

# JUNIOR LYCEUM ANNUAL EXAMINATIONS 2004

Educational Assessment Unit – Education Division

**FORM 4**

**CHEMISTRY**

**TIME: 1hr 30 mins**

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Useful Data: A copy of the Periodic Table is provided with this paper.

Relative atomic masses: Al = 27 , C = 12 , Cu = 63.5 , H = 1 , O = 16 , Na = 23

Molar volume of a gas at stp = 22.4 dm<sup>3</sup>

Faraday constant = 96500 C mol<sup>-1</sup>

Q = It

**Section A: Answer ALL questions in this section using the spaces provided.  
This section carries 60 marks.**

1. This question refers to some common non-metallic elements.

Bromine, Chlorine, Nitrogen, Sulphur

An element may be used more than once to complete the statements below.

Select the element which:

- (a) is most likely to form an ion of the type X<sup>2-</sup> \_\_\_\_\_
- (b) is a red liquid at room temperature \_\_\_\_\_
- (c) burns when heated in air to form an acidic oxide \_\_\_\_\_
- (d) is used to purify drinking water \_\_\_\_\_
- (e) is neutral and is used in food packaging \_\_\_\_\_

(5 marks)

2. Complete the passage by filling in the blank spaces with correct figures or words selected from the following list:

2 , 200 , 450 , 1000 , hydrogen , oxygen , platinum , iron , plastics , fertilisers.

In the Haber process for the manufacture of ammonia, nitrogen and \_\_\_\_\_  
are compressed to a pressure of \_\_\_\_\_ atmospheres and passed over \_\_\_\_\_  
catalyst at a temperature of \_\_\_\_\_ °C. The ammonia is used to make \_\_\_\_\_.

(5 marks)

3. This question is about Group 2 compounds.

(a) From your knowledge of calcium carbonate (limestone) predict:

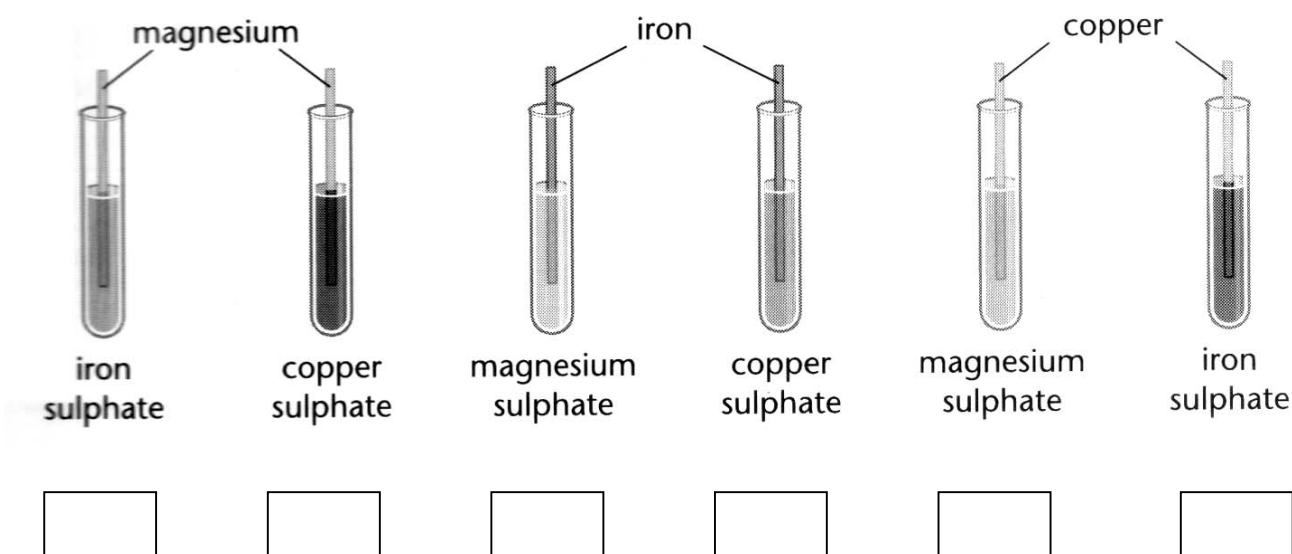
(i) whether barium carbonate is soluble or insoluble in water \_\_\_\_\_ (1 mark)

(ii) the effect of strong heating on barium carbonate. [You can write a word  
equation or a balanced chemical (formula) equation].

