

# JUNIOR LYCEUM ANNUAL EXAMINATIONS 2003

Educational Assessment Unit - Education Division

FORM 4

CHEMISTRY

TIME: 1hr 30 mins

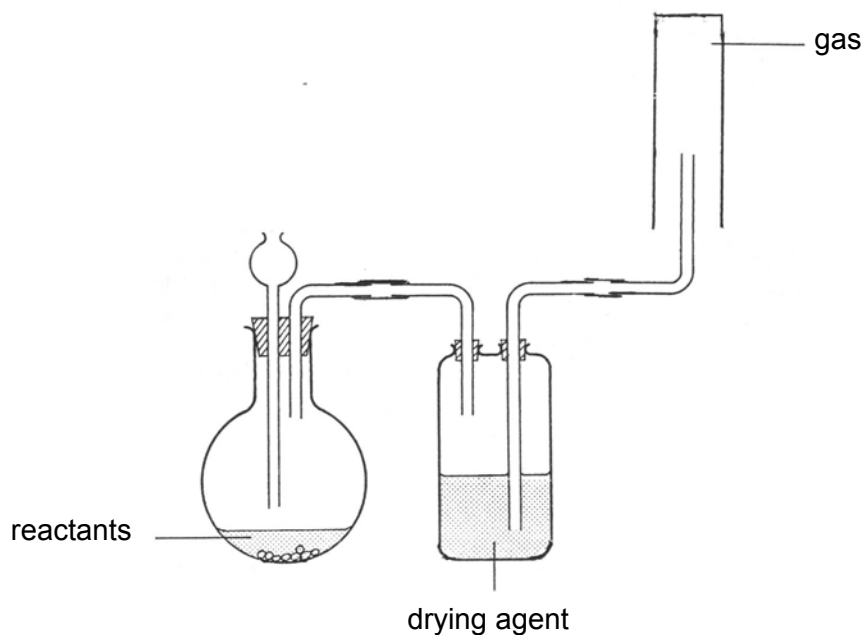
Name: \_\_\_\_\_

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

**Useful Data:** A copy of the Periodic Table is provided with this paper.  
Relative atomic mass Ca = 40  
Molar volume of a gas at stp =  $22.4\text{dm}^3$   
 $Q = It$   
Faraday constant =  $96500\text{ C mol}^{-1}$

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

1. The diagram below shows the apparatus that a student set up to prepare a **dry** sample of a gas that is *denser than air*.
- a) List **three** errors in the set up. (Stands and clamps have been omitted.)



Error 1: \_\_\_\_\_

Error 2: \_\_\_\_\_

Error 3: \_\_\_\_\_

- (b) Name another piece of apparatus that could be used to collect the *dry* gas (instead of using a gas jar). \_\_\_\_\_ (4 marks)

2. This question concerns the electrolysis of calcium bromide, using carbon electrodes.
- a) (i) Draw a labelled *circuit diagram* of the apparatus used for the electrolysis of **molten** calcium bromide. (3 marks)
- (ii) Suggest an important safety precaution whilst carrying out this electrolysis. \_\_\_\_\_ (1 marks)
- (b) Calcium is produced at the cathode by the discharge of  $\text{Ca}^{2+}$  ions. A current of 5A is passed for 193 seconds.
- (i) How many coulombs of electricity have passed? \_\_\_\_\_ (1 mark)
- (ii) How many Faradays of electricity have passed? \_\_\_\_\_ (1 mark)
- (iii) Calculate the mass of calcium produced. \_\_\_\_\_ (2 marks)
- (c) In another experiment, electrolysis of calcium bromide **solution** was carried out and a gas was formed at the cathode. Explain why a gas was liberated at the cathode and not calcium metal.
- \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2 marks)

3. Iron can form two chlorides.

(a) When dilute hydrochloric acid is reacted with iron, a pale green iron chloride solution is formed. Hydrogen is also liberated.

