JUNIOR LYCEUM ANNUAL EXAMINATIONS 2007

Educational Assessment Unit - Education Division

CHEMISTRY

Name:

FORM 4

Useful Data: A copy of the Periodic Table is printed below. Relative atomic masses may be taken as: Al =27, Fe =56 One mole of any gas occupies 22.4 dm³ at standard temperature and pressure

PERIODIC TABLE

1	2											3	4	5	6	7	0
		$\begin{bmatrix} 1\\ \mathbf{H}\\ 1 \end{bmatrix}$											He ⁴ 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	${}^{40}_{18}$
39 K 19	$\overset{40}{\mathop{Ca}\limits_{20}}$	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	$\mathbf{\overset{112}{Cd}}_{48}$	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

а

relative atomic mass symbol

 $\begin{bmatrix} \mathbf{X} \\ b \end{bmatrix}$ symbol atomic number

Marks Grid [For Examiners use only]

			Secti	ion A	S S	Section 1]			
Question Nº.	1	2	3	4	5	6	7	8	9	
Max Mark	10	15	10	10	10	5	20	20	20	
Actual Mark										Theory Total

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

TIME: 1h 30min

Class:

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

1. The diagram shows an outline of the Groups of the Periodic Table.



a) Using <u>only</u> the elements shown above, select the element which <u>best fits</u> the description below:

(i)	the element which has 4 electron shells.	
(ii)	the element which has 5 electrons in the outer shell.	
(iii)	the element which forms ions with a charge of 2+ and reacts only slightly with cold water.	
(iv)	the element whose oxide is amphoteric.	
(v)	the element which does not tend to react.	
(vi)	the metal which is most reactive.	
(vii)	the non-metal which is most reactive.	(7 marks)

- b) Elements in the same Group of the Periodic Table show a similarity in both physical and chemical properties.
 - (i) Give <u>one</u> similarity in <u>physical</u> properties between chlorine and bromine.

____ (1 mark)

(ii) Mention <u>two</u> reactions given by <u>both</u> chlorine and bromine which show that they are chemically similar. (Equations are not required.)

(2 marks)

2. A student was given samples of three metals – copper, zinc and magnesium. The student was asked to investigate the reaction of these metals with dilute hydrochloric acid. The diagram below shows the result for two of the metals. The third metal did not react.



- Write the symbols of the two metals that reacted *underneath each test-tube*. a) (i) (2 marks) (ii) What type of reaction is taking place? (1 mark)(iii) Write an equation for the reaction of one of these metals. (2 marks) (iv) Which metal did not react? (1 mark) Another example of this type of reaction is when iron metal reacts with dilute sulfuric acid. **b**) Name the metal, below which iron would be placed in the activity series. (i) (1 mark)The equation for this reaction is: (ii) $Fe_{(s)} + H_2SO_{4(aq)} \rightarrow FeSO_{4(aq)} + H_{2(g)}$ Write the <u>ionic</u> equation, omitting spectator ion(s), for this reaction. (2 marks) (iii) This is also a redox reaction.
 - Complete these statements to show what is oxidised / reduced, including the reason.
 Fe is ______ by _____

H⁺ ions are _____ by ____

 $\overline{(2 \text{ marks})}$

- c) If 0.7g of iron react with an excess of sulfuric acid:
 - (i) Calculate the volume of hydrogen liberated at standard temperature and pressure.

(2 marks)

(ii) Convert this volume of hydrogen gas at standard temperature (0°C) to the volume it would occupy at a room temperature of 20°C.

(2 marks)

3. The following dilute solutions are available:

FeSO₄, CuCl₂, Na₂SO₃, HCl, Fe(NO₃)₃

Choose, <u>from these solutions only</u>, those which fit the descriptions of tests given below. (N.B. Some of these solutions may be used more than once.)

(a) <u>One</u>, solution which gives a precipitate with silver nitrate solution. Name this precipitate. Formula of solution Name of the precipitate

(2 marks)

- b) (i) <u>Two</u> solutions which give a white precipitate with barium chloride solution. Formula of solutions
 - (ii) Formula of <u>one</u> solution that would be added to these white precipitates in order to distinguish between them ______ (3 marks)
- c) <u>Two</u> solutions that give a coloured precipitate with sodium hydroxide solution. State the colour of each precipitate.