\_\_\_\_\_ (2 marks)

3. (b) Barium hydroxide is similar to solid calcium hydroxide (known as slaked lime) and to calcium hydroxide solution (known as lime water).
- (i) Predict the effect of strong heating on solid barium hydroxide.  
 \_\_\_\_\_ (1 mark)
- (ii) Give an equation for the reaction.  
 \_\_\_\_\_ (2 marks)
- (c) What would be **seen** if carbon dioxide gas is bubbled through barium hydroxide solution? \_\_\_\_\_ (1 mark)
- (d) (i) **Name** the gas formed when barium hydroxide is heated with ammonium chloride. \_\_\_\_\_ (1 mark)
- (ii) Give a balanced equation for this reaction.  
 \_\_\_\_\_ (2 marks)

4. The drawings below show an experiment that was set up to investigate some reactions between metals and solutions.



- (a) What type of reaction is being investigated? \_\_\_\_\_ (1 mark)
- (b) What would you expect to SEE which shows that a reaction has taken place?  
 \_\_\_\_\_ (1 mark)
- (c) underneath each test tube, mark with a ✓ where a reaction takes place and with a ✗ where no reaction occurs. (3 marks)

(d) Another example of this type of reaction is shown below :

Work out the oxidation number for **zinc**, before and after the reaction, and state whether it is oxidised or reduced.

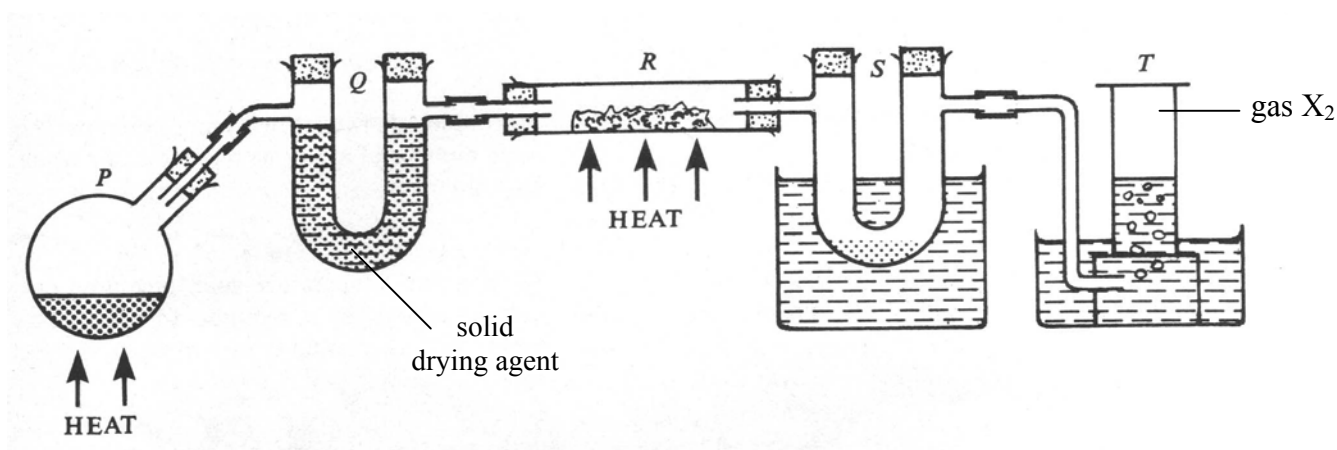


- (i) oxidation number \_\_\_\_\_  
zinc metal is \_\_\_\_\_ (3 marks)
- (ii) Write an ionic equation, omitting spectator ions, for this reaction  
\_\_\_\_\_ (2 marks)

5. Fluorine, formula  $\text{F}_2$ , is a member of the halogen family of elements. You will not be familiar with the chemistry of fluorine but you have studied the chemistry of chlorine and the trend or variation in reactions of the halogens going down Group 7.

- (a) Predict the appearance **or** physical state of fluorine \_\_\_\_\_ (1 mark)
- (b) What would you expect to SEE when fluorine comes into contact with moist litmus paper? \_\_\_\_\_ (1 mark)
- (c) How would you expect fluorine to react with hydrogen?  
\_\_\_\_\_ (1 mark)
- (d) (i) What would you expect to SEE if fluorine is reacted with colourless solution of potassium iodide?  
\_\_\_\_\_ (1 mark)
- (ii) Give a balanced equation for this reaction.  
\_\_\_\_\_ (2 marks)
- (e) (i) Give the **name** of the **product** formed by reaction between iron wool and fluorine \_\_\_\_\_ (1 mark)
- (ii) Write an equation for this reaction.  
\_\_\_\_\_ (2 marks)
- (f) What chemical property is shown by fluorine in the reactions referred to in parts (d) and (e)? \_\_\_\_\_ (1 mark)

6. The apparatus shown below was used to demonstrate the products formed when dry ammonia gas is passed over heated copper (II) oxide.



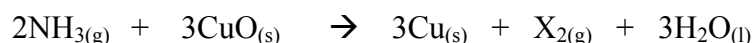
- (a) (i) Name a **solid** drying agent that is suitable for drying ammonia. \_\_\_\_\_ (1 mark)
- (ii) Give a reason why apparatus Q would NOT be replaced by a wash bottle containing concentrated sulphuric acid. \_\_\_\_\_ (1 mark)

- (b) Complete:
- (i) The copper (II) oxide changes colour from black to \_\_\_\_\_ as the reaction proceeds.
- (ii) A sample of the colourless liquid in tube S is shown to be water because, when tested, it turns anhydrous copper (II) sulphate from white to \_\_\_\_\_. (2 marks)

- (c) Name the colourless gas X<sub>2</sub> collected in apparatus T \_\_\_\_\_ (1 mark)

- (d) What property of ammonia is demonstrated in this experiment? \_\_\_\_\_ (1 mark)

- (e) Ammonia reacts with copper (II) oxide according to the following equation.



