

JUNIOR LYCEUM ANNUAL EXAMINATIONS 2005

Educational Assessment Unit - Education Division

FORM 4

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, O = 16, Na = 23
 One mole of any gas occupies 22.4 dm³ at standard temperature and pressure.
 Standard temperature and pressure (stp) = 0°C and 760 mm Hg
 Faraday constant = 96 500 Cmol⁻¹
 Q = It

PERIODIC TABLE

1	2											3	4	5	6	7	0												
																		4 He 2											
												11 B 5	12 C 6	14 N 7	16 O 8	19 F 9	20 Ne 10												
7 Li 3	9 Be 4											27 Al 13	28 Si 14	31 P 15	32 S 16	35.5 Cl 17	40 Ar 18												
23 Na 11	24 Mg 12											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												

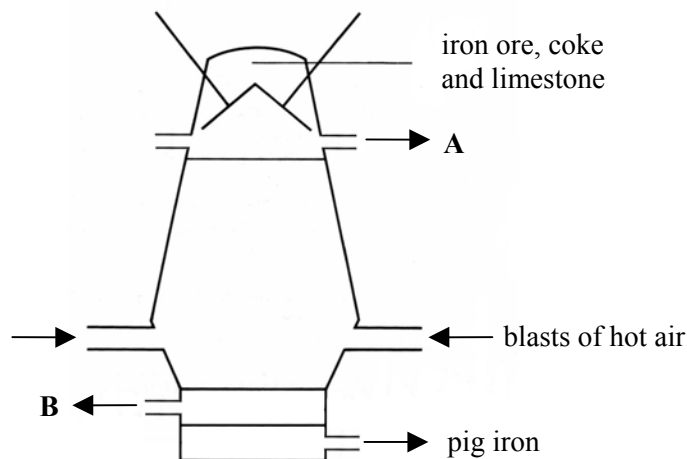
Marks Grid [For Examiners use only]

Question N°.	Section A						Section B			
	1	2	3	4	5	6	7	8	9	
Max Mark	8	15	10	9	8	10	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.

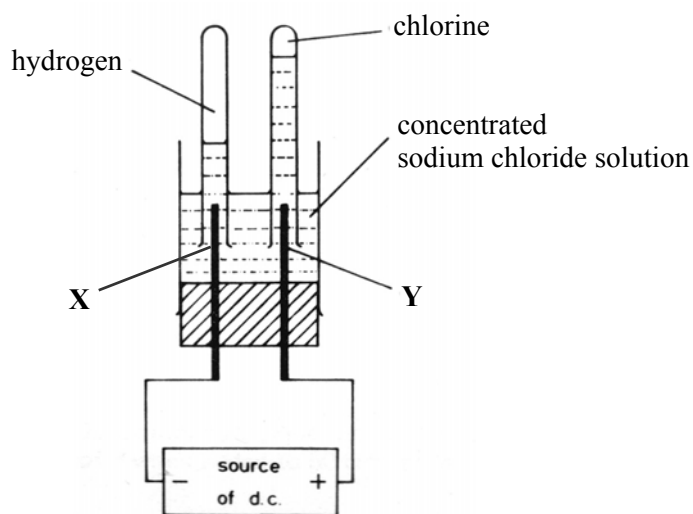
1. The diagram below is a simple outline of a Blast Furnace for the extraction of iron from iron ore that contains iron (III) oxide.



- a) Complete the labelling of the diagram by writing the names of the products A and B. _____ (2 marks)
- b) Which raw material acts as a solid fuel for the process? _____ (1 mark)
- c) Complete the equation for the reduction of iron (III) oxide to iron.
 $\text{Fe}_2\text{O}_3 + 3 \text{CO} \rightarrow$ _____ (2 marks)
- d) What is the function of the limestone?
 _____ (1 mark)
- e) Most of the pig iron is converted to steel. Give one use of pig iron or steel and state the property on which this use depends.
 use: _____
 property: _____ (2 marks)

2. This question is about tests or experiments using sodium chloride.
- a) If sodium chloride crystals are heated they are found to be **thermally stable**. What does this mean? _____ (1 mark)
- b) The presence of chloride ions in a solution of sodium chloride can be confirmed by adding acidified silver nitrate to a sample of the solution.
- i) What is **SEEN** in this test? _____ (1 mark)
- ii) Write an **ionic** equation for this reaction.
 _____ (2 marks)

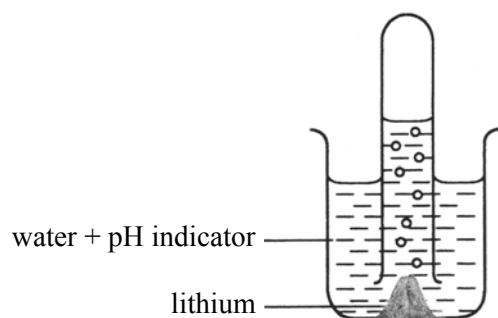
- c) A concentrated solution of sodium chloride can be electrolysed as shown in the diagram below.



