

JUNIOR LYCEUM ANNUAL EXAMINATIONS 2005

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: H = 1, Mg = 24, O = 16, S = 32

PERIODIC TABLE

1	2											3	4	5	6	7	0	
																		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	

Key

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

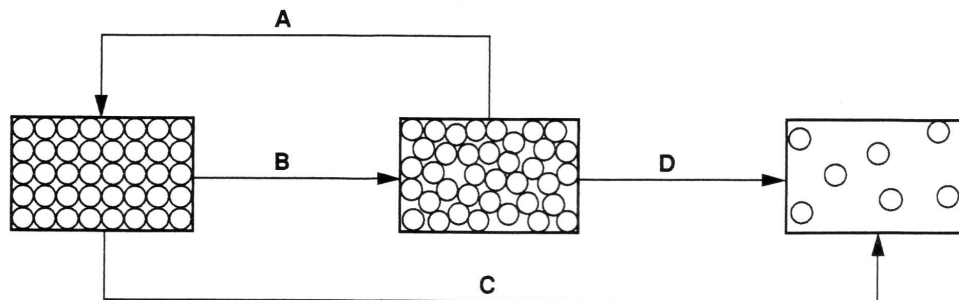
Marks Grid [For Examiners use only]

Question N ^o .	Section A						Section B			
	1	2	3	4	5	6	7	8	9	
Max Mark	10	10	5	10	10	15	20	20	20	
Actual Mark										Theory Total

85% of Theory Paper	15% Practical	100% Final Score

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

1. The diagram below represents the arrangement of particles in solids, liquids and gases.



- a) What changes are represented by
- i) arrow A _____
 - ii) arrow B _____
 - iii) arrow C _____
 - iv) arrow D _____
- b) Name a substance which will undergo change C. _____

(5 marks)

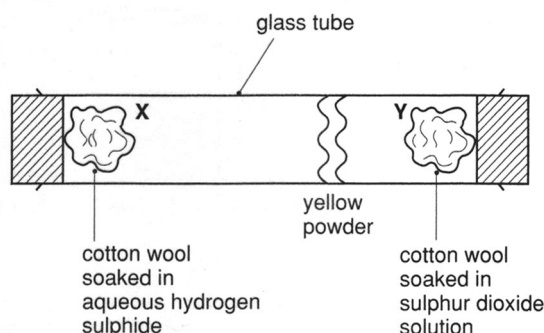
This part of the question is about experiments involving the **movement** of particles.

c) Some smoke is inserted in a smoke cell. Light is shone through it and observed under a microscope. The bits of smoke are lit up so bright specs are seen moving about randomly.

- i) What is the name given to this process? _____
- ii) Use the idea of particles to explain what causes the random movement of the bits of smoke. _____

(3 marks)

d) The apparatus was set up as shown below:



At X hydrogen sulphide gas is released. At Y sulphur dioxide gas is released.
 The yellow powder formed where the two gases met.

- i) What term is used to describe the movement of gas particles? _____
- ii) Which gas particles travelled fastest? _____ (2 marks)

2. Oxygen can be obtained in the laboratory by the decomposition of hydrogen peroxide in the presence of a catalyst and in industry from liquid air.

a) (i) Write a balanced equation for the decomposition of hydrogen peroxide.

_____ (2 marks)

(ii) Name a suitable catalyst _____ (1 mark)

b) Name the process by which oxygen is obtained from liquid air.

_____ (1 mark)

c) Oxygen and ozone are different forms of the same element.

(i) What term is used to describe these two forms of the element?

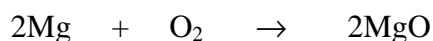
_____ (1 mark)

(ii) Complete the following table which compares the properties of oxygen and ozone.

	Oxygen	Ozone
formula	O ₂	
Toxic (yes/no)		

(2 marks)

d) 6.0g of magnesium burns completely in oxygen according to the following equation.



(i) Calculate the number of **moles** of magnesium in 6.0g of magnesium.

(1 mark)

(ii) How many moles of magnesium oxide would be formed?

(1 mark)

(iii) Calculate the mass of magnesium oxide formed.

(1 mark)

3. a) (i) Classify the liquids in the table below as acidic, alkaline or neutral.

Liquid	Approx. pH	Acidic, alkaline or neutral
caustic soda solution	14	
brine	7	
'spirits of salt' solution	1	

(3 marks)

- (ii) What would you expect the approximate pH of vinegar to be? _____ (1 mark)

- b) Name the type of reaction that takes place if caustic soda solution is reacted with 'spirits of salt' solution. _____ (1 mark)

4. a) Draw a diagram of the atomic structure of an atom of beryllium, symbol Be. Label **clearly** the **number** of protons, neutrons and electrons.

