JUNIOR LYCEUM ANNUAL EXAMINATIONS 2003

Educational Assessment Unit - Education Division

FORM 5	CHEMISTRY	TIME: 1hr 45 mins

Name: _____   Class: _____

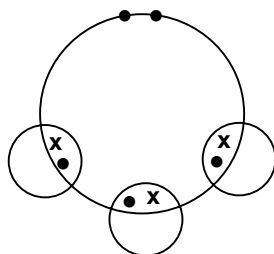Useful Data: A copy of the Periodic Table is provided with this paper.
Relative atomic masses may be taken as:
Cu = 63.5,   H = 1,   O = 16,   S = 32

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

1.   Use the Periodic Table provided to answer this question.

(a) The questions below refer to the following dot/cross diagram.

(i)   Write the formula of a compound which could have this structure. _____

(ii) What type of bonding is present in this compound? _____

(iii) Predict a property that you would expect this compound to show.

_____   (3 marks)

(b) Draw a similar dot/cross diagram to show the bonding of the compound hydrogen fluoride, HF.

(2 marks)

(c) Hydrogen fluoride is partially ionised when in solution in water.

If hydrogen fluoride is similar to hydrogen chloride:

(i)   Write down the *ions* formed by hydrogen fluoride. _____

(ii) State the effect you would expect this solution to have on litmus indicator.

_____   (3 marks)

2. Barium and calcium belong to Group 2 of the Periodic table.
   The apparatus shown below can be used to compare the reactivity of barium and calcium with water.
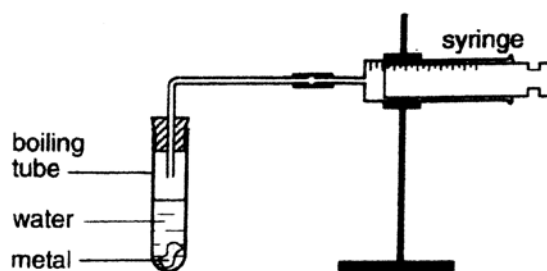
(a) To make the comparison 'fair', the mass of barium and calcium are kept the same.

State *two* other factors which should be kept the same to make the comparison fair.

_____

_____ (2 marks)

(b) After a time, the plunger of the syringe in the barium experiment had moved further than in the calcium experiment.

(i) Explain why this result is to be expected from the position of barium and calcium in the Periodic Table. _____

(ii) Predict how the reactivity of magnesium would compare with that of barium and calcium.

_____

(iii) The sketch below shows the curve obtained if the volume of gas liberated with calcium is recorded at fixed time intervals. *On the same axes*, sketch the curve you would expect for barium.
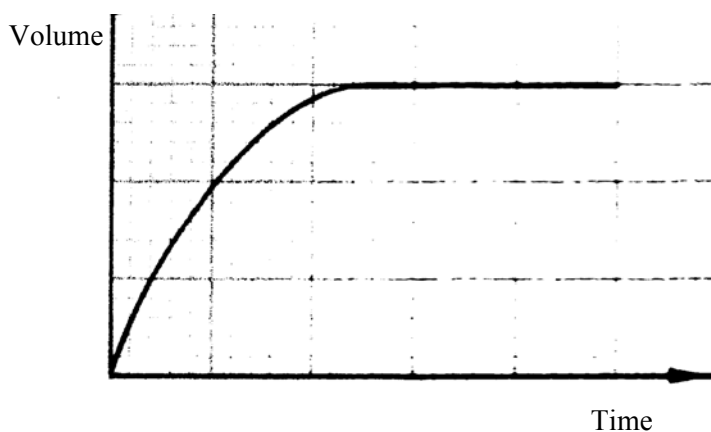
Time (3 marks)

(c) (i) Name the gas formed when barium and calcium react with water. _____

(ii) Write an equation for *one* of these metals reacting with water.

_____ (3 marks)

(d) The experiment described above shows that Group 2 metals are similar.

(i) Give *one physical* property in which the metals are similar.

_____

(ii) Give **one chemical** property (other than their reaction with water) which confirms that the metals are similar.

