Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
January 2019

GCSE Chemistry

Unit 1

Higher Tier

[GCH12]

GCH12

MONDAY 21 JANUARY, AFTERNOON

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.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all five** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Questions **1(b)** and **2(c)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

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1 **(a)** The Periodic Table below shows the symbols for some elements.

							H										He
Li													C		O		Ne
Na	Mg											Al					
							Fe			Cu						Br	
																I	

Using only the elements shown above answer the questions below.

(i) Write the symbol for an element which is a colourless gas at room temperature and pressure.

_____ [1]

(ii) Write the name of an element which is a liquid at room temperature and pressure.

_____ [1]

(iii) Write the symbol for a non-metal element which is a solid at room temperature and pressure.

_____ [1]

(iv) Write the name of an element which forms an oxide which is black.

_____ [1]

(v) Write the symbol for a metallic element which reacts vigorously with water.

_____ [1]

(vi) Write the symbol for a transition metal.

_____ [1]

(vii) The atoms of an element have the electronic configuration 2, 8, 3.
Write the symbol for this element.

_____ [1]

(viii) Write the names of the two elements which are chemically combined in the compound water.

_____ [2]

[Turn over

(b) Potassium reacts with water.

Describe the reaction between potassium and water, including observations and a balanced symbol equation for the reaction.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

(c) Potassium also reacts with chlorine to form potassium chloride.

(i) Write a balanced symbol equation for the reaction between potassium and chlorine.

_____ [3]

(ii) What colour is potassium chloride?

_____ [1]

(iii) Write a half equation to show how a chlorine atom becomes a chloride ion.

_____ [2]

[Turn over

2 **(a)** Copper(II) chloride is a salt that may be obtained by reacting copper(II) oxide with hydrochloric acid.

(i) Write a balanced symbol equation for the reaction of copper(II) oxide with hydrochloric acid.

_____ [3]

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

_____

_____

_____ [3]

(iii) Copper(II) compounds are coloured. Complete the table below.

Copper(II) compound	**Colour**
copper(II) carbonate	
hydrated copper(II) sulfate	

[2]

(b) Magnesium sulfate may be prepared by reacting excess magnesium metal with an acid.

(i) Name the acid which reacts with magnesium to form magnesium sulfate.

_____ [1]

(ii) Describe what you would observe when magnesium metal reacts with this acid.

_____

_____

_____ [2]

(iii) How would you know when this reaction has finished?

_____

_____ [1]

[Turn over

(c) Magnesium is a very important mineral in the body. Magnesium sulfate can be prescribed for people with a magnesium deficiency.

Describe how a sample of solid magnesium sulfate may be tested to confirm the presence of magnesium ions and sulfate ions.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

(d) The table below summarises the results obtained when an unknown compound was tested to determine the ions present.

Test carried out	Result
Flame test	Lilac flame
Add silver nitrate solution	Yellow precipitate

(i) Identify the cation present in the compound.

_____ [1]

(ii) Identify the anion present in the compound.

_____ [1]

(iii) Write the formula of the compound.

_____ [1]

[Turn over

3 **(a)** The element sodium has twenty isotopes.

(i) What are isotopes?

_____

_____

_____ [2]

(ii) Draw a labelled diagram of an atom of the isotope of sodium which has mass number 22, stating the number of each subatomic particle present and showing the position of each particle.

[4]

(b) Sodium nitride (Na_3N) is an ionic compound which contains two ions. Complete the table below to give information about the two ions present in sodium nitride.

Name of ion	Formula of ion	Number of protons	Number of electrons
sodium ion			
nitride ion			

[2]

(c) Another compound of sodium and nitrogen is sodium azide (NaN_3). Sodium azide decomposes into sodium and nitrogen when heated to 300 °C.

(i) Write a balanced symbol equation for this reaction.

_____ [3]

(ii) Name and describe the type of bonding in sodium.

_____

_____

_____

_____ [3]

(iii) Draw a dot and cross diagram to show the bonding in a nitrogen molecule.

[1]

(iv) Explain why nitrogen is a gas at room temperature and pressure.

_____

_____

_____

_____ [3]

[Turn over

(d) Sodium reacts with oxygen to form sodium oxide.

Using full electronic configurations, draw dot and cross diagrams to show how atoms of sodium combine with atoms of oxygen to form sodium oxide. Include the charge on each ion.

[6]

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(Questions continue overleaf)

[Turn over

4 The solubility of solids, such as silver nitrate and potassium chloride, varies with temperature.

(a) The table below gives the solubility values of both solids at different temperatures.

Temperature (°C)	0	20	40	60	80	100
Solubility of potassium chloride (g/100 g water)	28	34	40	46	52	58
Solubility of silver nitrate (g/100 g water)	122	216	311	440	585	733

(i) What is meant by the term solubility?

_____

_____

_____

_____ [4]

(ii) State the general trend in the solubility of a solid as temperature increases.

