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DIRECTORATE FOR QUALITY AND STANDARDS IN EDUCATION
Department for Curriculum Management and eLearning
Educational Assessment Unit
**Annual Examinations for Secondary Schools 2013**

Trac

| **FORM 4** | **CHEMISTRY** | **TIME: 1h 30min** |
|---|---|---|

**Name:** ________________________ **Class:** ______________

Useful Data: Atomic numbers and relative atomic masses are shown in the periodic table printed below.
One mole of any gas occupies 22.4 $dm^3$ at standard temperature and pressure
Faraday constant = 96500 C $mol^{-1}$ Q =It

**State symbols are expected to be included in all chemical equations.**

PERIODIC TABLE

| 1 | 2 | | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1 **H** 1 | | | | | | | | | | 4 **He** 2 |
| 7 **Li** 3 | 9 **Be** 4 | | | | | | | | | | | 11 **B** 5 | 12 **C** 6 | 14 **N** 7 | 16 **O** 8 | 19 **F** 9 | 20 **Ne** 10 |
| 23 **Na** 11 | 24 **Mg** 12 | | | | | | | | | | | 27 **Al** 13 | 28 **Si** 14 | 31 **P** 15 | 32 **S** 16 | 35.5 **Cl** 17 | 40 **Ar** 18 |
| 39 **K** 19 | 40 **Ca** 20 | 45 **Sc** 21 | 48 **Ti** 22 | 51 **V** 23 | 52 **Cr** 24 | 55 **Mn** 25 | 56 **Fe** 26 | 59 **Co** 27 | 59 **Ni** 28 | 63.5 **Cu** 29 | 65 **Zn** 30 | 70 **Ga** 31 | 73 **Ge** 32 | 75 **As** 33 | 79 **Se** 34 | 80 **Br** 35 | 84 **Kr** 36 |
| 85 **Rb** 37 | 88 **Sr** 38 | 89 **Y** 39 | 91 **Zr** 40 | 93 **Nb** 41 | 96 **Mo** 42 | 99 **Tc** 43 | 101 **Ru** 44 | 103 **Rh** 45 | 106 **Pd** 46 | 108 **Ag** 47 | 112 **Cd** 48 | 115 **In** 49 | 119 **Sn** 50 | 122 **Sb** 51 | 128 **Te** 52 | 127 **I** 53 | 131 **Xe** 54 |
| 133 **Cs** 55 | 137 **Ba** 56 | 139 **La** 57 | 178 **Hf** 72 | 181 **Ta** 73 | 184 **W** 74 | 186 **Re** 75 | 190 **Os** 76 | 192 **Ir** 77 | 195 **Pt** 78 | 197 **Au** 79 | 201 **Hg** 80 | 204 **Tl** 81 | 207 **Pb** 82 | 209 **Bi** 83 | 210 **Po** 84 | 210 **At** 85 | 222 **Rn** 86 |
| 223 **Fr** 87 | | | | | | | | | | | | | | | | | |

Key

| *a* **X** *b* | relative atomic mass<br>symbol<br>atomic number |
|---|---|

**Marks Grid [ For Examiner's use only ]**

| **Question N$^o$.** | **Section A** | | | | | | **Section B** | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | |
| **Max Mark** | 10 | 10 | 10 | 10 | 10 | 10 | 20 | 20 | 20 | **Theory Total** |
| **Actual Mark** | | | | | | | | | | |

| Theory Paper: 85% | Practical: 15% | Final Score: 100% |
|---|---|---|
| | | |

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**SECTION A – Answer ALL questions. This section carries 60 marks.**

1 Use the **given periodic table** to identify an element that matches each description.

| *Description* | *Element* |
|---|---|
| An element that can form both positive and negative ions | |
| The most reactive non-metal in the given periodic table | |
| A yellow solid at room temperature | |
| An element that has the same atomic mass as Argon | |
| A reddish brown transition metal | |
| A metal that is found in limestone | |
| A transition metal that is the major component of steel | |
| Is a red liquid at room temperature | |
| An element that reacts vigorously with water and burns with a lilac flame | |
| The most reactive metal in the given periodic table | |

**[10]**

2 Place each of the sulfur compounds below near the best description.

| | | | |
|---|---|---|---|
| sulfur dioxide | sulfur trioxide | sulfurous acid | concentrated sulfuric acid |
| hydrogen sulfide | copper (II) sulfate | barium sulfate | |
| calcium sulfate | iron (III) sulfate | iron (II) sulfate | |

| *Description* | *Compound* |
|---|---|
| A liquid that is a strong drying and dehydrating agent | |
| A blue-coloured, water-soluble solid | |
| Its hydrated form is known as gypsum | |
| A gas that reacts with water to form sulfuric acid | |
| The substance formed when sulfur dioxide reacts with water | |
| A gas produced from the combustion of sulfur | |
| A white solid which is not soluble at all in water | |
| A substance that dissolves to form a brown solution | |
| A poisonous gas that smells of rotten eggs | |
| Forms a green aqueous solution that turns brown on standing | |

**[10]**

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3a. 3.6 g of magnesium granules were added to excess dilute hydrochloric acid.

