TWO elements in period 2 (1 mark)**

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- (iii) give the letter of an element that normally forms an ion with a charge of +1. (1 mark)**

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**(Question continues on next page)**

**(b) Element E has an atomic number of 5.**

**In a sample of E there are two isotopes. One isotope has a mass number of 10 and the other isotope has a mass number of 11.**

**(i) Explain, in terms of subatomic particles, what is meant by the term ISOTOPES. (2 marks)**

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**(ii) All atoms of element E in this sample contain (1 mark)**

☐ **A 5 protons**

☐ **B 5 neutrons**

☐ **C 6 protons**

☐ **D 6 neutrons**

- (c) Element X has an atomic number of 18.

State the electronic configuration of an atom of element X. (1 mark)

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- (d) In an experiment, 3.5 g of element A reacted with 4.0 g of element G to form a compound.

Calculate the empirical formula of this compound.

(relative atomic masses:  $A = 7$ ,  $G = 16$ )

You must show your working. (3 marks)

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empirical formula of this compound = \_\_\_\_\_

(TOTAL FOR QUESTION 2 = 10 MARKS)

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(Questions continue on next page)

- 3 (a) Water, acidified with sulfuric acid, is decomposed by electrolysis.**

**The water is decomposed to produce hydrogen and oxygen.**

- (i) A sample of hydrogen is mixed with air and ignited.**

**State what would happen. (1 mark)**

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**(Question continues on next page)**

- (ii) Throughout the experiment the volume of hydrogen and the volume of oxygen are measured at two-minute intervals.

The results are shown in Figure 2.

time in minutes	volume of hydrogen in cm <sup>3</sup>	volume of oxygen in cm <sup>3</sup>
0	0	0
2	4	2
4	8	4
6	12	6
8	16	8

Figure 2

(Question continues on next page)

**Describe, using the data in Figure 2, what the results show about the volumes of hydrogen and of oxygen produced in this experiment.**  
**(2 marks)**

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**(b) Molten lead bromide is electrolysed.**

**The products of this electrolysis are (1 mark)**

- ☐ **A    hydrogen and bromine**
- ☐ **B    hydrogen and oxygen**
- ☐ **C    lead and bromine**
- ☐ **D    lead and oxygen**

- (c) Calcium nitrate and calcium carbonate are both ionic compounds.

Calcium nitrate mixed with water behaves as an electrolyte.

Calcium carbonate mixed with water does not behave as an electrolyte.

Explain, in terms of solubility and movement of ions, this difference in behaviour. (2 marks)

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(Question continues on next page)



- (d) When molten zinc chloride is electrolysed, zinc ions,  $\text{Zn}^{2+}$ , form zinc atoms.

Write the half equation for this reaction. (2 marks)

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(TOTAL FOR QUESTION 3 = 8 MARKS)

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(Questions continue on next page)

- 4 Calcium carbonate decomposes on heating to form calcium oxide and carbon dioxide.



- (a) 8.000 g of  $\text{CaCO}_3$  was heated strongly for about 10 minutes. 6.213 g of solid remained.  
Calculate the mass of carbon dioxide gas given off. (1 mark)

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mass of carbon dioxide = \_\_\_\_\_ g

(Question continues on next page)

(Turn over)

- (b) A second sample of calcium carbonate is strongly heated in a crucible until there is no further loss in mass.

The mass of calcium oxide remaining in the crucible is 5.450 g.

- (i) The theoretical yield of calcium oxide in this experiment is 5.600 g.

Calculate the percentage yield of calcium oxide. (2 marks)

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percentage yield = \_\_\_\_\_

(Question continues on next page)

(Turn over)

- (ii) The mass of solid left in the crucible is less than the theoretical mass of calcium oxide that should be obtained.

A possible reason for this is that (1 mark)

- ☐ A some solid was lost from the crucible
- ☐ B the solid remaining absorbed some water from the air
- ☐ C some carbon dioxide remained in the crucible
- ☐ D the decomposition was incomplete

(Question continues on next page)

- (c) Another sample of calcium carbonate is heated and the mass of solid remaining is measured each minute.

The results are shown in Figure 3.

time in minutes	0	1	2	3	4	5	6	7
mass of solid remaining in g	9.0	8.1	7.2	6.4	6.0	5.6	5.3	5.2

Figure 3

- (i) Explain the trend shown by the data in Figure 3. (2 marks)

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(Question continues on next page)

(Turn over)

- (ii) It is impossible to be sure from this data that the reaction is complete.

