

# JUNIOR LYCEUM ANNUAL EXAMINATIONS 2006

Educational Assessment Unit - Education Division

FORM 3

CHEMISTRY

TIME: 1h 30min

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

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

Useful Data: A copy of the Periodic Table is printed below.

Relative atomic masses may be taken as: Mg = 24, O = 16

## PERIODIC TABLE

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

Key

<i>a</i>	relative atomic mass
<b>X</b>	symbol
<i>b</i>	atomic number

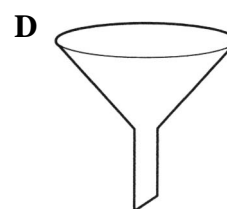
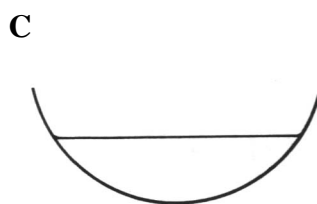
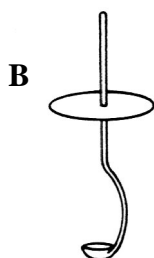
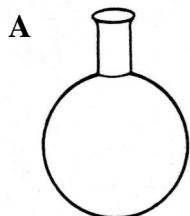
### Marks Grid [ For Examiners use only ]

Question N <sup>o</sup> .	Section A							Section B			
	1	2	3	4	5	6	7	8	9	10	
Max Mark	5	8	10	4	13	10	10	20	20	20	
Actual Mark											Theory Total

85% of Theory Paper	15% Practical	<b>100% Final Score</b>

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

1. During your practical work you have used different items of apparatus. Some of this apparatus is drawn below



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- (a) Write the name of each item of apparatus above. (4 marks)
- (b) In chemical write ups we draw *diagrams* instead of 3-dimensional drawings. Which of the above is a correct diagram? \_\_\_\_\_ (1 mark)

2. (a) The statements below refer to processes involving water and 'water of crystallisation'.
- (i) If a hydrated substance is heated so that the water of crystallisation is driven off, the remaining solid is said to be \_\_\_\_\_.
- (ii) Substances that lose all, or part, of their water of crystallisation, simply on exposure to air and are said to be \_\_\_\_\_.
- (iii) Substances that absorb water when exposed to air and form a solution, are said to be \_\_\_\_\_.
- (iv) Substances that absorb water on exposure to air but do not dissolve in it are said to be \_\_\_\_\_ (4 marks)
- (b) (i) A student is provided with aqueous copper sulfate.  
In this mixture, the dissolved copper sulfate is called the \_\_\_\_\_,  
while water is said to be the \_\_\_\_\_.
- (ii) The method of separation to obtain water from copper sulfate solution is called \_\_\_\_\_.
- The method to obtain hydrated copper sulfate from the solution is called \_\_\_\_\_ (4 marks)

3. This question is about elements (metals and non-metals)

(a) **Two** of the following statements about elements are **false**.

Put a cross ✗ next to these two false statements.

- (i) elements can be split up into simpler substances by chemical methods
- (ii) elements contain only one type of atom
- (iii) there are only about 92 naturally occurring elements
- (iv) most elements are liquids or gases at room temperature

(2 marks)

(b) Give two physical properties shown by most metals.

\_\_\_\_\_

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

(c) (i) Some metals, such as sodium, react with water as shown by the following incomplete equation.  $\text{Na} + \text{H}_2\text{O} \rightarrow \text{NaOH} + \text{_____}$

Write the name of the missing product, then balance the equation. (2 marks)

(ii) Give the test you would carry out to show that the water had turned alkaline and the result you would obtain .

test \_\_\_\_\_

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

(d) Hydrogen is a non-metal. It can react with other non-metals such as chlorine.

(i) Give one property of hydrogen that shows it is a non-metal.

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

(ii) Complete and balance the equation for the reaction of hydrogen with chlorine.

$\text{H}_2 + \text{Cl}_2 \rightarrow \text{_____}$  (1 mark)

4. Consider the changes listed below.

A. Burning a fuel    B. Melting a solid    C. Condensing a vapour

(a) (i) From the above, choose **one** change which involves a change of state. \_\_\_\_\_

(ii) How could you prove that this is only a physical change.