(i) What is the valency of iron in this chloride? \_\_\_\_\_ (1 mark)

(ii) Write a balanced equation for this reaction.  
\_\_\_\_\_ (2 marks)

(b) When sodium hydroxide is added to a solution of the green iron chloride, a green precipitate is formed. This precipitate goes darker on standing.

(i) Give an equation to show the formation of the green precipitate.  
\_\_\_\_\_ (2 marks)

(ii) Why does the precipitate darken on standing.  
\_\_\_\_\_ (1 mark)

(c) When chlorine is passed over heated iron, a brown iron chloride is formed.

(i) What is the valency of iron in this chloride? \_\_\_\_\_ (1 mark)

(ii) Give a reason why chlorine gives this brown chloride with iron, *not* the same chloride formed with dilute hydrochloric acid.

\_\_\_\_\_  
\_\_\_\_\_ (1 mark)

(d) Iron is a transition metal. Write down **two** properties which are *typical of a transition metal*, and that are illustrated in the above reactions.

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

4. Consider the following list of metals.

Zn, Mg, Cu, Ag, Fe, Al.

(a) (i) Rewrite this list of metals, starting with the **most** reactive.

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

(ii) Suggest the two metals between which hydrogen could be placed.

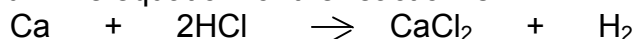
\_\_\_\_\_ and \_\_\_\_\_ (1 mark)

(b) Complete the following statements by inserting the name of *one of the metals given above*.

(i) \_\_\_\_\_ cannot displace magnesium but it displaces all the other metals from solutions of their salts.

(ii) \_\_\_\_\_ can displace silver but cannot displace the other metals. (2 marks)

(c) Some metals, for example calcium, can also displace hydrogen from dilute hydrochloric acid. The equation for the reaction is.



(i) Write an *ionic* equation for this reaction (omitting spectator ions).

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

(ii) Write the *ionic half equations* for this reaction.

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

(iii) Give a reason why this displacement reaction is also a redox reaction.

\_\_\_\_\_ (1 mark)

5. (a) (i) What are allotropes?

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

(ii) Name the two allotropes of sulphur.

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

(b) Sulphur dioxide is an acidic gas.

(i) How could you show that sulphur dioxide is acidic?

\_\_\_\_\_ (1 mark)

(ii) Give a balanced equation for the reaction of sulphur dioxide with water.

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

(c) Describe a test to show that sulphur dioxide is a reducing agent.

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

(d) An excess of sodium sulphite is added to 200cm<sup>3</sup> of dilute hydrochloric acid of molar concentration 2M (2 mol dm<sup>-3</sup>).



Calculate:

(i) the number of moles of hydrochloric acid in solution

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

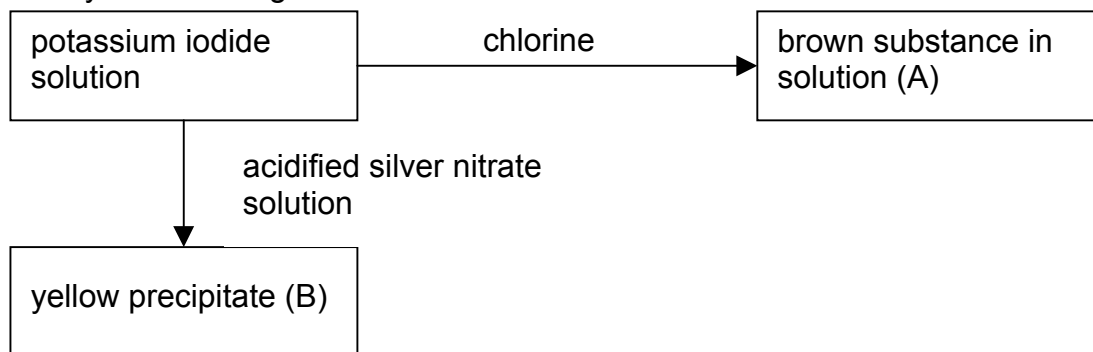
(ii) The number of moles of sulphur dioxide liberated.