State why. (1 mark)

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(Question continues on next page)

- (d) (i) Calculate the relative formula mass of calcium carbonate,  $\text{CaCO}_3$ .  
(relative atomic masses: C = 12, O = 16, Ca = 40)  
(2 marks)

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relative formula mass = \_\_\_\_\_

(Question continues on next page)

- (ii) Calculate the atom economy for the formation of calcium oxide in this reaction.



You must show your working.

(relative atomic masses: C = 12, O = 16, Ca = 40;

relative formula mass: calcium oxide = 56)

(2 marks)

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atom economy = \_\_\_\_\_ %

(TOTAL FOR QUESTION 4 = 11 MARKS)

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(Questions continue on next page)

(Turn over)



- 5 (a) One way to extract metals from land contaminated with metal compounds is phytoextraction. When plants grow they absorb metal ions through their roots.

The plants are harvested, dried and burned forming an ash.

The ash contains metal compounds.

Plants were grown in a piece of ground contaminated with nickel compounds.

- (i) 1 kg of the ash from these plants contained 142.0 g of nickel compounds.

Calculate the percentage by mass of nickel compounds in the ash. (3 marks)

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percentage by mass = \_\_\_\_\_

**(ii) Nickel is extracted from nickel compounds.**

**State an advantage of extracting nickel by phytoextraction rather than from its ore.**

**(1 mark)**

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**(b) Some nickel ores contain nickel sulfide.**

**(i) In the first stage of extracting nickel from nickel sulfide, the nickel sulfide,  $\text{NiS}$ , is heated in air to form nickel oxide,  $\text{NiO}$ , and sulfur dioxide.**

**Write the balanced equation for this reaction.**

**(2 marks)**

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- (ii) In the final stage of the extraction process, a nickel compound is electrolysed to produce pure nickel.

An advantage of producing a metal by electrolysis is that (1 mark)

- ☐ A electrolysis uses a large amount of electricity
- ☐ B the metal produced by electrolysis is very pure
- ☐ C electrolysis is a very cheap method of extraction
- ☐ D electrolysis is the only method of extracting unreactive metals

(Question continues on next page)

- (c) In a different method of obtaining nickel, the process produces a mixture of the liquids nickel tetracarbonyl and iron pentacarbonyl.

The boiling point of nickel tetracarbonyl is  $43^{\circ}\text{C}$ .  
The boiling point of iron pentacarbonyl is  $103^{\circ}\text{C}$ .  
These two liquids mix together completely.

Describe the process used to separate these two liquids. (3 marks)

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(TOTAL FOR QUESTION 5 = 10 MARKS)

- 6 (a) Hydrated copper sulfate,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ , is a blue solid. Anhydrous copper sulfate,  $\text{CuSO}_4$ , is a white solid.

Heat energy is needed to convert hydrated copper sulfate to anhydrous copper sulfate. This is a reversible reaction.



Devise an experiment to show that this is a reversible reaction. (4 marks)

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(Continue your answer on next page)

(Turn over)

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**(Question continues on next page)**

- (b) Hydrogen reacts with iodine to form hydrogen iodide. Iodine gas is purple and hydrogen iodide gas is colourless.



Hydrogen and iodine are placed in a sealed container.

The container is left until equilibrium is reached.

The conditions are changed favouring the forward reaction.

Explain what you would SEE. (2 marks)

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- (c) Calculate the number of atoms combined in one mole of copper iodide,  $\text{CuI}_2$ .

(Avogadro constant =  $6.02 \times 10^{23}$ ) (2 marks)

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number of atoms = \_\_\_\_\_

(TOTAL FOR QUESTION 6 = 8 MARKS)

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(Questions continue on next page)



