

JUNIOR LYCEUMS ANNUAL EXAMINATIONS 2001

Educational Assessment Unit - Education Division

FORM 4

CHEMISTRY

TIME : 1hr 30min

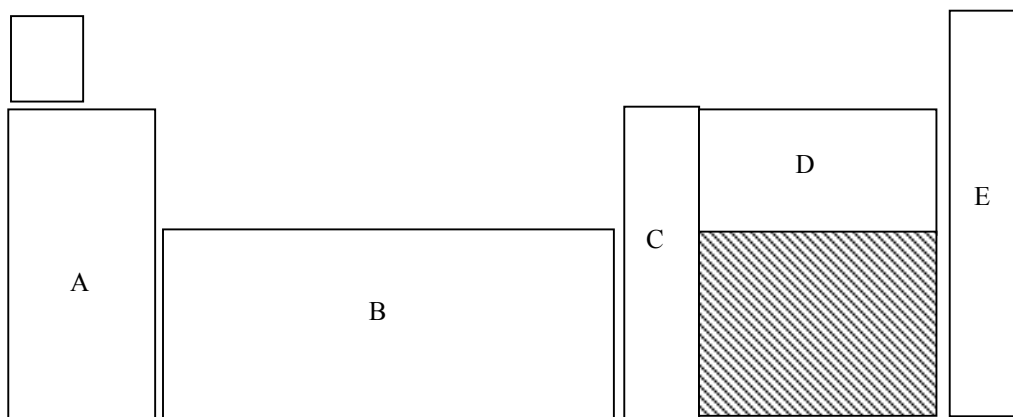
Name: _____

Class: _____

Useful Data: A copy of the Periodic Table is provided with this paper.
Relative atomic masses. H = 1, Fe = 56, O = 16, Na = 23.

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

1. a) The outline diagram below shows different areas of the Periodic Table.



Give the letter of the area in which you would find –

- i) elements that do not tend to form compounds _____
- ii) the most reactive metals _____
- iii) a metal which is borderline with non-metals and whose oxide is amphoteric _____
- iv) a solid non-metal that burns in air to form an acidic oxide _____
- v) a metal that has a variable valency and forms coloured ions _____
- vi) a halogen _____
- vii) an element that reacts with water to form an alkaline solution _____

b) Give the number of electrons in the **outer shell** of the **atoms** of-

- i) most noble gases _____
- ii) metals that form ions of the type x^{2+} _____
- iii) non-metals that form ions of the type x^- _____

(10 marks)

2. a) Give a **brief ionic** explanation for the following:
- (i) hydrogen chloride dissolved in water is acidic but hydrogen chloride dissolved in methylbenzene is neutral.
- _____
- _____
- (ii) ethanoic acid is a weak electrolyte while sulphuric acid is a strong electrolyte.
- _____
- _____
- (4 marks)
- b) Give the general ionic equation (omitting spectator ions) for the following reactions.
- (i) $\text{K}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{KCl} + \text{H}_2\text{O} + \text{CO}_2$
(i.e. an acid on a carbonate)
- _____
- (ii) $\text{NaOH} + \text{HNO}_3 \rightarrow \text{NaNO}_3 + \text{H}_2\text{O}$
(i.e. neutralisation)
- _____
- (4 marks)
-

3. a) The questions below refer to the reactions of copper metal with different acids.
- i) Copper does not react with dilute hydrochloric acid or dilute sulphuric acid. Give a reason for this observation.
- _____ (1 mark)
- ii) Copper reacts with concentrated nitric acid to give a brown gas. Give the **name** and **formula** of this gas. _____ (2 marks)
- iii) What property is shown by concentrated nitric acid that enables it to react with copper metal?
- _____ (1 mark)
- b) Copper reacts directly with chlorine to form copper (II) chloride.
- $$\text{Cu} + \text{Cl}_2 \rightarrow \text{CuCl}_2$$
- (i) Name this type of reaction in which the two elements combine to form one compound. _____ (1 mark)
- (ii) Write the balanced ionic **half** equations for this reaction and use them to explain why this is a redox reaction.
- _____
- _____
- (5 marks)

4. This question is about the action of heat on materials.

Consider the following list of substances:

magnesium, hydrated copper (II) sulphate, sodium chloride,
sodium hydrogencarbonate, sodium nitrate, sucrose (sugar), zinc oxide.

Using **only** substances in this list, give the name of **one** substance in each case which, when heated, behaves as described below.