- (i) Give the name of electrodes X and Y.
 X _____ Y _____ (2 marks)
- (ii) Write the ionic half equation for the reaction at electrode Y.
 _____ (2 marks)
- (iii) Theoretically, the same volume of gases should be liberated at each electrode. However, it is noted that bubbles of chlorine fail to reach the top of the tube so initially very little chlorine gas is collected. Suggest a reason for this.
 _____ (1 mark)
- The equation for the reaction at electrode X is $2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$
 If a current of 0.41 amperes flows for 20 minutes:
- (iv) Calculate the electrical charge in coulombs.
 _____ (1 mark)
- (v) Convert the answer to Faradays
 _____ (1 mark)
- (vi) Calculate the volume of hydrogen (in cm^3) liberated at stp.
 _____ (2 marks)
- (vii) What volume would this gas occupy at room temperature and pressure?
 (25°C and 760mm Hg pressure)
 _____ (2 marks)

3. This question is about the trends down Group 1 of the Periodic Table.

a) Lithium was allowed to react with water as shown in the diagram.



(i) Name the products of this reaction.

_____ (2 marks)

(ii) What colour change does the universal indicator undergo?

_____ (1 mark)

b) Your teacher needs to demonstrate the reaction of sodium with water.

It would be dangerous to restrict the movement of sodium as above.

(i) Draw a diagram to show how sodium can be reacted with water.

(2 marks)

(ii) Give **two** observations that would be made when sodium is added to water.

_____ (2 marks)

c) What would be **SEEN** if a small piece of potassium were added to water that *shows it to be more reactive than sodium*? _____ (1 mark)

d) Give a balanced equation for the reaction that occurs when **one** of these metals reacts with water. _____ (2 marks)

4. The table below gives a list of solutions and a list of reagents that can be used to test for cations and anions in Qualitative Analysis.

Solutions
copper sulphate
iron (III) nitrate
calcium sulphite
magnesium bromide
sodium carbonate

Reagents
acidified silver nitrate solution
barium chloride solution only
acidified barium chloride solution
sodium hydroxide solution
dilute hydrochloric acid

Choose, from these solutions only, those which fit each of the descriptions given below. The solutions may be used more than once.

a) **One** solution which gives a precipitate with acidified silver nitrate. _____ (1 mark)

b) (i) **Two** solutions which give a precipitate with barium chloride solution *only*. _____ (2 marks)

(ii) **One** solution which gives a precipitate with *acidified* barium chloride. _____ (1 mark)

c) (i) **One** solution which gives a **white** precipitate with sodium hydroxide solution. _____ (1 mark)

(ii) **Two** solutions which give a **coloured** precipitate with sodium hydroxide solution. _____ (2 marks)

d) **Two** solutions that would give effervescence with dilute hydrochloric acid. _____ (2 marks)

5. This question is about a titration experiment.

a) A solution of sodium hydroxide was prepared in order to be used in a titration experiment. If 1.5g of the solid was dissolved in 250cm³ solution, calculate the concentration of the solution in mol dm⁻³.

(2 marks)

This part of the question is about the practical steps to be followed when carrying out the titration. Assume that the apparatus has already been washed and set up so that the acid, alkali and indicator are already in place.

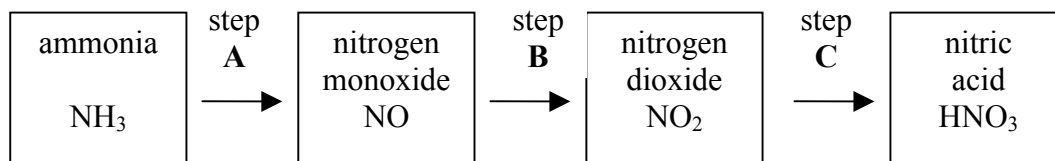
b) Draw and label a diagram of the apparatus set up needed to carry out the titration. (The stand and clamp need not be shown).

(4 marks)

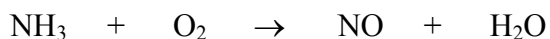
c) Several precautions are needed to carry out an accurate titration. Mention **two** of these precautions. _____

(2 marks)

6. The flow diagram below shows the main steps in the production of nitric acid starting from ammonia. This is known as the Ostwald Process.



- a) The conversion of ammonia to nitrogen monoxide is shown by the unbalanced equation below.