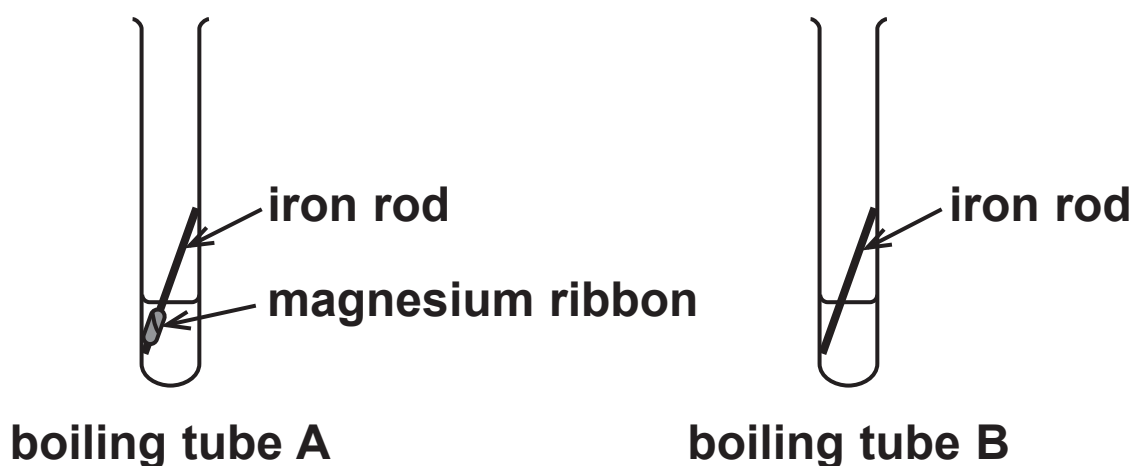
**7 Many metals corrode.**

**(a) When a metal corrodes (1 mark)**

- ☐ A the metal reacts with nitrogen
- ☐ B the metal reacts with another metal
- ☐ C the metal element decomposes
- ☐ D the metal is oxidised

**(b) An experiment is carried out to see if magnesium ribbon wrapped around a piece of iron rod has an effect on the rate at which the iron rod rusts.**

**The apparatus is shown in Figure 4.**



**Figure 4**

**(Question continues on next page)**

**(Turn over)**

The method used is

- an iron rod, with magnesium ribbon wrapped around it, is placed in a boiling tube labelled A
- $10\text{ cm}^3$  water from a measuring cylinder is poured into this boiling tube
- an identical rod but with no magnesium ribbon wrapped around it is placed in a second boiling tube labelled B
- $10\text{ cm}^3$  water from a measuring cylinder is poured into this boiling tube.

Both boiling tubes are left for a few days.

- (i) Explain why iron rod rather than stainless steel rod is used in this experiment. (2 marks)

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- (ii) State why it is not necessary to use a pipette to measure out  $10\text{ cm}^3$  water in this experiment. (1 mark)

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(Question continues on next page)

- (iii) After a few days the two boiling tubes were examined.

The results are shown in Figure 5.

boiling tube A	the appearance of the iron rod is unchanged the magnesium has started to disappear
boiling tube B	a small amount of brown deposit has formed around the rod

Figure 5

Explain the results of this experiment.  
(2 marks)

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(Question continues on next page)

(Turn over)

(c) Hydrazine,  $\text{N}_2\text{H}_4$ , reacts with oxygen.



A metal in water corrodes faster than an identical piece of metal in the same volume of water containing dissolved hydrazine.

Use the information to explain how hydrazine slows corrosion. (2 marks)

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(Question continues on next page)

**(d) Ammonia is used to make hydrazine.**

**In the industrial process to manufacture ammonia, nitrogen and hydrogen are combined in the presence of an iron catalyst.**



**(i) State the name of the industrial process to manufacture ammonia. (1 mark)**

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**(ii) Predict the effect that adding the catalyst has on the rate of attainment of equilibrium. (1 mark)**

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**(Question continues on next page)**

**(Turn over)**

- (iii) Predict the effect that adding the catalyst has on the equilibrium yield of ammonia. (1 mark)

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**(TOTAL FOR QUESTION 7 = 11 MARKS)**

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**(Questions continue on next page)**

- 8 Pieces of zinc react with copper sulfate solution.  
Zinc sulfate solution is colourless.



- (a) Describe what you would SEE when an excess of zinc is added to copper sulfate solution and the mixture left until the reaction is complete.  
(2 marks)

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(Question continues on next page)



**(b) This reaction is described as a redox reaction.**

**Explain, in terms of electrons, which particles have been oxidised and which particles have been reduced in this reaction. (4 marks)**

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**(Question continues on next page)**

**(Turn over)**

- (c) The copper sulfate solution used has a concentration of  $15.95 \text{ g dm}^{-3}$ .

Calculate the number of moles of copper sulfate,  $\text{CuSO}_4$ , in  $50.00 \text{ cm}^3$  of this solution.

(relative atomic masses: O = 16, S = 32, Cu = 63.5)  
(3 marks)

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number of moles of copper sulfate = \_\_\_\_\_ mol

(Question continues on next page)

(Turn over)

- (d) In another experiment, 0.043 mol of copper sulfate,  $\text{CuSO}_4$ , is used.

Calculate, to one decimal place, the minimum mass of zinc that must be added to react with all the copper sulfate.

(relative atomic mass:  $\text{Zn} = 65$ ) (2 marks)

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mass = \_\_\_\_\_ g

(TOTAL FOR QUESTION 8 = 11 MARKS)

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(Questions continue on next page)

(Turn over)

- 9 (a) X and Y are solutions of two different acids.  
The concentration of acid in each solution, in  $\text{mol dm}^{-3}$ , is the same.  
Solution X has a pH of 3.40 and solution Y has a pH of 4.40.