(i) Write two observations for this reaction.

______________________________________________

______________________________________________ **[2]**

(ii) Write a balanced chemical equation to represent this reaction.

______________________________________________ **[2]**

b. (i) Calculate the number of moles of magnesium that reacted with the acid.

______________________________________________

______________________________________________ **[2]**

(ii) How many moles of hydrogen were produced?

______________________________________________

______________________________________________ **[1]**

(iii) Find the volume of hydrogen produced from this reaction at standard temperature and pressure.

______________________________________________

______________________________________________ **[1]**

c. If all the hydrogen given off from this reaction were collected and the temperature changed from 0 ºC (standard temperature) to 20 ºC (room temperature), calculate the new volume of gas, given that there was no change in pressure.

______________________________________________

______________________________________________

______________________________________________

______________________________________________ **[2]**

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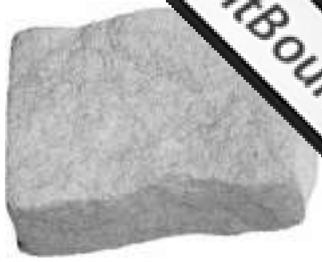
4 An experiment was carried out in order to find the percentage of calcium carbonate by mass in limestone. 3 g of crushed limestone were placed in a flask and 30 $cm^3$ of 2 $moldm^{-3}$ hydrochloric acid solution were added to it. The contents were swirled till there was no more effervescence. 1.2 $cm^3$ of the acid remained unreacted after the reaction stopped completely.



a. (i) What volume of acid solution reacted with the calcium carbonate in the limestone?

______________________________ **[1]**

(ii) Find the number of moles of hydrochloric acid present in the volume found in question a.(i) above, given that the molar concentration of the acid was 2 $moldm^{-3}$.

______________________________

______________________________

______________________________ **[2]**

b. Using the equation below:

$$2HCl_{(aq)} + CaCO_{3(s)} \rightarrow CaCl_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$$

(i) Find the number of moles of calcium carbonate that reacted with the acid.

______________________________

______________________________ **[1]**

(ii) Calculate the mass in g of calcium carbonate that reacted with the acid.

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

______________________________

______________________________ **[2]**

(iii) Use the above result to find the percentage of calcium carbonate in the 3 g sample of limestone used.

______________________________

______________________________ **[1]**

c. (i) Limestone is the raw material used to produce quicklime. Write a balanced chemical equation to show this process.

______________________________ **[2]**

(ii) Name an important condition that is necessary for this process to occur efficiently.

______________________________ **[1]**

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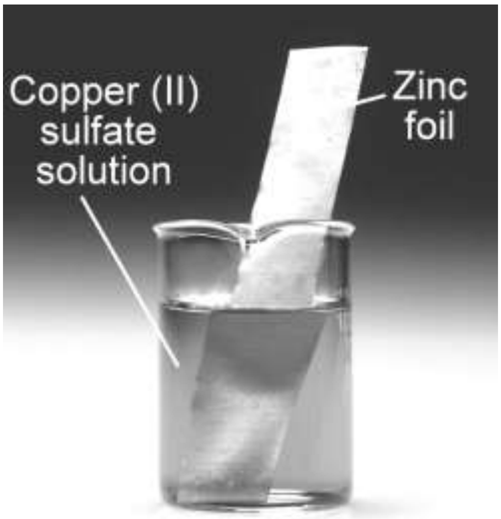
5a. A piece of zinc foil was dipped into a beaker containing copper (II) sulfate s shown in the diagram below. The reactants were left for about 2 hours to allow enough time to react.




(i) Write a balanced chemical equation to represent this reaction.

______________________________________________ [2]

(ii) Describe two observations that would be noted some hours following the start of this reaction.

______________________________________________

______________________________________________ [2]

b. (i) State, giving reasons, which substance in this reaction is acting as the **oxidizing agent** and which substance is acting as a **reducing agent**.

______________________________________________

______________________________________________

______________________________________________

______________________________________________ [2]

(ii) Write a balanced ionic equation for this reaction.

______________________________________________ [2]

c. What would you observe if a piece of silver metal had been dipped into the copper (II) sulfate solution instead of zinc? Give a reason for your answer.