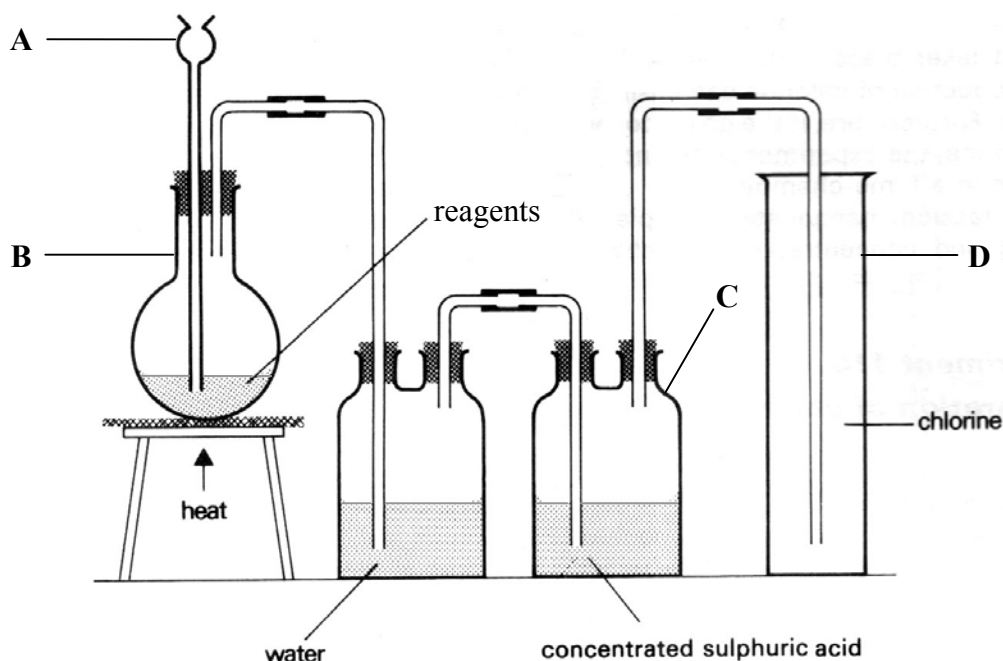
- (i) Balance this equation _____ (2 marks)
- (ii) This reaction is known as the 'catalytic oxidation of ammonia'.
Name the catalyst used and give a reason why ammonia is oxidised.

_____ (2 marks)
- b) (i) Give an equation for the conversion of nitrogen monoxide to nitrogen dioxide.
_____ (2 marks)
- (ii) What would be SEEN if this conversion is carried out in the laboratory?
_____ (1 mark)
- c) Nitrogen dioxide dissolves in water to form a mixture of two acids.
- (i) Give the name or formula of the other acid formed besides nitric acid.
_____ (1 mark)
- (ii) What is done in industry so that only nitric acid is formed?
_____ (1 mark)
- d) Give one important large scale use of nitric acid.
_____ (1 mark)

Section B: Answer any TWO questions from this section on the separate sheets provided.

Each question carries 20 marks.

7. The diagram below shows the apparatus that can be used for the laboratory preparation of chlorine gas.



- a) Name the items of apparatus labelled A, B, C and D. (4 marks)
- b) Name another item of apparatus that could be used instead of:
- (i) apparatus A to add the liquid reagent (ii) apparatus D to collect the gas (2 marks)
- c) the equation for the reaction taking place in apparatus B is :
- $$\text{MnO}_2 + 4\text{HCl} \rightarrow \text{MnCl}_2 + 2\text{H}_2\text{O} + \text{Cl}_2$$
- (i) Give the names of the reagents (chemicals that react in apparatus B). (2 marks)
- (ii) Give any important conditions for the reaction. (2 marks)
- (iii) This is a redox reaction. State, giving a reason, what is oxidised and what is reduced. (4 marks)
- d) Give **two** observations that would be noted as the reaction takes place in apparatus B. (2 marks)
- e) What is the function of passing the gases through
- (i) water (ii) concentrated sulphuric acid. (2 marks)
- f) What would be the effect of **dry** chlorine on
- (i) **dry** blue litmus (ii) **damp** red litmus (2 marks)

8. The following list indicates some reactions of sulphuric acid.

Reaction 1. **A** + sulphuric acid → copper sulphate + water

Reaction 2. **B** + sulphuric acid → copper sulphate + water + sulphur dioxide

Reaction 3. **C** + sulphuric acid → sodium sulphate + water + carbon dioxide

Reaction 4. **D** + sulphuric acid → sodium hydrogensulphate + hydrogen chloride

a) For **each** of the reactions, 1 to 4:

(i) Name the reagents (chemicals), A, B, C and D that have to be reacted with sulphuric acid in order to obtain the named product(s).

(ii) State whether the acid has to be dilute or concentrated.

(iii) Write a balanced equation for the reaction. (16 marks)

b) Describe tests to identify sulphur dioxide and hydrogen chloride gases. (4 marks)

9. The following statements refer to experiments that can be carried out in the laboratory.

Experiment 1. Small samples of magnesium and calcium are added to dilute hydrochloric acid and the rate of their reaction is observed.

Experiment 2. An electric current is first passed through copper sulphate solution using carbon electrodes then through copper sulphate solution using copper electrodes.
A different result is obtained *at the anode*.

Experiment 3. If chlorine is passed through colourless solutions of potassium bromide and potassium iodide a coloured substance is formed in each case.

Experiment 4. A different result is obtained when crystals of potassium nitrate and lead nitrate are both decomposed by heating.

For **each** of the experiments 1 to 4:

a) State what would be **SEEN** during the reaction, emphasizing any **difference** in results for **each** substance.

b) Give an equation for **ONE** of the reactions that takes place in **each** experiment.

c) Give a conclusion that can be drawn from the experiment.

(5 x 4 marks)

END OF PAPER