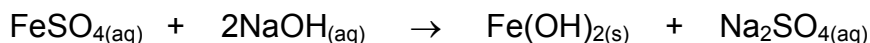
- a) liberates oxygen as the only gas _____.
 - b) is thermally stable _____.
 - c) forms a solid product which weighs more than the original substance _____.
 - d) changes to yellow while hot but becomes white again on cooling _____.
 - e) undergoes a reversible chemical change _____.
 - f) gives off a gas which turns lime water milky _____.
 - g) gives off clouds of water vapour and then turns black with a strong smell of charring
_____.
- (7 marks)
-

5. a) A solution of sodium hydroxide, NaOH, was prepared by dissolving 5g sodium hydroxide per 250cm³ solution.

- i) What is the relative formula mass of sodium hydroxide?
- ii) How many moles of sodium hydroxide are dissolved in solution?
- iii) What is the molar concentration of the solution?

(3 marks)

b) An excess of iron (II) sulphate solution is added to 100cm³ of sodium hydroxide solution of molar concentration 2M (2mol dm⁻³). The equation for the reaction is



Calculate:

- i) the number of moles of NaOH in solution,
- ii) the number of moles of Fe(OH)₂ precipitated,
- iii) the mass of Fe(OH)₂ precipitated.

(5 marks)

6. a) Aluminium powder reacts, on heating, with iron (III) oxide to liberate the metal iron according to the equation $2\text{Al} + \text{Fe}_2\text{O}_3 \rightarrow \text{Al}_2\text{O}_3 + 2\text{Fe}$
- i) What conclusion can be drawn about the relative degree of reactivity of the two metals aluminium and iron?
- _____
- ii) Give a reason why aluminium is not used to extract iron from iron (III) oxide in this way.
- _____
- iii) Give the name of **one** other metal which you would expect to be released from its oxide by heating with aluminium powder. _____ (3 marks)
- b) The **method** and **form of energy** used to extract a metal from its oxide depends on the stability of the metal oxide, which in turn, is related to the position of the metal in the reactivity series. The uses of metals depend on their properties. Complete the table below:

	Aluminium	Iron
type of energy used to bring about the extraction		
the other substance required for the extraction in addition to the oxide		
(i) use of metal	(i)	(i)
(ii) the property on which the use depends	(ii)	(ii)

(8 marks)

- c) All methods of extracting metals involve the same type of reaction. Name this type of reaction. _____ (1 mark)

7. 50cm^3 methane were mixed with 125cm^3 of oxygen and the mixture was exploded. The following reaction occurred. $\text{CH}_{4(g)} + 2\text{O}_{2(g)} \rightarrow \text{CO}_{2(g)} + 2\text{H}_2\text{O}_{(g)}$
- Calculate the **total** volume of the gases remaining immediately after the explosion. N.B. This should include the volume of any gas that remains unreacted. Show your reasoning/working. (Assume that all volumes are measured under the same conditions of temperature and pressure).

(5 marks)

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

8. a) Describe briefly, with the aid of a labelled diagram, how you would carry out the electrolysis of an aqueous solution of copper (II) sulphate using carbon (inert) electrodes. Your answer should include observations you would make at the electrodes and any observations due to a change in solution during electrolysis. Give equations for the reactions taking place at the electrodes. (14 marks)
- b) i) Describe the difference in **observations** (at electrodes and in solution) and in any of the **electrode reactions** if both electrodes are made of copper.
ii) Give an industrial application of this electrolysis. (6 marks)
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9. This question is about qualitative tests on pairs of substances.
- a) Solutions of calcium chloride and magnesium chloride give the same result when sodium hydroxide solution is added to them, first a few drops then in excess.
(i) Describe the result of this test and give an equation for one of the reactions.
(ii) Describe another test, including the observations, that would enable you to distinguish between the two compounds. (6 marks)
- b) Solutions of aluminium nitrate and lead nitrate also give the same result with sodium hydroxide solution.
(i) Describe the result of this test.
(ii) Describe another test, including the observations, that would enable you to distinguish between the two solutions.
Give an equation for any reaction that takes place. (6 marks)
- c) Two tests that would enable you to distinguish between sodium sulphite and sodium sulphate are.
Test 1. adding dilute hydrochloric acid to samples of the solids.
Test 2. adding acidified barium chloride solution to a solution of each compound.
Give the results of **each** test for **both** substances and write balanced equations for any reactions taking place. (8 marks)
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10. The Haber process is used to synthesize ammonia from nitrogen and hydrogen. Ammonia itself is used to manufacture nitric acid by the Ostwald process.
- a) **Briefly** outline the manufacture of ammonia by the Haber process, giving the names of the raw materials, the essential conditions and an equation for the reaction. (8 marks)
- b) The manufacture of nitric acid from ammonia occurs in three stages. **Briefly** outline these three stages, by giving the chemical reactions and any important conditions. (8 marks)
- c) Both ammonia and nitric acid have important industrial uses. Suggest, with reasons, two effects on society if these chemicals were no longer available. (4 marks)