Rewarding Learning

71	

Candidate Number

General Certificate of Secondary Education
2010

Science: Chemistry

Paper 1
Higher Tier

[G1403]

G1403

WEDNESDAY 26 MAY, MORNING

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all five** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 120.
Quality of written communication will be assessed in question **5(c)**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
A Data Leaflet which includes a Periodic Table of the Elements is provided.

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
Total Marks	

Examiner Only	
Marks	Remark

1 **(a)** The modern Periodic Table has been in use for over 100 years. Its development included the work of several chemists including John Newlands and Dmitri Mendeleev.

(i) What name was given to the law developed by John Newlands?

_____[1]

(ii) State **three** features of the Periodic Table developed by Mendeleev which are different from the modern Periodic Table.

1. _____

_____

2. _____

_____

3. _____

_____[3]

(b) The modern Periodic Table is made up of Groups and Periods. What name is given to the following Groups?

Group I _____

Group VII _____[2]

(c) Often a short form of the Periodic Table like the one shown below is used.

Group	I	II	III	IV	V	VI	VII	0
	H							He
	Li	Be	B	C	N	O	F	Ne
	Na	Mg	Al	Si	P	S	Cl	Ar
	K	Ca	Ga	Ge	As	Se	Br	Kr

Using ONLY the elements in the table above:

(i) Name one noble gas.

_____[1]

(ii) Name one element which is a liquid at room temperature and pressure.

_____[1]

(iii) Name one diatomic gas.

_____[1]

(iv) Name one non-metal which is a solid at room temperature and pressure.

_____[1]

(v) Name one element which forms a simple ion with a charge of 2–

_____[1]

(vi) Suggest one reason why hydrogen may be placed in Group I.

_____

_____[1]

Examiner Only

Marks	Remark

(d) Group III of the Periodic Table contains the elements boron, aluminium and gallium.

Group III
$^{11}_{5}B$
$^{27}_{13}Al$
$^{70}_{31}Ga$

All of these elements form compounds with oxygen and chlorine.

(i) Write the formula of aluminium oxide.

_____[1]

(ii) Write a balanced symbol equation for the reaction of aluminium with chlorine.

_____[3]

(iii) In which period of the Periodic Table is gallium found?

_____[1]

(iv) Suggest why boron would have different physical properties to the other elements of Group III.

_____[1]

(v) The elements of Group III can form a simple ion with a 3+ charge. Name one other element, apart from those in Group III, which forms an ion with a 3+ charge. You may use your Data Leaflet to help answer this question.

_____[1]

Examiner Only	
Marks	Remark

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(Questions continue overleaf)

Examiner Only	
Marks	Remark

2 Some substances dissolve very well in water and are said to have high solubility.

(a) Explain what is meant by the term solubility.

_____

_____

_____

_____ [4]

(b) To determine the solubility of potassium chloride in water, 20 g of potassium chloride were placed in a beaker.

40 cm^3 of water were added to the beaker and warmed until all the potassium chloride had dissolved.

The beaker was then allowed to cool. The temperature at which crystals first appeared was recorded.

The experiment was repeated five more times adding an extra 5 cm^3 of water each time.