Formula of solution Colour of the precipitate

(4 marks)

d) <u>One</u> solution which gives a bright yellow colour to a Bunsen flame.
 Formula of solution ______ (1 mark)

4. In industry, aluminium is extracted from alumina (purified bauxite) by means of electrolysis. An outline diagram of the cell is shown below.



h) Calculate the number of Faradays required to deposit 1.8kg of aluminium.

- 5. Ammonia and hydrogen chloride are very soluble gases.
- a) Draw a labelled diagram to show how a very soluble gas is dissolved in water.

(4 marks) Which of the above gases dissolves in water to give: **b**) an acidic solution? (i) _____ (ii) an alkaline solution? (2 marks) Ammonia and hydrogen chloride react with each other to form one solid product. c) Write an equation for this reaction. (i) (2 marks) (ii) What happens to this solid when heated? (1 mark)d) Write an ionic equation, omitting spectator ions, for the reaction between aqueous solutions of ammonia and hydrogen chloride. (1 mark)

6. 25cm³ of an aqueous solution of sodium hydroxide is exactly neutralised by 20cm³ of dilute sulfuric acid having a concentration of 0.25M (0.25 mol dm⁻³). The balanced equation for the reaction is:

 $2NaOH_{(aq)} \ + \ H_2SO_{4 \ (aq)} \ \rightarrow \ Na_2SO_{4 \ (aq)} \ + \ 2H_2O_{(l)}$

a) How many moles of sulfuric acid are present in the 20 cm^3 of the acid solution?

(2 marks)

b) What is the number of moles of sodium hydroxide needed to neutralise the acid?

(1 mark)

c) Given that the number of moles obtained in your answer to part (b) must have been present in the 25cm³ of the aqueous solution of the alkali, calculate the molar concentration of the sodium hydroxide solution.

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

7. The diagram below shows the apparatus set up for the <u>laboratory</u> preparation of <u>dry</u> sulfur dioxide.



- a) State the function of each piece of apparatus, labelled A to D, shown in the diagram. (4 marks)
- b) There are two different sets of reagents that can be used to prepare sulfur dioxide.
 - (i) The first set is: copper metal and concentrated sulfuric acid. Write an ionic half equation to show what happens to copper metal. What property is shown by concentrated sulfuric acid in this reaction? (2 marks)
 - (ii) The second set is: sodium sulfite and dilute sulfuric acid. Write an equation for the reaction. (2 marks)
- c) Give the <u>name</u> of the reagent used to test for sulfur dioxide and state the colour changes that take place during this test. (2 marks)
- d) Describe what you would SEE when sulfur dioxide is bubbled through the two solutions named below and state what property sulfur dioxide is showing in each of these reactions.
 (i) water containing universal indicator
 - (ii) iron (111) sulfate solution

(6 marks)

- e) (i) Write a balanced equation for the reaction of sulfur dioxide with water.
 - (ii) Write an ionic half equation to show what happens to the iron (111) ions in d) (ii).

(4 marks)

8. The following scheme shows some reactions of nitric acid.



- a) For <u>each</u> of the reactions, A to D
 - (i) Give the <u>name</u> of a substance that has to be reacted with nitric acid to obtain the product shown. (4 marks)
 - (ii) Give an observation or appearance of the <u>named product</u> as it is formed. (4 marks)
- b) Using your answers to a) (i), write balanced equations for reactions A, B and C.

(6 marks)

- c) Describe how you would test for the presence of nitrate ions, including the result. (Equations are not required) (4 marks)
- d) Give two important large scale uses of nitric acid. (2 marks)
- 9. For each of the statements below, give:
 - a chemical reason for the change described.
 - one observation (other than those described).
 - the term that describes either the process or the reactants / products.
 - a balanced equation for the reaction described.
 - a) On heating <u>crystals</u> of copper (II) sulfate a powder is obtained.
 - b) When zinc is added to aqueous copper (11) sulfate, a precipitate is formed and the colour of the solution fades.
 - c) If carbon dioxide is passed through an aqueous solution of strontium hydroxide, Sr(OH)₂, an immediate change is seen. [Hint: Strontium is a Group 2 element below calcium.)
 - d) When a direct current is passed through colourless aqueous potassium iodide, a coloured substance is formed around the anode. (20 marks)