If 2.24dm<sup>3</sup> of ammonia (measured at stp) reacted completely with copper (II) oxide:

- (ii) How many moles of ammonia reacted? \_\_\_\_\_ (1 mark)

- (iii) Calculate the volume of X<sub>2</sub> that would be formed. \_\_\_\_\_ (1 mark)

- (iv) Calculate the mass of copper that would be formed. \_\_\_\_\_ (2 marks)

7. Washing soda is hydrated sodium carbonate,  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ .  
28.6g of fresh hydrated sodium carbonate crystals were dissolved in distilled water and the solution made up to a volume of  $1000\text{cm}^3$  solution.  
 $25\text{cm}^3$  of this solution were transferred to a conical flask and a few drops of methyl orange indicator were added. The solution in the conical flask was titrated with hydrochloric acid and  $20\text{cm}^3$  of acid were required to reach the end-point. The equation for the reaction is:



- a) Name the most suitable piece of apparatus for:
- (i) measuring out exactly  $25\text{cm}^3$  of the sodium carbonate solution.  
\_\_\_\_\_ (1 mark)
  - (ii) adding the acid to the conical flask \_\_\_\_\_ (1 mark)
- b) How would you know that the end point of the titration had been reached?  
\_\_\_\_\_ (1 mark)
- c) (i) Calculate the formula mass of  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ .  
(2 marks)
- (ii) Calculate the number of moles of  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$  that were dissolved in  $1000\text{cm}^3$  solution (and hence the molar concentration of the solution).  
(1 mark)
- (iii) Calculate the number of moles of  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$  dissolved in  $25\text{cm}^3$  of the sodium carbonate solution.  
(1 mark)
- d) (i) Use the mole ratio of carbonate : acid from the equation to find the number of moles of hydrochloric acid that reacted.  
(1 mark)
- (ii) Use your answer to part (d)(i) to find the molarity of the hydrochloric acid.

(2 marks)

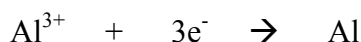
**Section B: Answer any TWO questions from this section on the separate sheets provided. Each question carries 20 marks.**

8. a) Nitrogen dioxide gas can be prepared in the laboratory by the thermal decomposition of lead (II) nitrate crystals. The gas can be cooled and liquefied.
- (i) Draw a clear, labelled diagram of the apparatus that can be used to carry out this preparation. (5 marks)
  - (ii) Describe three changes that would be SEEN when lead nitrate crystals are heated and give an equation for the reaction (5 marks)
  - (iii) Why should this preparation be carried out in a fume cupboard? (1 mark)
- b) Describe a test, (including the expected result), to show the presence of nitrate ions ( $\text{NO}_3^-$ ) in a solution of lead nitrate. (Equations are not required.) (5 marks)
- c) Nitrogen dioxide is an air pollutant and contributes to making rain water acidic.
- (i) give a source or activity that releases nitrogen dioxide into the air.
  - (ii) give an equation for the reaction of nitrogen dioxide with water. (4 marks)

9. The following terms are frequently used in electrochemistry:

electrolyte, non-electrolyte, cations, anions, discharged.

- a) Draw a labelled circuit diagram of the apparatus you would use to check if a **molten** substance is an electrolyte. (5 marks)
- b) Molten lead (II) iodide is tested using your circuit in (a).
- (i) Describe the result of electrolysis of molten lead (II) iodide in terms of cations and anions being discharged, including equations. (6 marks)
  - (ii) Explain, in terms of their particles, why molten lead (II) iodide is an electrolyte while tetrachloromethane is a non-electrolyte. (3 marks)
- c) Briefly explain why aqueous sulphuric acid is a strong electrolyte while aqueous ethanoic acid is a weak electrolyte. (2 marks)
- d) When aluminium is deposited at an electrode the reaction is



If a current of 4.02 amperes flows for 2 hours, calculate the mass of aluminium deposited. (4 marks)

10. Describe an experiment to illustrate each of the following statements.

Include any observations that would be made and, where possible equations should also be given. Diagrams are NOT required, except for part (b).

- a) Concentrated sulphuric acid is a dehydrating reagent. (4 marks)
- b) Hydrogen chloride gas is very soluble in water and forms an acidic solution. **Include a diagram** with your description. (7 marks)
- c) Different coloured flames are produced in a Bunsen burner flame when a flame test is carried out on crystals of potassium chloride and sodium chloride. (5 marks)
- d) Metals like magnesium tarnish (become coated in air) but non-metals like sulphur do not tarnish. (4 marks)