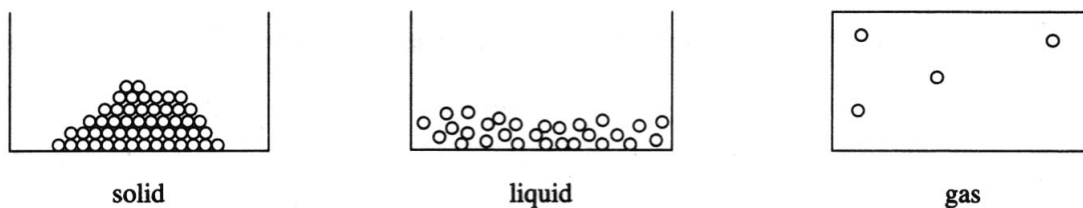
\_\_\_\_\_ (2 marks)

(b) (i) Which **one** of the changes involves a chemical reaction? \_\_\_\_\_

(ii) Give a reason for your choice. \_\_\_\_\_

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

5. (a) According to the particle theory of matter, the particles in solids, liquids and gases are arranged as shown below.



Use the theory to give a reason why:-

- (i) you can smell dinner being cooked a long way from the kitchen.

\_\_\_\_\_

\_\_\_\_\_

- (ii) you can obtain well shaped crystals of many salts.

\_\_\_\_\_

\_\_\_\_\_

- (iii) you can add some salt to a glass full of water and it does not overflow.

\_\_\_\_\_

\_\_\_\_\_

(3 marks)

- (b) The smallest particles that can exist on their own are atoms. The table below gives some information about atoms of some elements.

Complete the table below by putting in the missing numbers.

Element Symbol	Mass Number	Number of protons	Number of neutrons	Electron configuration
Li	7	3		2.1
F		9	10	2.7
Al	27		14	

(4 marks)

- (c) Lithium has two different atoms  ${}^6\text{Li}$  and  ${}^7\text{Li}$ .

Complete the following statements that describe these atoms.

- (i) These different atoms are called \_\_\_\_\_
- (ii) These atoms have different number of \_\_\_\_\_
- (iii) The relative atomic mass of lithium is 6.9.

This shows that the most abundant atoms have a mass of \_\_\_\_\_ (3 marks)

- (d) Write the formula for:
- (i) lithium fluoride \_\_\_\_\_
  - (ii) aluminium oxide \_\_\_\_\_ (2 marks)
- (e) Which element would form **ions** with a charge of 3+ \_\_\_\_\_ (1 mark)

6. (a) Complete the following statements about the atmosphere.

- (i) The main gas in air is \_\_\_\_\_
- (ii) Oxygen forms about \_\_\_\_\_% by volume of the gases of the atmosphere.  
About 1% of the atmosphere is made up of \_\_\_\_\_ gases.
- (iii) There is a very small percentage of carbon dioxide in air. However the percentage of this gas is increased due to the combustion of \_\_\_\_\_. An excess of carbon dioxide in air is the cause of \_\_\_\_\_. (5 marks)

(b) Gases from the atmosphere, both those that are present naturally and others that are pollutants, can dissolve in water.

- (i) It is found that the percentage of oxygen compared to nitrogen dissolved in water is higher than in ordinary air. Suggest a reason for this. \_\_\_\_\_ (1 mark)

(ii) Carbon dioxide dissolves in water to form carbonic acid.

This in turn reacts with limestone ( $\text{CaCO}_3$ ) to give temporary hardness of water.

Complete the equation for this reaction.



Why is it called 'temporary' hardness?

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

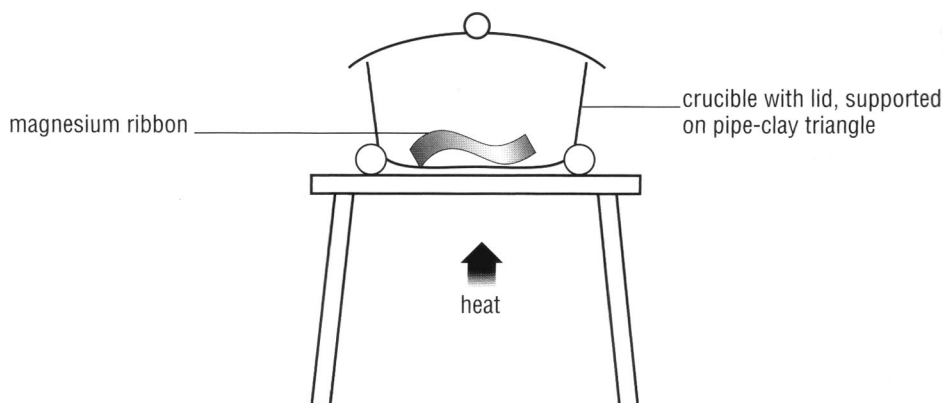
(iii) Name a gaseous pollutant (other than excess  $\text{CO}_2$ ) that causes acid rain.