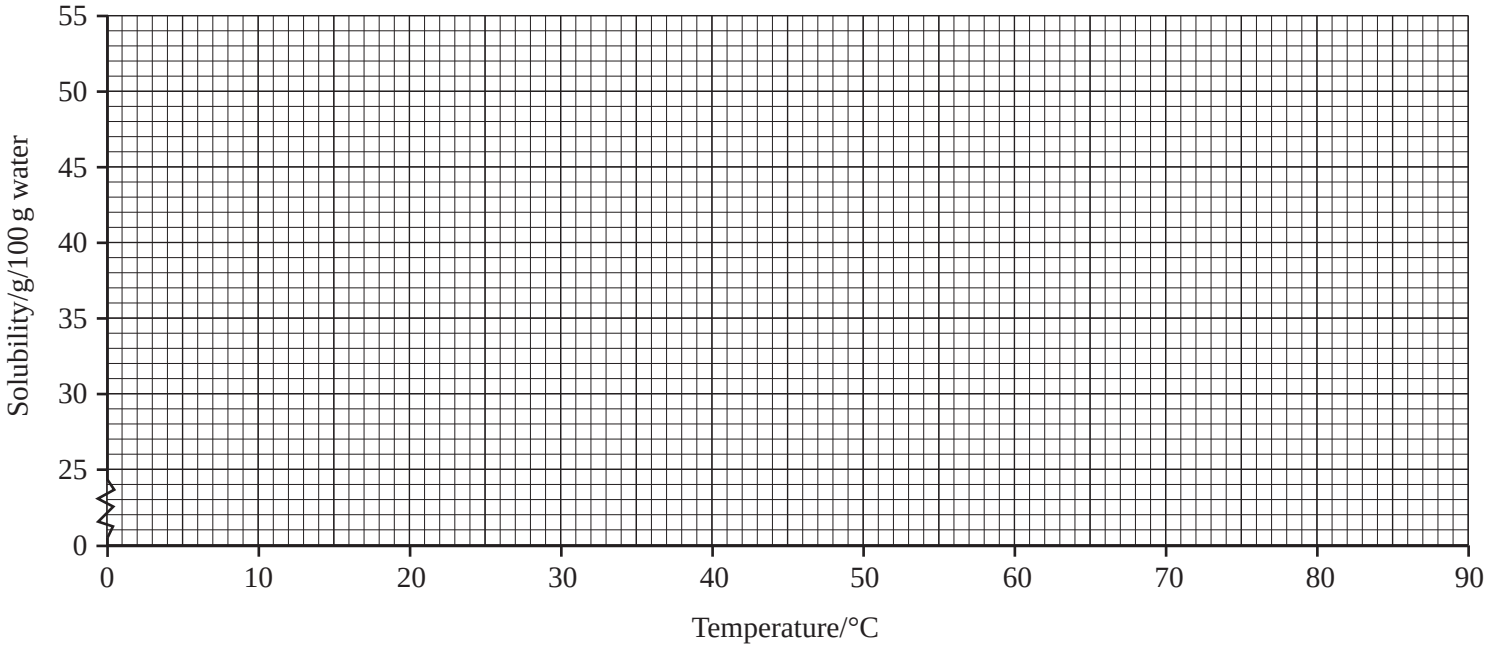
The results obtained are shown in the table below.

Mass of potassium chloride (g)	**Volume of water (cm^3)**	**Temperature at which crystals first appear (°C)**	**Solubility (g/100 g water)**
20	40	80	50.0
20	45	59	44.4
20	50	41	
20	55	27	36.4
20	60	15	33.3
20	65	5	30.8

(i) Calculate the solubility of potassium chloride at 41 °C and insert the value in the table.

Solubility_____ g/100 g water [1]

(ii) Use the results table to plot a solubility curve for potassium chloride on the graph provided below.



[4]

(iii) How does the solubility of potassium chloride vary with increasing temperature?

_____ [1]

(iv) Using your graph, determine the solubility of potassium chloride at 10 °C.

_____ [1]

(v) If a saturated solution of potassium chloride containing 50 g of water is cooled from 80 °C to 5 °C, what mass of potassium chloride will crystallise out of solution?

_____ g [3]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

(c) The solution of potassium chloride was tested for the presence of chloride ions.
Name a suitable reagent that could be used to test for the presence of chloride ions and state the observations for a positive test.

Suitable reagent _____

Observations _____

_____ [3]

(d) Many substances, such as sodium hydroxide and anhydrous calcium chloride interact with moist air.

(i) Describe the observations made when some pellets of sodium hydroxide are left on a watch glass in the laboratory for several days.

_____

_____

_____

_____ [3]

(ii) Explain what you understand by the term anhydrous.

_____

_____ [2]

(e) Bottles of sodium hydroxide often have a white crust around their neck. This crust forms when sodium hydroxide reacts with carbon dioxide in the air.

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(i) Write the chemical name of the white crust.

_____[1]

(ii) Write a balanced symbol equation to show the formation of the white crust.

_____ [3]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

3 Sulphur is a non-metallic element which occurs native in the Earth's crust. It is an important raw material in the chemical industry.

(a) Sulphur undergoes combustion when heated in air.

(i) Write a balanced symbol equation for the combustion of sulphur.

_____[2]

(ii) Describe what would be observed when sulphur is heated in air.

_____

_____

_____[3]

(b) Air pollution is caused by the presence of substances which are bad for health. One of the main pollutants in air is sulphur dioxide.

(i) Name one source of sulphur dioxide pollution.

_____[1]

(ii) Sulphur dioxide reacts with water vapour in the air to form acid rain. Write a balanced symbol equation for this reaction.

_____[2]

(iii) Acid rain is a weak acid. Suggest the pH value of a sample of acid rain.

_____ [1]

(iv) State two effects of acid rain.

1. _____

_____

2. _____

_____[2]

(v) Suggest two ways of preventing the formation of acid rain.

