

JUNIOR LYCEUM ANNUAL EXAMINATIONS 2004

Educational Assessment Unit – Education Division

FORM 3

CHEMISTRY

TIME: 1hr 30 mins

Name: _____

Class: _____

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

Relative atomic masses: C = 12 , H = 1 , O = 16 , Si = 28 , Na = 23

Avogadro constant (L) = 6.02×10^{23}

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

1. Silicon is a non-metal but some of its properties resemble those of a metal. This table describes the properties of silicon.

Silicon	Property
appearance	shiny grey solid
strength	hard but brittle
melting point	high (1410°C)
electrical conductivity	low (conducts slightly)
type of oxide	acidic

- a) (i) Give two pieces of evidence, from the table, for silicon being a non-metal.

(2 marks)

- (ii) Give two properties, from the table, which we would normally expect of a metal.

(2 marks)

- b) Silicon, symbol Si, has an atomic number of 14.

(i) What would you expect the valency of silicon to be? _____

(ii) Write the formula for silicon chloride. _____

(iii) What type of bonding would be present in this compound? _____

(3 marks)

- c) Calculate (i) the number of moles of atoms present in 14g of silicon.

(2 marks)

(ii) the number of atoms in 14g of silicon.

(1 mark)

2. a) The statements below describe different types of solid/solid mixtures.
- type A.** one solid is soluble in water / the other solid is insoluble
type B one solid is stable to heat / the other solid sublimes.
type C a solid / solid mixture of two metals
type D a mixture of solids that have a different rate of solubility in a solvent.

Give the **letter** for the statement that describes each of the following mixtures.

- (i) sodium chloride and ammonium chloride _____
- (ii) the pigments in green leaves _____
- (iii) bronze (an alloy) _____
- (iv) calcium nitrate and calcium carbonate _____ (4 marks)
- b) (i) Name the **three** steps or techniques that are needed to separate a solid / solid mixture of type A. _____
 _____ (3 marks)
- (ii) Name the technique that would be used to separate the substances in a mixture of type D. _____ (1 mark)
- c) Iodine is another solid that sublimes. In a simple experiment, some iodine crystals are heated in a long test-tube.
 Describe what you would **SEE** that proves that iodine sublimes.

 _____ (2 marks)

3. a) Dilute acids and alkalis react with other substances according to a general pattern.

Some examples of these reactions are:

- A.** an acid on a metal
B. an acid on a sulphite
C. an alkali on an ammonium salt
D. an alkali on an amphoteric metal

Select, from A to D

- (i) the two types of reaction that would liberate hydrogen gas _____
- (ii) the reaction that would liberate sulphur dioxide _____
- (iii) the reaction that would liberate ammonia gas _____ (4 marks)
- b) Complete and balance the following equations
- (i) $\text{CuO} + \text{HNO}_3 \rightarrow$ _____ $+ \text{H}_2\text{O}$
- (ii) $\text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow$ _____ $+ \text{H}_2\text{O} +$ _____
- (iii) $\text{KOH} + \text{H}_2\text{SO}_4 \rightarrow$ _____ $+ 2\text{H}_2\text{O}$ (6 marks)

4. a) Consider the following particles denoted by V, W, X, Y and Z.
Study the information given in the table and use it to answer the questions below.

particle	number of protons	electron configuration
V	11	2.8.1
W	16	2.8.8
X	17	2.8.7
Y	18	2.8.8
Z	20	2.8.8

Select, from V to Z, the particle which is:

- (i) a metal atom _____
- (ii) a non-metal atom _____
- (iii) a noble gas atom _____
- (iv) a positive ion (cation) _____
- (v) a negative ion (anion) _____ (5 marks)

- b) What is the relationship between the valency of a metal and its electron configuration?
_____ (1 marks)

- c) (i) Give the name of the following compounds:
KNO₂ _____
NO₂ _____ (2 marks)

- (ii) Give formulae for the following compounds:
iron (II) sulphide _____
silver bromide _____ (2 marks)

5. a) Calcium hydrogencarbonate, $\text{Ca}(\text{HCO}_3)_2$, is present in water in limestone areas such as Malta. Calcium hydrogencarbonate is formed by the action of rain water (**water** and **carbon dioxide**) on limestone (**calcium carbonate**) and makes water hard.

(i) Give an equation to show the formation of calcium hydrogencarbonate by the action of rain water on limestone.

_____ (2 marks)

(ii) What type of hardness does calcium hydrogencarbonate cause?

_____ (1 mark)

(iii) Give one way by which this type of hardness can be removed.

_____ (1 mark)

b) A hard water does not lather with soap.

(i) Describe another effect or disadvantage which is due to calcium hydrogencarbonate dissolved in water.

_____ (2 marks)

(ii) Give one advantage of hard water.

_____ (1 mark)

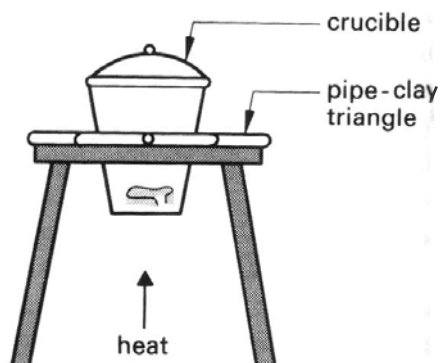
c) (i) Calculate the relative formula mass of sodium hydrogencarbonate, NaHCO_3 .

(1 mark)

(ii) Calculate the percentage by mass of **sodium** in the compound sodium hydrogencarbonate.