______________________________________________

______________________________________________ [2]

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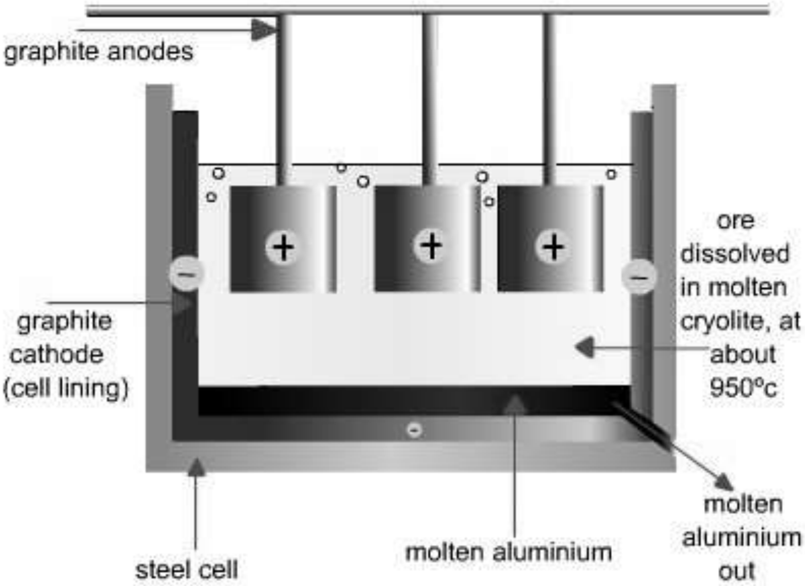
6 The diagram below shows the electrolytic process which is used to extract a

from its ore.




a. (i) Give the **common name** and **formula** of the ore that is mined in order to extract aluminium from it.

______________________________________________ **[2]**

(ii) Write the formulas of the ions present in the liquid inside the steel tank.

______________________________________________ **[1]**

b. Write **half equations** to represent the processes taking place at the anode and cathode.

Anode: ______________________________________________ **[2]**

Cathode:______________________________________________ **[2]**

c. (i) Apart from aluminium and oxygen, what other by-product is formed during this process?

______________________________________________ **[1]**

(ii) To what type of world pollution does aluminium extraction contribute most?

______________________________________________ **[1]**

(iii) What measure can be taken to reduce the pollution resulting from the extraction of aluminium?

______________________________________________ **[1]**

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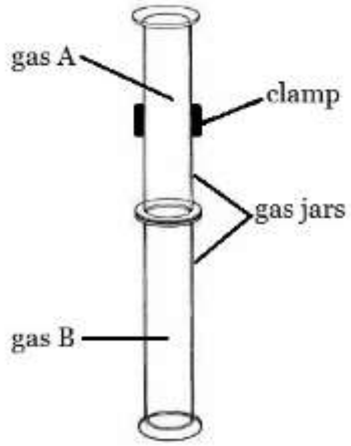
**SECTION B – Answer TWO questions only on the foolscap provided.**
**This section carries 40 marks.**

7 Ammonia is an important gas that has a high commercial value. It is manufactured industrially (on a large scale) by the direct combination of nitrogen gas and hydrogen gas. Jake, a chemistry student, tries to use this method to prepare ammonia in the school laboratory. He places a gas jar full of one gas over a gas jar filled with the other gas as shown in the diagram. He leaves them for an hour to make sure that they mix and maybe react.




Afterwards, he tests the contents to check if ammonia has been formed but he gets a negative result. No ammonia is produced.

a. (i) Suggest which gas Jake should have placed on top and which at the bottom to ensure that they mixed rapidly. Give a reason for your answer. **[3]**

(ii) Give 3 reasons why you think no ammonia was produced from Jake's experiment. **[3]**

(iii) What is the single most important reason (limiting factor) that makes it very difficult to produce ammonia by direct combination of elements in a school lab? **[1]**

(iv) Describe one chemical test that Jake could have used to check if ammonia had been formed. **[2]**

(v) What important safety precaution should Jake take while carrying out this test? **[1]**

b. Name 2 industrial uses of ammonia. **[2]**

c. In the laboratory, a more convenient way of producing a sample of ammonia gas is by reacting a metal hydroxide with an ammonium salt.

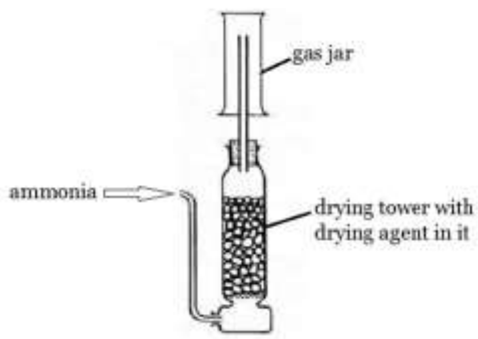
(i) **<u>Name</u>** 2 suitable substances that can be reacted to produce ammonia in the lab. **[2]**

(ii) Write a balanced chemical equation to show how these two substances react. **[2]**

d. Ammonia can be dried and collected using a drying tower as shown.

(i) Name a suitable drying agent for ammonia.