1. _____

_____

2. _____

_____[2]

(c) Sulphur is used in the manufacture of sulphuric acid. The first stage in this process is the combustion of sulphur to form sulphur dioxide. The second stage is the conversion of sulphur dioxide to sulphur trioxide using a catalyst.

(i) Write a balanced symbol equation for the conversion of sulphur dioxide to sulphur trioxide.

_____[3]

(ii) Name the catalyst used in this reaction.

_____[1]

(d) Concentrated sulphuric acid is a dehydrating agent.

(i) Explain the meaning of the term dehydrating agent.

_____

_____[1]

(ii) Describe what you would observe when concentrated sulphuric acid is added to sugar.

_____

_____

_____

_____[3]

Examiner Only	
Marks	Remark

4 Lithium is a metal which is used in LCD televisions, computer monitors and mobile phones.

Examiner Only	
Marks	Remark

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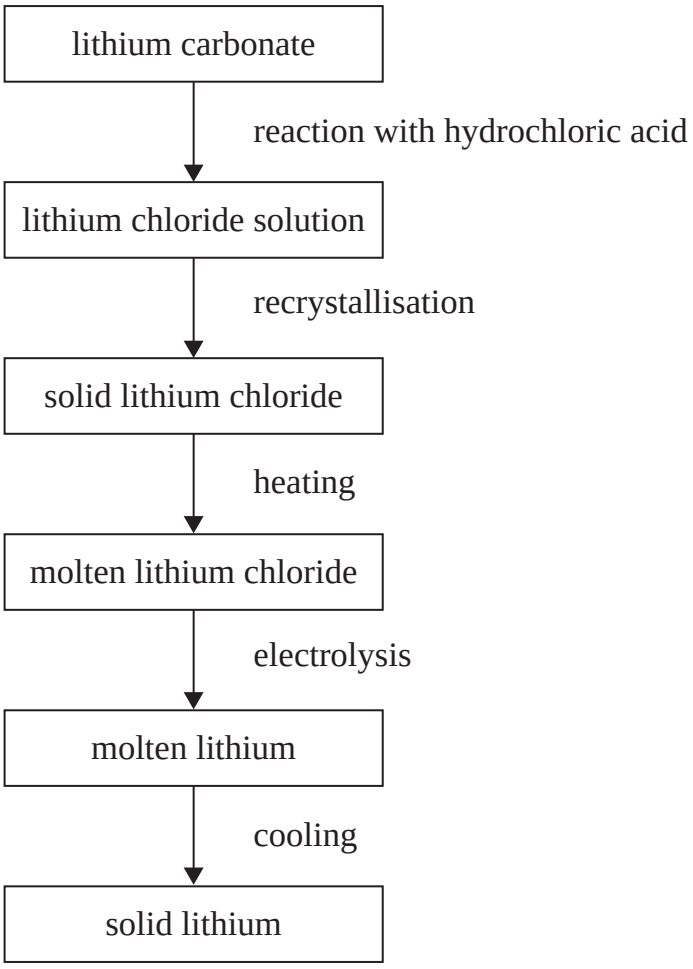
(a) Most lithium is obtained from lithium carbonate. The diagram below shows how solid lithium is produced from lithium carbonate.



(i) Write a balanced symbol equation for the reaction of lithium carbonate with hydrochloric acid.

_____[3]

(ii) Explain what is meant by the term electrolysis.

_____

_____[2]

(b) Complete the table below by placing a tick (✓) to indicate if the substance conducts electricity or does not conduct electricity. Place only one tick for each substance.

Substance	Conducts electricity	Does not conduct electricity
solid lithium		
molten lithium		
solid lithium chloride		
lithium chloride solution		