_____ (2 marks)

3. This question is concerned with the *properties* and *uses* of the oxides of carbon.

(a) Fill in the following table about the properties of the oxides of carbon.

Name of oxide	*Type* of oxide	*Reason* why it is a pollutant
Carbon monoxide		
Carbon dioxide		

(4 marks)

(b) In each case, give the *name* of the oxide of carbon which is used as described below and give a *property* of the gas *which makes it suitable for this purpose.*

Use of gas	**Name of oxide of carbon**	**Property**
In fire extinguishers		
In the extraction of iron		

(4 marks)

4. (a) 24.95g of hydrated copper (II) sulphate, $CuSO_4.5H_2O$, are dissolved in 200cm^3 solution.
   (i) Calculate the relative formula mass of $CuSO_4.5H_2O$.

   (ii) Calculate the number of moles of $CuSO_4.5H_2O$ that were dissolved.

   (iii) Calculate the molarity of the solution.

(4 marks)

(b) The table below shows tests carried out in a sample of the copper (II) sulphate solution. Complete the observation and ionic equation columns.

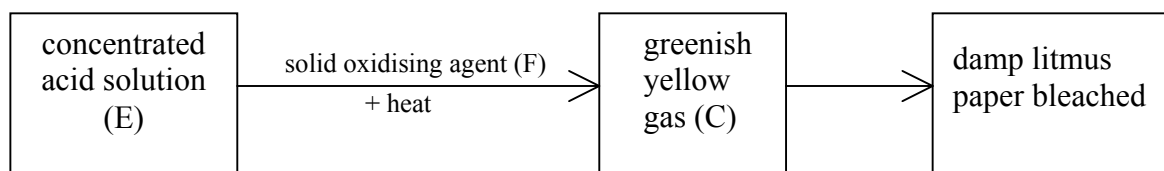| Ion	Test/reagent	Observation	Ionic equation omitting spectator ions
$Cu^{2+}_{(aq)}$	sodium hydroxide solution		
$SO_4^{2-}_{(aq)}$	acidified barium chloride		

(6 marks)

3

5. Chloride ions, $Cl^-_{(aq)}$, can be oxidised to produce a greenish yellow gas (C) which bleaches damp litmus paper. The oxidation can be done by electrolysis or by means of a solid oxidising agent.

(a) The diagram below shows an apparatus in which chloride ions would be oxidised to gas (C).
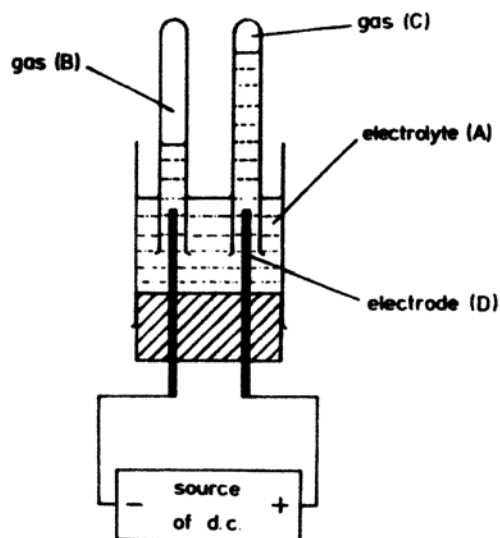
(i) Name a suitable electrolyte (A). _____

(ii) Name the gas (C) produced when chloride ions are oxidised. _____

(iii) Write an *ionic half equation* to show how the chloride ions are oxidised at electrode (D) to the gas you have named in (a)(ii)_____

(iv) Why does the oxidation of chloride ions take place at electrode (D) and not at the other electrode? _____

(v) Name the gas (B) which is produced from the electrolyte you have named in (a)(i)

_____ (6 marks)

(b) Study the following reaction in which oxidation of chloride ions to gas (C) is brought about by the solid oxidising agent (F).

| concentrated acid solution (E) | solid oxidising agent (F) + heat → | greenish yellow gas (C) | → | damp litmus paper bleached |

(i) Name the concentrated acid (E). _____

(ii) Name a suitable *solid* oxidising agent (F). _____
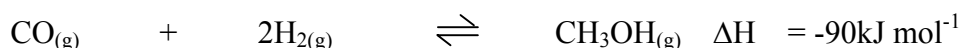
(2 marks)

4

6. This incomplete passage refers to alkane hydrocarbons. Complete the statements by writing the missing names or terms in the spaces provided.