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

Mention one harmful effect of acid rain.

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

7. A group of students were asked to plan an experiment to confirm the formula of magnesium oxide. The students used the apparatus shown below.



The following passage describes the experimental procedure.

1. A piece of magnesium ribbon was cleaned using emery paper.
2. The crucible and lid were weighed empty (mass M.1) then weighed again with the piece of magnesium in it (mass M.2).
3. The crucible was then heated. Every now and again, the crucible lid was lifted slightly until all the magnesium appeared to react.
4. Heating was continued for some time without the lid. When heating was stopped, the crucible was allowed to cool and weighed.
5. The crucible and contents were reheated, cooled and reweighed several times until two readings were the same. (mass M.3).

Results:

Reading		Mass
M.1	crucible and lid	23.1g
M.2	crucible, lid and magnesium	24.3g
M.3	crucible, lid and magnesium oxide	25.1g

- (a) (i) What would be SEEN as the magnesium reacts?  
\_\_\_\_\_.
- (ii) What would be the appearance of the residue after the reaction?  
\_\_\_\_\_. (2 marks)
- (b) Suggest a reason why the lid was only lifted *slightly* during the heating of magnesium.  
\_\_\_\_\_. (1 mark)

- (c) (i) What was the purpose of step 5? \_\_\_\_\_  
 \_\_\_\_\_.
- (ii) What is this practical step called?  
 \_\_\_\_\_ (2 marks)
- (d) Use the results to calculate:
- (i) the mass of magnesium that reacted \_\_\_\_\_g
- (ii) the mass of oxygen that combined with magnesium \_\_\_\_\_g (2 marks)
- (e) (i) Convert the masses of magnesium and oxygen into **moles of atoms**.
- |    |  |   |
|----|--|---|
| Mg |  | O |
|    |  |   |
- (2 marks)
- (ii) Convert the answers of (e) (i) into a whole number ratio. This confirms that the formula of magnesium oxide is \_\_\_\_\_ . (1 mark)

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

8. This question is about reactions of iron with oxygen and water.
- (a) If iron reacts with both oxygen and water together, it rusts.
- (i) You are provided with three boiling tubes, iron nails and any other materials that you need. Draw diagrams to show how you would set up an experiment to show that iron does not rust in dry air only, or in water only, but rusts if water and air are present together. State clearly how the air is dried and how air is expelled from water. (9 marks)
- (ii) Write the chemical name and formula of rust. (2 marks)
- (iii) Give **two** reasons why rusting is similar to combustion of a metal. (2 marks)
- (iv) Give **three** ways in which iron can be prevented from rusting (3 marks)
- (b) When red hot iron is reacted with oxygen only, it forms tri-iron tetra-oxide ( $\text{Fe}_3\text{O}_4$ ).  
 When iron reacts with steam only it forms tri-iron tetra-oxide and hydrogen.  
 Give balanced equations for these two reactions. (4 marks)

9. This question is about types of bonding and related properties.
- (a) The elements magnesium,  ${}_{12}\text{Mg}$ , and oxygen,  ${}_{8}\text{O}$ , combine to form an electrovalent (ionic) compound.
- Give the electron configurations for atoms of magnesium and oxygen.
  - Draw dot/cross diagrams, showing ALL electron shells, to show the structure and charge for the magnesium and oxide ions.
  - Give the name of another ionic compound.
  - Give three properties of ionic compounds.

(10 marks)

- (b) The elements nitrogen,  ${}_{7}\text{N}$ , and hydrogen,  ${}_{1}\text{H}$ , combine to form a covalent compound.
- Give the name and formula of the compound formed.
  - State the number of electrons that nitrogen and hydrogen need to share to become stable.
  - Draw a diagram, showing OUTER shell electrons only, to show the bonding in a molecule of the compound.
  - Give the name of another covalent compound.
  - Give two properties that are expected of covalent compounds.

(10 marks)

10. This question is about two methods of preparing salts. In your answers you should include the experimental steps, an observation and an equation for the reactions.

- (a) (i) Describe the method of titration to prepare soluble sodium chloride by neutralisation of sodium hydroxide with dilute hydrochloric acid.
- (ii) Give a brief description of the procedure to obtain pure, dry crystals of sodium chloride from the sodium chloride solution.

(12 marks)

- (b) Describe the method of precipitation to prepare a pure, dry sample of insoluble barium sulfate from solutions of barium nitrate and sodium sulfate. (8 marks)

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END OF PAPER