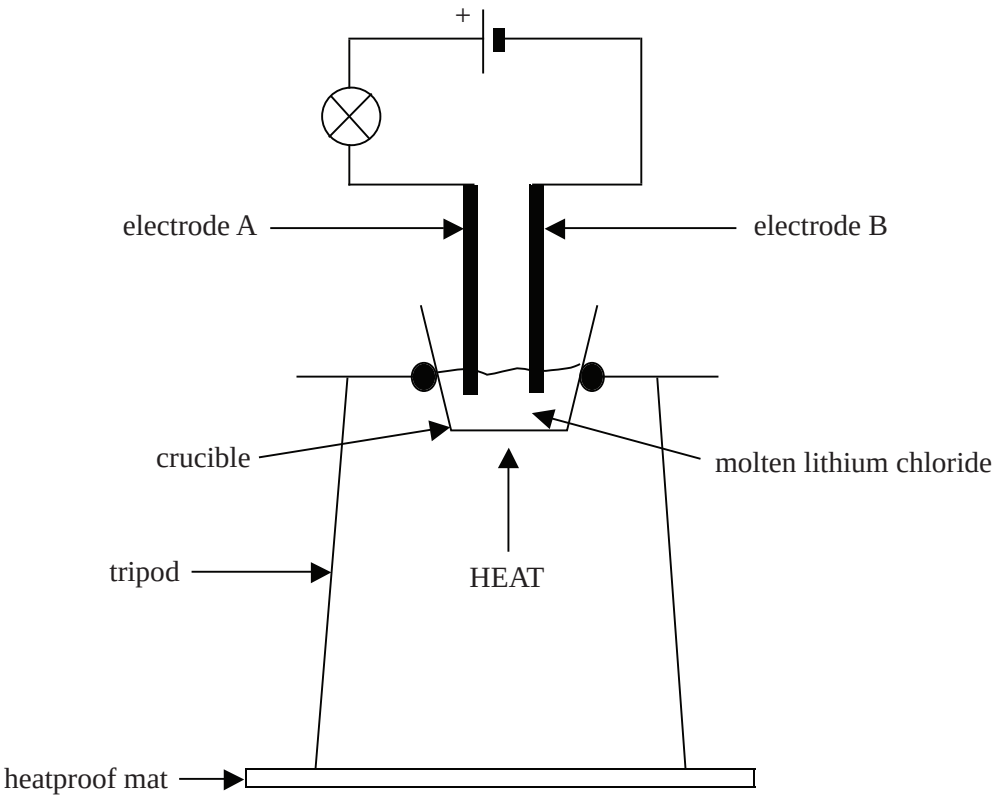
[4]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

(c) The electrolysis of molten lithium chloride may be carried out using the apparatus shown below. Molten lithium chloride is the electrolyte.



(i) What is meant by the term electrolyte?

_____

_____

_____[3]

(ii) Name electrode A and electrode B.

Electrode A _____

Electrode B _____[2]

(iii) What material is used to make the electrodes?

_____[1]

(iv) State one reason why this material is chosen to make the electrodes.

_____[1]

(v) At which electrode, A or B, is lithium produced?

_____[1]

(vi) What would you observe at the other electrode?

_____

_____[2]

(vii) Write half equations for the reactions which are occurring at each electrode.

Electrode A _____[3]

Electrode B _____[2]

Examiner Only	
Marks	Remark

5 Ethene is a very important and versatile organic compound.

Examiner Only	
Marks	Remark

(a) (i) Name the homologous series to which ethene belongs.

_____[1]

(ii) Complete the table below giving the molecular formula, structural formula and physical state of ethene at room temperature and pressure.

Molecular formula of ethene	
Structural formula of ethene	
Physical state of ethene at room temperature and pressure	

[3]

(iii) Ethene is described as an unsaturated molecule. Explain what is meant by the term unsaturated.

_____

_____[1]

(b) One use of ethene in industry is in the manufacture of ethanol.

(i) Write a balanced symbol equation for the reaction between ethene and steam.

_____[2]

(ii) Draw the full structural formula of ethanol, showing all bonds.

[2]

(c) The ethanol present in alcoholic drinks is made by fermentation. Describe in detail how ethanol is produced by fermentation. Include:

- names of the reactants
- names of the products (other than ethanol)
- necessary conditions

_____

_____

_____

_____

_____

_____[5]

Quality of written communication [2]

(d) Wine and other alcoholic drinks are often used in cooking during which the ethanol may undergo combustion.

(i) Write a balanced symbol equation for the complete combustion of ethanol.

_____[3]

(ii) What colour is the flame when ethanol burns?

_____[1]

Examiner Only

Marks	Remark

(e) If a bottle of wine is left open to the atmosphere for a number of days it is oxidised by oxygen in the air and a solution of ethanoic acid forms.

(i) Explain what you understand by the term oxidation.

_____

_____[2]

(ii) Draw the full structural formula of ethanoic acid showing all bonds.

[2]

(iii) A solution of ethanoic acid is widely used as a food flavouring. By what name is this solution more commonly known?

_____[1]

(f) Ethanoic acid reacts as a typical dilute acid.

(i) State what you would observe when a strip of magnesium metal is dropped into a solution of ethanoic acid.

_____

_____

_____[2]

(ii) Write a balanced symbol equation for the reaction between magnesium metal and ethanoic acid.

_____[3]

Examiner Only	
Marks	Remark

THIS IS THE END OF THE QUESTION PAPER