\_\_\_\_\_ (1 mark)

(ii) the volume of sulphur dioxide liberated in cm<sup>3</sup> at stp.

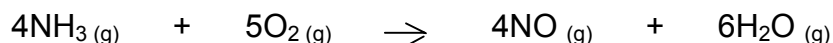
\_\_\_\_\_ (2 marks)

6. Study the following reactions:



- (a) (i) *Name* the product of the reaction between chlorine and potassium iodide solution which would produce the brown colour in solution (A) \_\_\_\_\_ (1 mark)
- (ii) Write an equation for the reaction between chlorine and potassium iodide. \_\_\_\_\_ (2 marks)
- (b) (i) Name the yellow precipitate (B) \_\_\_\_\_ (1 mark)
- (ii) Write an **ionic** equation for the reaction producing (B) \_\_\_\_\_ (2 marks)

7. Ammonia can be converted to nitrogen monoxide in the presence of platinum according to the following equation.



- (a) What is the function of the platinum? \_\_\_\_\_ (1 mark)
- (b) Give a reason why ammonia is oxidised in this reaction. \_\_\_\_\_ (1 mark)
- (c) Assuming that all conditions of temperature and pressure remain constant and that  $12\text{dm}^3$  of ammonia react completely.
- (i) Calculate the volume of oxygen required to react with ammonia. \_\_\_\_\_ (2 marks)
- (ii) Calculate the *total* volume of the gaseous products. \_\_\_\_\_ (2 marks)

**Section B:**

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

8. Aluminium is an important metal. It is the most abundant metal in the Earth's crust but it does not occur free in nature and is expensive to extract.
- (a) Describe how aluminium is extracted from its purified ore emphasizing the conditions of the electrolyte and the chemical principles. Your answer should include a simple labelled outline diagram of the process. (14 marks)
- (b) Give *two* reasons why the process is expensive. (2 marks)
- (c) Give *two different* uses of aluminium and, in each case, state the property of the metal on which the use depends. (4 marks)
9. This question is about the compounds of copper.
- (a) Read the following description about the action of heat on copper (II) sulphate crystals and copper (II) nitrate crystals, then answer the questions that follow.
- When heated, blue crystals of copper (II) sulphate give off a misty vapour A, which turns cobalt chloride paper pink, and leaves a white residue B.
- When heated, blue crystals of copper (II) nitrate first give off the misty vapour A. On stronger heating, a mixture of a brown gas C together with another gas D, which relights a glowing splint, is produced. Finally the black residue E is left.
- (i) Name the substances A to E. (5 marks)
- (ii) Name the type of reaction that takes place when these copper compounds are heated. (1 mark)
- (iii) Write balanced equations for the *two* reactions described. (4 marks)
- (b) Copper (II) oxide can be used to prepare soluble salts of copper by reaction with dilute acids.
- (i) Give balanced equations for the reaction of copper (II) oxide **both** with dilute hydrochloric acid and with dilute sulphuric acid (4 marks)
- (ii) Name the type of reaction that takes place. (1 mark)
- (c) The presence of copper (II) ions in the solutions formed in (b) can be confirmed by adding aqueous sodium hydroxide to a sample of the solution.
- (i) What is *seen* in this test? (2 marks)
- (ii) What type of reaction takes place? (1 mark)
- (iii) Give an *ionic* equation for this reaction (2 marks)
10. Consider the following 'pairs of elements':  
sodium and potassium ; magnesium and calcium ; chlorine and bromine.
- (a) For EACH pair; give *two* typical PHYSICAL properties which are similar for both elements. (6 marks)
- (b) Select TWO pairs of elements. For EACH pair selected describe fully a reaction, **including the observations and equations**, which show that both elements have similar CHEMICAL properties. (14 marks)

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END