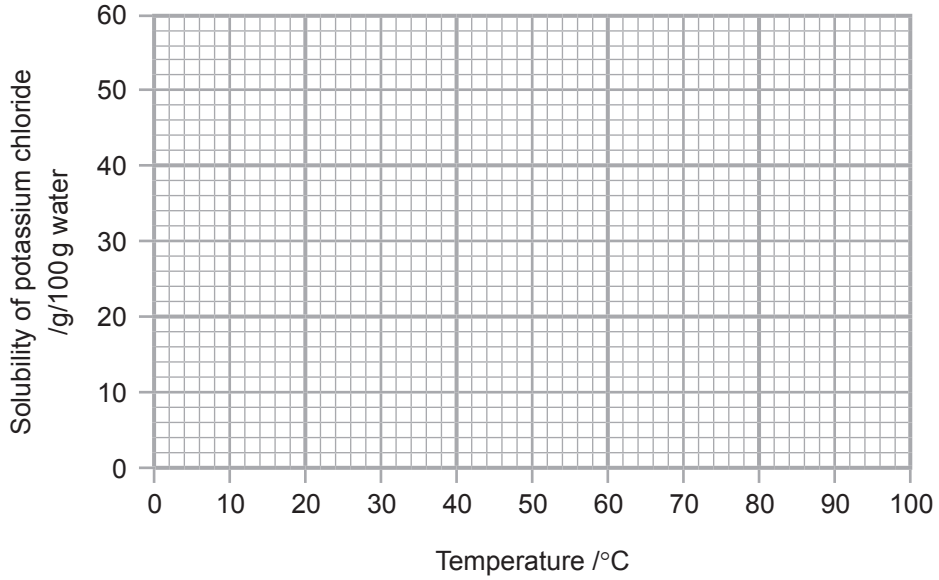
_____ [1]

(iii) Calculate the mass of silver nitrate which would crystallise when a saturated solution containing 40 g of water at 40 °C is cooled to 20 °C.

Show your working.

Mass = _____ g [3]

(b) Plot a solubility curve for potassium chloride below using the data in the table in **(a)**.



[3]

(c) Using the graph you have drawn in **(b)**, answer the questions below.

(i) What is the solubility of potassium chloride at 10 °C?

_____ g/100 g water [1]

(ii) At what temperature is the solubility of potassium chloride 50 g/100 g water?

_____ [1]

(iii) A saturated solution of potassium chloride containing an unknown mass of water at 70 °C is cooled to 30 °C and 18 g of solid potassium chloride crystallised out of solution. Calculate the mass of water in the solution.

Mass of water = _____ g [4]

[Turn over

5 Chlorine and sodium hypochlorite are two substances used to disinfect the water in swimming pools.

(a) Sodium hypochlorite, NaOCl, may be prepared by reacting chlorine gas with sodium hydroxide as shown in the equation below.

$$Cl_2 + 2NaOH \rightarrow NaOCl + NaCl + H_2O$$

(i) What is the maximum mass of sodium hypochlorite that could be formed when 1.60 g of sodium hydroxide are reacted with excess chlorine gas?

(Relative atomic masses: H = 1; O = 16; Na = 23; Cl = 35.5)

Mass of NaOCl = _____ g [5]

(ii) A student carried out this experiment and only obtained 1.35 g of sodium hypochlorite. Calculate the percentage yield.

Percentage yield = _____ % [2]

(b) Another compound added to swimming pool water is calcium chloride. It is added to protect the calcium sulfate present in the tile grouting.

(i) Write the formula of calcium chloride.

_____ [1]

(ii) Calcium sulfate may contain water of crystallisation. What is meant by the term water of crystallisation?

_____

_____ [1]

[Turn over

(c) Hydrated calcium sulfate has the formula $CaSO_4.xH_2O$. To determine the value of x, a student heated some hydrated calcium sulfate in a crucible and recorded the results in the table below.

Mass of empty crucible	12.56 g
Mass of crucible and hydrated calcium sulfate	14.28 g
Mass of crucible and contents after heating for 5 minutes	14.12 g
Mass of crucible and contents after heating for 10 minutes	14.03 g
Mass of crucible and contents after heating for 15 minutes	13.92 g
Mass of crucible and contents after heating for 20 minutes	13.92 g

(i) Explain why the student weighed the crucible and its contents several times during the heating process.

_____

_____

_____ [1]

(ii) Calculate the mass of water of crystallisation lost.

Mass of water of crystallisation = _____ g [1]

(iii) Calculate the number of moles of water of crystallisation lost.

(Relative atomic masses: H = 1; O = 16)

Moles of water of crystallisation = _____ [2]

(iv) Calculate the mass of anhydrous calcium sulfate.

Mass of anhydrous calcium sulfate = _____ g [1]

(v) Calculate the number of moles of anhydrous calcium sulfate.

(Relative atomic masses: O = 16; S = 32; Ca = 40)

Moles of anhydrous calcium sulfate = _____ [2]

(vi) Using your answers to parts **(iii)** and **(v)**, determine the value of x in $CaSO_4.xH_2O$.

x = _____ [1]

THIS IS THE END OF THE QUESTION PAPER

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

Examiner Number