(3 marks)

- b) On your diagram, **name** and **label** the part of the atom which contains the protons, neutrons and electrons. (2 marks)

- c) (i) Beryllium sulphide, BeS, is an electrovalent (ionic) compound. Draw a dot/cross diagram showing ALL electrons, to show the electron arrangement and charge for the beryllium ion and the sulphide ion.

(4 marks)

- (ii) Give one property of electrovalent compounds.

_____ (1 mark)

5. a) Water is a covalent compound. Draw a dot/cross diagram, showing only the OUTER shell electrons, to show the bonding in a molecule of water, H₂O.

(2 marks)

- b) We can predict if a salt is soluble or insoluble by using the solubility rule. Consider the salts given in column A below.

In column B state whether the salt is soluble or insoluble. In column C write the term that describes the type of solid/liquid mixture formed. The first salt has been given as an example.

A	B	C
Salt	soluble / insoluble	solution / suspension
sodium carbonate	soluble	solution
Lead sulphate		
Potassium nitrate		

(4 marks)

- c) (i) What would you do to show that a sample of water contains **dissolved** solid impurities? _____

_____ (1 mark)

- (ii) Describe a **chemical** test to show the **presence** of water in a solid/liquid mixture.

_____ (2 marks)

- (iii) How would you check if a liquid is **pure** water?

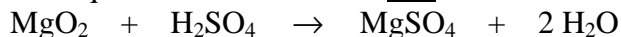
_____ (1 mark)

6. Magnesium sulphate was discovered in water at Epsom, England and due to this it is known as 'Epsom salt'. The chemical formula for crystals of the salt is $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$. A solution of the salt can be prepared in the laboratory by reacting dilute sulphuric acid with 1. magnesium metal, **or** 2. magnesium oxide, **or** 3. magnesium carbonate.

a) (i) Complete the following word equation:

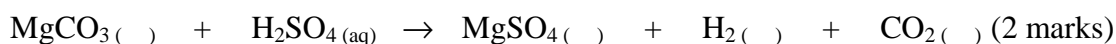
magnesium + sulphuric acid \rightarrow magnesium sulphate + _____ (1 mark)

(ii) The equation below contains two mistakes. Rewrite the equation correctly.



_____ (2 marks)

(iii) Fill in the missing state symbols for the following equation.



b) To prepare some magnesium sulphate solution, some solid magnesium carbonate is added to the sulphuric acid. This is done a spatula measure at a time. The mixture is stirred after each addition until the magnesium carbonate is in excess.

(i) Suggest why the magnesium carbonate is not added *all at once*.

_____ (1 mark)

(ii) Why is magnesium carbonate added *in excess*?

_____ (1 mark)

(iii) How is the excess magnesium carbonate removed from the remaining mixture?

_____ (1 mark)

c) **Hydrated** crystals of Epsom salt are obtained from magnesium sulphate solution by crystallisation. If the solution is heated to dryness, *crystals* of Epsom salt are not obtained. Give a reason for this.

_____ (1 mark)

d) Epsom salt and other salts are used in our everyday lives. **Either**, give a use for Epsom salt **or**, for another salt of your own choice.

_____ (1 mark)

e) Use the steps below to calculate the percentage composition by mass of water of crystallisation in hydrated magnesium sulphate.

(i) The formula mass of $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ is:

(2 marks)

(ii) The formula mass of $7\text{H}_2\text{O}$ is:

(1 mark)

(iii) The percentage by mass of water of crystallisation is:

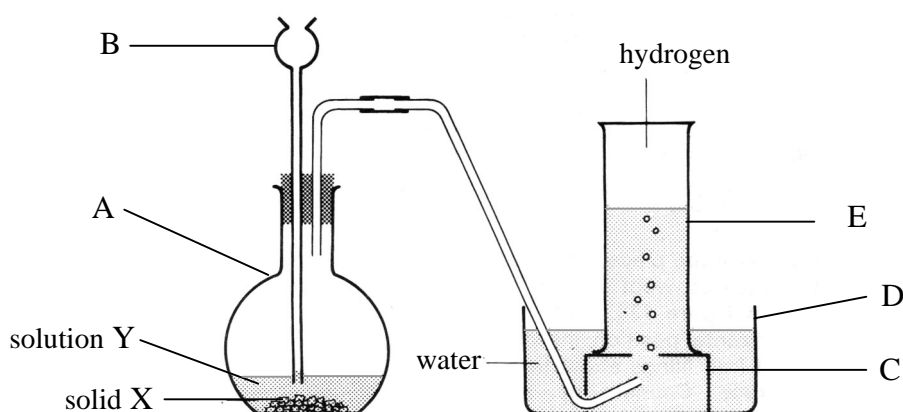
(2 marks)