Alkane hydrocarbons are useful fuels. Many alkane hydrocarbons are separated from the raw material _____ by the process of _____.
One gaseous fuel is natural gas whose main alkane hydrocarbon component is _____. The main hydrocarbon (alkane gas) present in bottled gas (LPG) used in Malta is _____. An alkane hydrocarbon found in petrol is _____.
The products of complete combustion of hydrocarbons are _____ and steam. Incomplete combustion of hydrocarbon fuels results in the formation of the poisonous gas _____ together with soot, which is a form of the solid element _____. (8 marks)

7. Methanol (CH_3OH) is manufactured by the reaction between carbon monoxide and hydrogen at a temperature of 300°C and a pressure of 300 atmospheres. The equation for the reaction is:

$$CO_{(g)} \quad + \quad 2H_{2(g)} \quad \rightleftharpoons \quad CH_3OH_{(g)} \quad \Delta H \quad = \text{-90kJ mol}^{-1}$$

Note that the forward reaction is exothermic.

(a) Explain why a high pressure *increases both*

(i) the *rate* of reaching equilibrium,

_____
_____ (2 marks)

(ii) the *percentage* (or yield) of methanol in the equilibrium mixture.

_____
_____ (2 marks)

(b) (i) Use Le Chatelier's principle to explain why, *in theory*, a *low* temperature would favour a good yield of methanol.

_____
_____ (2 marks)

(ii) Suggest why an *optimum* temperature of 300°C is used.

_____ (1 mark)

(iii) State *one* other way in which the percentage of methanol in the equilibrium mixture can be increased. _____ (1 mark)

8. One of the key reactions in the formation of acid rain is the oxidation of sulphur dioxide to sulphur trioxide. This is catalysed by iron particles from rusty car exhausts.

    (a) (i)   What is rust? Under what conditions is it produced?   (3 marks)

        (ii) State *two* ways of preventing rusting.   (2 marks)

    (b) (i)   Write an equation for the oxidation of sulphur dioxide to sulphur trioxide, including the sign that shows the reaction can reach a dynamic equilibrium.   (2 marks)

        (ii) What is a catalyst? Name the *industrial* catalyst used in the oxidation of sulphur dioxide.
                                                                                      (3 marks)

        (iii) What effect, if any, does the catalyst have on the equilibrium position (or yield of sulphur trioxide)?   Explain your answer.   (3 marks)

        (iv) State *one condition* that would favour a *good yield* of sulphur trioxide.   (1 mark)

    (c) Acid rain often contains both sulphuric acid and nitric acid.

        Explain, *with equations*, how

        (i)   sulphuric acid corrodes iron structures

        (ii) nitric acid corrodes limestone buildings (calcium carbonate).   (6 marks)

9. Distinguish between the following terms by explaining the meaning of *each* term *using a suitable example*.

    (a) distillate and filtrate   (4 marks)

    (b) anion and cation   (4 marks)

    (c) dehydrating agent and drying agent   (6 marks)

    (d) allotrope and isotope   (6 marks)

10. For *each* of the reactions described below
        (i)   *name* the type of reaction
        (ii) give an *equation* for the reaction
        (iii) explain the *chemical process* that occurs, including the importance of the phrase in italics.

    (a) When ethane is mixed with red bromine vapour, and *the mixture is exposed to sunlight*, the bromine is not decolourised.

    (b) Silver nitrate solution is added to potassium bromide solution to form a *pale yellow precipitate which darkens when exposed to sunlight*.

    (c) Some hydrogen gas is mixed with chlorine gas, but care is taken *not to expose the mixture to direct sunlight*.

    (d) Containers of hydrogen peroxide liquid are found to slowly build up pressure of a gas, so *hydrogen peroxide is usually stored in dark brown bottles*.

                                                                                      (20 marks)

END