- (i) State what could be used to measure these pH values of 3.40 and 4.40. (1 mark)

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- (ii) What is the concentration of hydrogen ions in solution X compared with that in solution Y? (1 mark)

- ☐ A ten times lower
- ☐ B lower by a factor of 3.30 / 4.40
- ☐ C higher by a factor of 4.40 / 3.30
- ☐ D ten times higher

(Question continues on next page)

(Turn over)

- (b) An experiment is planned to record the change in pH as a powdered base is added to 50 cm<sup>3</sup> dilute hydrochloric acid.

The method suggested is

step 1 add dilute hydrochloric acid up to the 50 cm<sup>3</sup> mark on a beaker

step 2 add one spatula of the base and stir

step 3 measure the pH of the mixture

step 4 repeat steps 2 and 3 until the pH stops changing.

- (i) State how you could change the method so that the amounts of dilute hydrochloric acid and of the base can be measured more accurately. (2 marks)

dilute hydrochloric acid \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

base \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

- (ii) During the experiment the pH changes from 2 to 10.

If phenolphthalein indicator is added at the beginning of the experiment, a colour change occurs as the base is added.

State the colour change that occurs. (1 mark)

colour at start \_\_\_\_\_

colour at end \_\_\_\_\_

- (iii) Explain, in terms of the particles present, why the pH increases during the experiment. (2 marks)

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(Question continues on next page)

(Turn over)

**\*(c) Some properties of four solids, A, B, C and D, are shown in Figure 6.**

**The solids, in no particular order, are copper carbonate, copper oxide, magnesium metal and sodium hydroxide.**

	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>colour of solid</b>	black	silver	white	green
<b>observation when solid is added to water</b>	black solid remains	a few bubbles appear on surface of solid	solid dissolves and forms colourless solution	green solid remains
<b>pH of mixture of solid added to water</b>	7	8	13	7
<b>observation when solid is added to dilute sulfuric acid</b>	on warming, solid disappears to form blue solution	effervescence solid disappears to form colourless solution	solid disappears to form colourless solution	effervescence solid disappears to form blue solution

**Figure 6**

**(Question continues on next page)**

**(Turn over)**

**Identify the solids A, B, C and D, explaining how the information in Figure 6 supports the identification of each solid. (6 marks)**

[illegible]

**(Continue your answer on next page)**

**(Turn over)**



**(Turn over)**

**(Turn over)**

**(Questions continue on next page)**

**(Turn over)**

10 (a) Nitric acid can be titrated with a solution of ammonia.

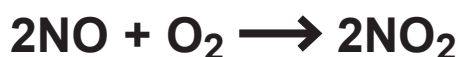
(i) State the type of reaction occurring when nitric acid reacts with ammonia. (1 mark)

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(ii) What salt is formed in this reaction? (1 mark)

- ☐ A ammonia nitric
- ☐ B ammonia nitrate
- ☐ C ammonium nitric
- ☐ D ammonium nitrate

(b) In one stage of the production of nitric acid, nitrogen oxide, NO, is reacted with oxygen to make nitrogen dioxide, NO<sub>2</sub>.



Calculate the minimum volume of air, measured at room temperature and pressure, required to react with 1000 g nitrogen oxide to form nitrogen dioxide.

**Assume that the air contains 20% oxygen by volume.**

**(relative atomic masses: N = 14, O = 16)**

**1 mol of gas occupies 24 dm<sup>3</sup> at room temperature and pressure) (4 marks)**

[illegible]

**volume of air = \_\_\_\_\_ dm<sup>3</sup>**

**(Question continues on next page)**

**(Turn over)**

- \*(c) In another stage in the production of nitric acid, ammonia is reacted with oxygen to form nitrogen oxide and water.**



**Heat energy is given out when ammonia reacts with oxygen.**

**The conditions chosen for the reaction are**

- excess air, rather than just the right amount**
- a pressure of 10 atm, rather than atmospheric pressure**
- a temperature of 900 °C, rather than room temperature.**

**Explain the effect of the conditions chosen on the equilibrium yield of nitrogen oxide and on the rate of attainment of equilibrium. (6 marks)**

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**(Continue your answer on next page)**

**(Turn over)**

**(Turn over)**

**(Turn over)**



**(Turn over)**

**(Turn over)**

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**(TOTAL FOR QUESTION 10 = 12 MARKS)**

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**TOTAL FOR PAPER = 100 MARKS**  
**END**