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

7. This question is about types of oxide and their properties.

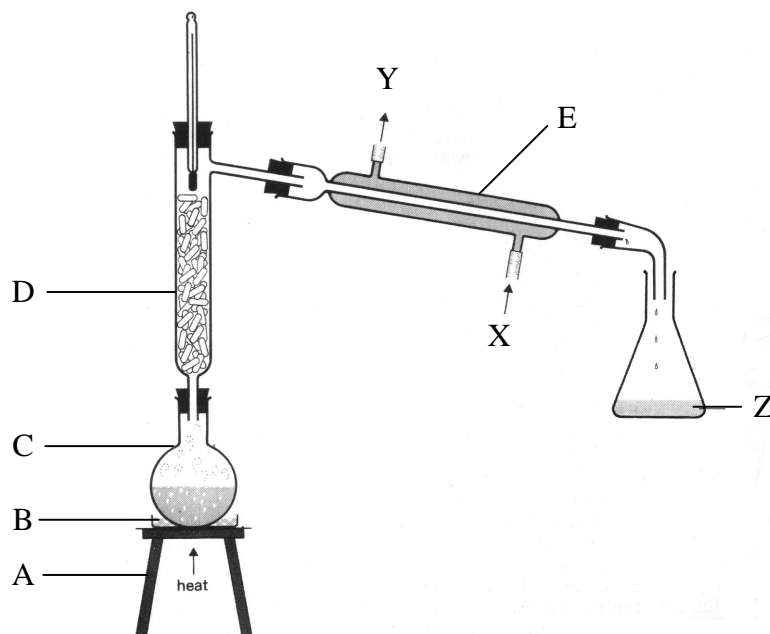
- Give formulae for the following oxides:
(i) aluminium oxide (ii) silicon oxide (iii) zinc oxide (iv) nitrogen monoxide (4 marks)
- Explain why
(i) aluminium oxide is said to be 'amphoteric',
(ii) zinc oxide is said to be 'basic'. (4 marks)
- What type of oxide are (i) silicon oxide, (ii) nitrogen monoxide? (2 marks)
- State what colour the pH indicator would turn and give balanced equations for the reactions of (i) calcium oxide and (ii) carbon dioxide with water containing pH indicator. (6 marks)
- Many oxides are air pollutants e.g. carbon monoxide, carbon dioxide, sulphur dioxide and nitrogen dioxide.
Select one of these oxides then state:
(i) what activity produces this oxide (its source),
(ii) its effect or hazard, and
(iii) how to prevent or reduce its formation. (4 marks)

8. The diagram below shows the laboratory preparation of hydrogen gas.



- Give the names of the apparatus labelled A to E. (5 marks)
- Name the reagents, solid X and solution Y, and give an equation for the reaction between them. (4 marks)
- Why can hydrogen be collected over water? (1 mark)
- If hydrogen is required dry it must be passed through a solid or liquid drying agent then collected in a gas jar.
 - Draw a diagram to show ONE method for drying hydrogen and how it is collected in the gas jar. Name the apparatus used for drying the gas and name the drying agent. (5 marks)
 - State the name given to this method of collecting a gas and give a reason why hydrogen can be collected in this manner. (2 marks)
- During the test for hydrogen, the gas reacts with oxygen.
Describe what happens during the test for hydrogen and give an equation for the reaction. (3 marks)

9. A sample of 95% ethanol can be obtained from a mixture of ethanol and water using the apparatus shown below. (The stands and clamps are not shown.)



- a) Name the items of apparatus labelled A to E. (5 marks)
- b) Among the instructions for setting up and carrying out the experiment were the following:
- (i) the apparatus labelled B must be used to heat the apparatus C containing the mixture.
 - (ii) Some pieces of porcelain should be added to the mixture before heating.
 - (iii) The bulb of the thermometer should be placed as shown in the diagram, not in the mixture.
 - (iv) The cold flow of water must enter apparatus E from the bottom at X and leave at Y.
 - (v) It is preferable to use a conical flask to collect the ethanol at Z.
- Give a reason why each of these practical steps are important. (5 marks)
- c) (i) Draw and label a diagram of the set up for chromatography.
(ii) Describe how you would use paper chromatography to show that black ink contains more than one colour. (10 marks)

END OF PAPER