

JUNIOR LYCEUM ANNUAL EXAMINATIONS 2008
 DIRECTORATE FOR QUALITY AND STANDARDS IN EDUCATION
 Educational Assessment Unit

FORM IV

CHEMISTRY

TIME: 1h 30min

Name: _____

Class: _____

Useful Data: A copy of the Periodic Table is printed below.
 Relative atomic mass may be taken as: Pb = 207, N = 14, O = 16
 One mole of any gas occupies 22.4 dm³ at standard temperature and pressure

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

$\frac{a}{X}$	relative atomic mass
$\frac{b}{X}$	symbol
$\frac{b}{X}$	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	10	10	15	5	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. Rubidium is in Group 1 of the Periodic Table below potassium. Use your knowledge of the similarity and trend in reactivity of the Group 1 metals to answer the following questions about Rubidium and its compounds.
- a) Write the formula for (i) the rubidium ion _____
(ii) rubidium sulfate _____ (2 marks)
- b) Predict **one physical** property you would expect rubidium to show, that is particular to Group 1 metals.
_____ (1 mark)
- c) Which process would be necessary to extract rubidium from molten rubidium chloride?
_____ (1 mark)
- d) (i) Would you expect rubidium to be more, or less, reactive than potassium?

- (ii) State **one** thing you would expect to **see** when rubidium is added to water in a trough.

- (iii) Give a balanced equation for the reaction of rubidium with water.
_____ (4 marks)
- e) Predict if rubidium chloride would:
(i) be soluble or insoluble in water _____
(ii) have a low or high melting point _____ (2 marks)
2. a) In each of the following statements, identify the metal from its description.
- (i) Objects made of iron are protected from corrosion by coating them with this metal in a process called galvanising. _____
- (ii) This metal is found uncombined in nature and is used in jewellery and in electrical contacts. _____
- (iii) This metal forms an alloy with tin (called bronze) and an alloy with zinc (called brass). _____
- (iv) Limestone is composed of a compound of this metal. _____
- (v) This metal burns with a bright white flame, so it is used in flares and in pyrotechnics. _____ (5 marks)

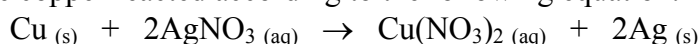
- b) Iron is a transition metal. Give **three** properties of iron, or its compounds, which are typical of transition metals.

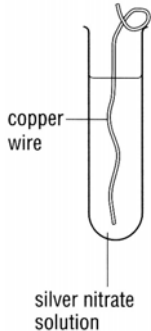
_____ (3 marks)

- c) Give **two** reasons why it makes sense to recycle aluminium.

_____ (2 marks)

3. a) A student placed a piece of copper wire in a solution of silver nitrate as shown below. The copper reacted according to the following equation.



Experiment	Observations
	

- (i) In the table above, write **two** observations that the student would have recorded in the 'Observations' column. (2 marks)

- (ii) What **term** is used to describe this type of reaction?

_____ (1 mark)

- b) This reaction is also a redox process.

- (i) Write the **ionic** equation, omitting the spectator ion(s), for this reaction.

_____ (2 marks)

- (ii) State what is oxidised and what is reduced **in terms of electrons**.

_____ is/are oxidised by _____

_____ is/are reduced by _____

(2 marks)

- c) (i) Two similar experiments were set up by other students. Mark with a ✓ to show when a reaction occurred and with an × to show no reaction.

copper wire was put in magnesium nitrate solution.	
zinc wire was put in lead nitrate solution.	

- (ii) From the results of these experiments, write the order of reactivity of the three metals, copper, magnesium and zinc, starting with the **most** reactive.

_____ (3 marks)

4. This question refers to some reactions involving nitrogen and its compounds.

a) At very high temperatures, nitrogen and oxygen will react with each other to form nitrogen monoxide.

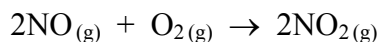
(i) Write an equation for this reaction.

_____ (2 marks)

(ii) Give **one** example where this reaction would occur in everyday life.

_____ (1 mark)

b) The following equation shows what happens when nitrogen monoxide comes into contact with air.



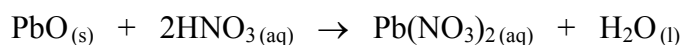
(i) What would be seen as soon as nitrogen monoxide comes in contact with air?

_____ (1 mark)

(ii) What volume of oxygen would be required to react with 2.5 dm^3 of nitrogen monoxide? (Assume that all conditions of temperature and pressure remain constant.)

(1 mark)

c) Dilute nitric acid reacts with lead (II) oxide according to the following equation.



An excess of lead (II) oxide is added to 200 cm^3 of dilute nitric acid of concentration 0.5 mol dm^{-3} (0.5M). The resulting mixture was filtered and lead (II) nitrate crystals were obtained from the filtrate by crystallisation.

(i) Calculate the number of moles of nitric acid used in this reaction.

(ii) Calculate the formula mass of lead (II) nitrate.

(iii) Calculate the maximum mass of lead (II) nitrate crystals that could be obtained by crystallisation of the filtrate.

(5 marks)

5. This question is about sulfur and its compounds.

a) Fill in the blanks to complete these statements that describe the chemistry of sulfur.

(i) At room temperature, the physical state of sulfur is _____ and its colour is _____.

(ii) Two important allotropes of sulfur are _____ and _____ sulfur.