(ii) Explain how ammonia is dried and collected using this apparatus.




**[4]**

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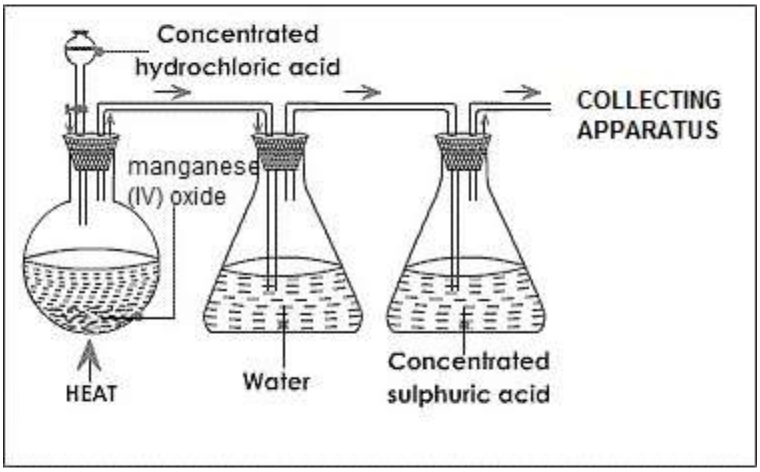
8 Trudy, a chemistry student, wants to prepare a pure sample of dry chlorine g... laboratory. She thinks of 2 possible methods.

**Method A:** By heating concentrated hydrochloric acid with manganese (IV) oxide powder

**Method B:** By electrolysing a concentrated sodium chloride solution

a. For **method A**, Trudy uses the following equipment:




(i) On your foolscap, draw 2 different possible pieces of apparatus that could be added to the above setup for collecting dry chlorine. In your drawings show how chlorine that is coming out of the delivery tube is collected in each piece of equipment. Include labels in your diagrams. **[4]**

(ii) In the diagram above, explain why it is necessary to pass chlorine through water. **[2]**

(iii) Why is chlorine then bubbled through concentrated sulfuric acid? **[1]**

(iv) Write a balanced chemical equation to represent the reaction of concentrated hydrochloric acid with manganese (IV) oxide. **[2]**

(v) State one condition which is necessary for this reaction to take place. **[1]**

b. For **Method B**: Draw a diagram of the apparatus that Trudy needs to use to produce and collect a small sample of chlorine from the electrolysis of concentrated sodium chloride solution. Label the diagram and do not forget to label all the products. **[5]**

c. Trudy decides to compare the two methods, **A** and **B**, in order to choose the best one for preparing **<u>dry</u>** chlorine gas in the laboratory.

(i) Give 2 advantages of method A over method B. **[2]**

(ii) Give 2 advantages of method B over method A. **[2]**

(iii) Trudy eventually realises that one method is really not suitable at all for her purpose. Which method is **<u>not</u>** suitable? **[1]**

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9 A mixture consisted of two white powders **A** and **B**, which had been accidentally [...] same container.

A laboratory analyst wanted to determine what the white powders in the mixture were made of. She needed to separate them and analyse them. So she carried out the following steps:

**Step 1**

She heated the solid mixture. Substance **A** sublimed to form a white cloud. This vapour formed a white solid crust as it hit a cool inverted funnel. The crust was scraped off with a spatula and dissolved in a small amount of water to form a colourless solution.

**Step 2**

Some of the solution of **A** was heated with sodium hydroxide solution. It gave out a pungent gas **X** that turned moist red litmus paper blue.

**Step 3**

Another sample of solution **A** gave a white precipitate when tested with **acidified** silver nitrate solution.

**Step 4**

A flame test was carried out on the remaining powder **B**. It gave the flame a golden yellow colour.

**Step 5**

Powder **B** quickly dissolved in water to form a colourless solution. It gave a persistent white precipitate when **acidified** barium chloride solution was added to it.

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a. (i) Draw a labelled diagram of the apparatus the analyst needed for **step 1** in whic solids were separated.

(ii) Identify the gas **X** which was produced in **step 2** and briefly describe another chemica test that can be used to test for it instead of the litmus paper. **[2]**

(iii) What does the result of **step 2** prove about substance **A**? **[1]**

(iv) What does the result of **step 3** prove about substance **A**? **[1]**

(v) Give the full chemical name of substance **A**. **[1]**

(vi) Write 2 ionic equations to represent the reactions in **step 2** and **step 3** (one for each step). **[4]**

b. (i) What does the test in **step 4** show about substance **B**? **[1]**

(ii) Describe briefly how a flame test should be carried out on a powder sample. **[2]**

(iii) What does the test in **step 5** show about substance **B**? **[1]**

(iv) Give the full chemical name of substance **B**. **[1]**

(v) Write an ionic equation to represent the reaction in **step 5**. **[2]**

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