(2 marks)

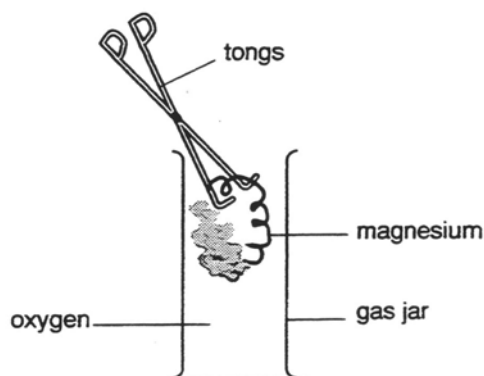
6. An experiment was carried out to investigate the heating of magnesium.
- a) In the first part of the experiment, a piece of magnesium ribbon was covered with sand in a crucible as shown in the diagram and the crucible was heated to redness. On cooling magnesium was found to be unchanged.



(i) Suggest why the magnesium was covered with sand.
 _____ (1 mark)

(ii) What does this experiment prove? _____
 _____ (1 mark)

- b) In the second part of the experiment, a piece of magnesium ribbon was heated in oxygen as shown in the diagram. The magnesium burned with a brilliant white flame and formed white ashes.



(i) Give two reasons why this is a chemical change _____
 _____ (2 marks)

(ii) State whether the white ashes would weigh more or less than the original piece of magnesium. Give a reason for your answer. _____
 _____ (2 marks)

(iii) Give a balanced equation for the burning of magnesium.
 _____ (2 marks)

c) Give two similarities between the burning of a metal and the rusting of iron.
 _____ (2 marks)

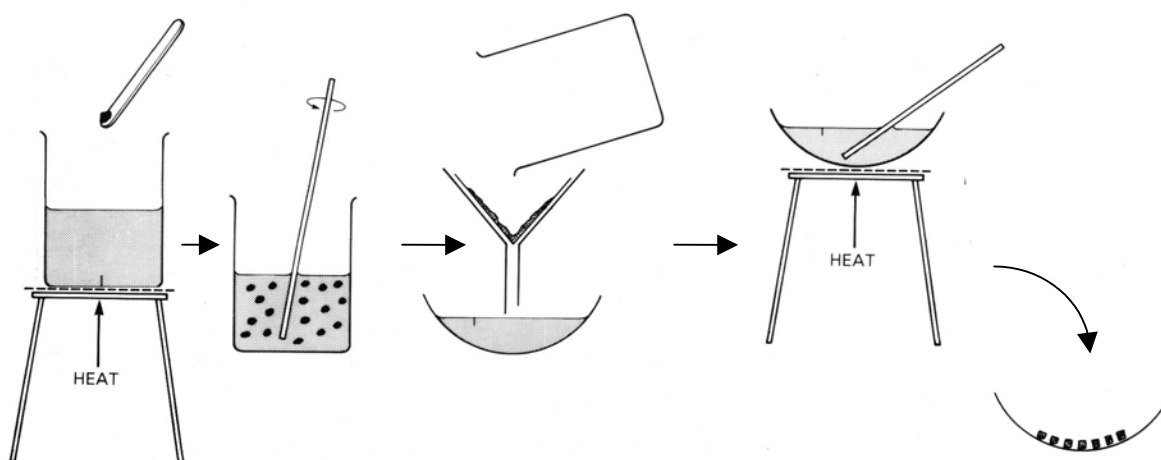
Section B: Answer any TWO questions from this section on the separate sheets provided. Each question carries 20 marks.

7. Air is a mixture of gases – nitrogen, oxygen and argon, which have many uses, together with carbon dioxide and water vapour.
- a) Describe simple experiments, ONE in EACH case, that could be carried out in the laboratory to show the presence of carbon dioxide and water vapour in air. (10 marks)
- b) Describe the principles of the industrial method for obtaining nitrogen, oxygen and argon by fractional distillation of liquid air. (Technical details or diagrams are not required.) (7 marks)
- c) Give one use for each of the gases nitrogen, oxygen and argon. (3 marks)
8. The following is a list of symbols to be used in your answers to the questions below.



- a) Sodium fluoride is an electrovalent (ionic) compound.
- (i) Give the electron configuration for the atoms of sodium and fluorine. (2 marks)
- (ii) Write the formula for sodium fluoride. (1 mark)
- (iii) Draw dot/cross diagrams, showing ALL electron shells, to show the structure and charge for the sodium ion and fluoride ion. (4 marks)
- (iv) Give two properties you would expect the ionic compound sodium fluoride to have. (2 marks)
- b) Methane, CH₄, is a covalent compound.
- (i) Give the electron configuration for an atom of carbon. (1 mark)
- (ii) State the number of electrons that the atoms of carbon and hydrogen need to share. (2 marks)
- (iii) Draw a dot/cross diagram, showing OUTER electron shells only, to show the bonding in a molecule of methane. (2 marks)
- (iv) Give two properties that you would expect the covalent compound methane to have. (2 marks)
- c) Carbon has two other atoms, ${}_{6}^{13}\text{C}$ and ${}_{6}^{14}\text{C}$.
- (i) State what these atoms are called. (1 mark)
- (ii) Explain the difference between the three atoms of carbon. (3 marks)

9. The flow chart given below shows the steps involved in preparing crystals of zinc chloride by reacting zinc metal with dilute hydrochloric acid.



- a) Describe, in detail, the practical steps shown in the diagram.
Emphasise what is done to ensure that:
- all the acid is used up, and
 - that pure, dry crystals are obtained.
- Your description should also include names of apparatus used and observations that would be made in each step. (12 marks)
- b) (i) Hydrogen gas is usually prepared by the reaction of zinc metal with dilute hydrochloric acid. Give an equation for this reaction and describe a test for the gas including the result. (4 marks)
- (ii) Hydrogen is also produced when metals react with water or steam.
Write balanced equations for the reaction of sodium with water, and for the reaction of zinc with steam. (4 marks)

END