(iii) When sulfur is burned in air, it forms sulfur dioxide gas that has a _____ smell. (5 marks)

b) Sulfur dioxide is converted to sulfur trioxide in the second stage of the Contact process.

(i) Write a balanced equation for this conversion. _____ (2 marks)

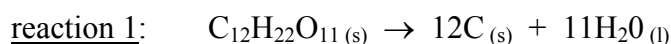
(ii) State the approximate temperature and the name or formula of the catalyst used in this conversion. _____ (2 marks)

c) Sulfuric acid shows different properties as a dilute acid and when in concentrated form.

i) Either describe one reaction, or write a balanced equation, which shows a typical property of sulfuric acid as a **dilute** acid.

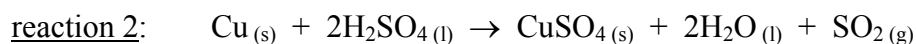
_____ (2 marks)

ii) The equations shown below represent two of the properties that are typical of **concentrated** sulfuric acid. For each reaction, describe **one** thing that would be **seen** and state the property exhibited by concentrated sulfuric acid.



observation: _____

In this reaction concentrated sulfuric acid acts as



observation: _____

In this reaction concentrated sulfuric acid acts as

(4 marks)

6. The statements below refer to the following substances:

Calcium hydroxide, copper(II) carbonate, potassium nitrate, anhydrous sodium carbonate, iodine

- a) Choose, from this list, **one** substance in each case which, **when heated**, behaves as described below.
- (i) liberates a gas which relights a glowing splint _____
 - (ii) changes from green to black _____
 - (iii) gives off misty fumes _____
 - (iv) sublimes to a violet vapour _____ (4 marks)
- b) Which substance from the above list is thermally stable?
_____ (1 mark)

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

7. This question refers to the electrolysis of copper(II) sulfate solution.

- a) (i) Draw a labelled diagram of the apparatus and circuit that you would use to carry out the electrolysis of an aqueous solution of copper(II) sulfate using carbon (inert) electrodes. (5 marks)
- (ii) Describe what would be **seen** at each electrode and give equations for the reaction at each electrode. (6 marks)
- (iii) Describe and explain the change in colour and pH of the solution. (4 marks)
- b) If copper electrodes are used instead of carbon, there is a different result at the anode, and in the appearance of the solution.
- (i) State what happens at the anode and give an equation for the electrode reaction. (3 marks)
 - (ii) Describe and explain the appearance of the solution after electrolysis. (2 marks)

8. A sample of dry hydrogen chloride gas can be prepared in the laboratory by adding concentrated sulfuric acid to solid sodium chloride.

- a) (i) Draw a clear diagram of the apparatus that would be a suitable method for carrying out the reaction, for drying the gas and the correct method of delivery into a gas jar.
Label **all items of apparatus** and the **name of the drying agent**. (6 marks)
- (ii) State what would be **seen** when the reagents are mixed. (2 marks)
- (iii) Write a balanced equation for the reaction. (2 marks)
- b) (i) Describe a chemical test for the gas. (2 marks)
- (ii) Give a balanced equation for the reaction occurring during this test. (2 marks)
- c) Explain why hydrogen chloride dissolved in methyl benzene has no effect on litmus while hydrogen chloride dissolved in water is acidic. (2 marks)
- d) **Either** describe **or** give a balanced equation for (i) **one** chemical reaction involving **dilute** hydrochloric acid, and (ii) **one** chemical involving **concentrated** hydrochloric acid. (4 marks)

9. The following qualitative tests were performed on unknown simple salts A, B, C and D. Read the descriptions of the results of these tests, then answer the questions below.

Salt A

When a flame test was performed on A, a lilac flame was observed. To an aqueous solution of A, acidified silver nitrate solution was added and a yellow precipitate U was formed.

Salt B

To an aqueous solution of B, sodium hydroxide solution was added dropwise until in excess. A slight white precipitate V was formed which did not dissolve in excess sodium hydroxide. A flame test was performed on solid B and a brick red flame was produced. Another sample of B was warmed with sodium hydroxide solution and aluminium turnings. The gas W was liberated, which turned damp red litmus blue.

Salt C

To an aqueous solution of C, sodium hydroxide solution was added dropwise until in excess. A white precipitate X was formed which did not dissolve in excess sodium hydroxide. When a flame test was performed on C, no colour was imparted to the flame. To an aqueous solution of C, acidified silver nitrate solution was added and a pale cream precipitate Y was formed.

Salt D

Some sodium hydroxide solution was added to a sample of D and warmed. The pungent gas W was evolved which turned damp red litmus blue. To another sample of D, dilute hydrochloric acid was added, and a colourless gas Z was liberated which turned lime water milky.

- a) Identify the **cation** and **anion** present in the four unknowns, A, B, C and D. (8 marks)
- b) (i) Give the **names** of the precipitates X and Y.
(ii) Give the **names** of the gases W and Z. (4 marks)
- c) Write **full** balanced equations for the reactions of:
(i) A with acidified silver nitrate solution to give precipitate U.
(ii) B with sodium hydroxide solution to give precipitate V. (4 marks)
- d) Write **ionic** equations (omitting spectator ions) for the reactions of:
(i) D with sodium hydroxide solution.
(ii) D and dilute hydrochloric acid. (4 marks)