



Rewarding Learning

General Certificate of Secondary Education
2017

Centre Number

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Candidate Number

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GCSE Chemistry

Unit 1

Higher Tier



[GCH12]

GCH12

WEDNESDAY 14 JUNE, 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.

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 **4(c)** and **5(b)**.

A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.



1 (a) Group 1 of the Periodic Table is a group of reactive metals.

(i) By what name are the Group 1 metals known?

_____ [1]

(ii) A piece of sodium metal is cut with a knife. Describe the appearance of the metal when it is freshly cut and a few minutes after it is cut.

_____ [2]

(iii) Write the symbol for the least reactive element in Group 1.

_____ [1]

(b) An atom of an element has the electronic configuration 2,8,5.

(i) In which group of the Periodic Table is this element found?

_____ [1]

(ii) In which period of the Periodic Table is this element found?

_____ [1]



(c) Group 0 of the Periodic Table is a group of unreactive non-metals.

(i) By what name are the elements of Group 0 known?

_____ [1]

(ii) Explain why the elements of Group 0 are unreactive.

 _____ [2]

(d) The elements in Group 7 are reactive non-metals.

(i) The physical properties of two Group 7 elements are shown in the table below. Complete the table.

Element	Colour	Physical state at room temperature
Chlorine		Gas
Iodine	Dark grey	

[2]

(ii) State the trend in reactivity on descending Group 7.

_____ [1]

(e) (i) A displacement reaction occurs when chlorine is added to a solution of potassium iodide. State the colour change observed in the solution.

From _____ to _____ [2]

(ii) Write a half equation to represent the conversion of iodide ions to iodine molecules.

_____ [3]

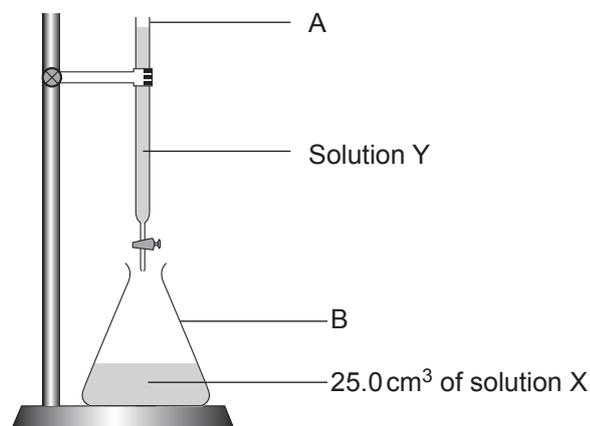
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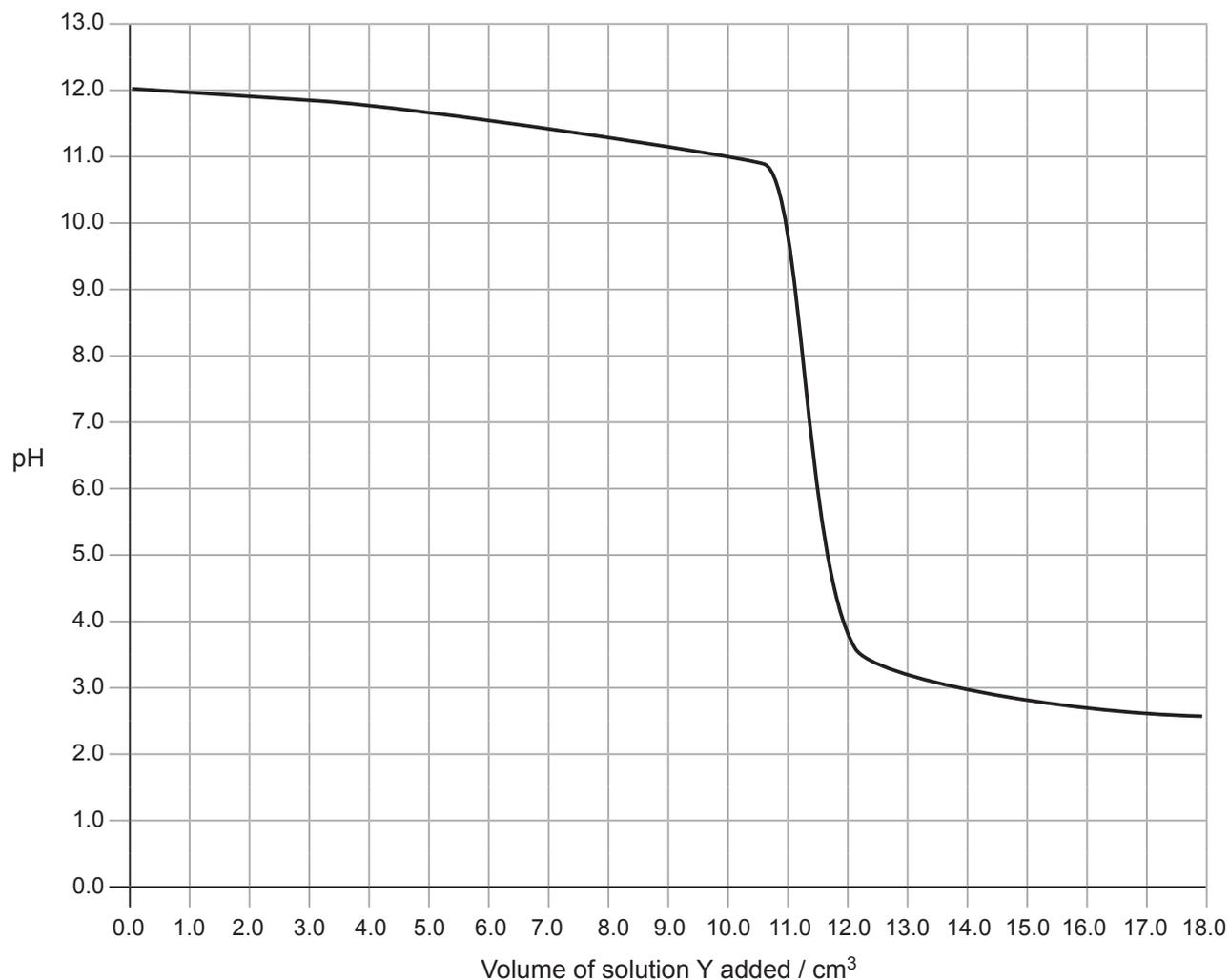


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- 2 (a) In an experiment a student slowly added solution Y in 0.5 cm^3 portions to 25.0 cm^3 of a solution X and swirled the mixture. The apparatus for the experiment is shown below.



The pH after each addition of solution Y was measured and recorded. A graph of pH against volume of solution Y added was drawn.



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(i) Name the piece of apparatus labelled A.

_____ [1]

(ii) Name the piece of apparatus labelled B.

_____ [1]

(iii) Suggest how the pH of the solution was measured.

_____ [1]

(iv) Why was the flask swirled after each addition of 0.5 cm^3 of solution Y?

_____ [1]

(v) Use the graph to explain if solution X is an acidic, alkaline or neutral solution.

_____ [2]

(vi) Use the graph to describe how the pH of the mixture in the conical flask changes as solution Y is slowly added until 14.0 cm^3 have been added.

_____ [2]

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(vii) Write an ionic equation for the neutralisation reaction which occurs between solution X and solution Y.

_____ [2]

(viii) What volume of solution Y is needed to react with solution X to form a neutral solution?

_____ [1]



(b) Solution Z contains a mixture of two compounds. The mixture was tested to identify the cations and anions present in the mixture.

(i) Complete the table to give the expected observations.

Test	Observation	Deduction
1. flame test		sodium ions present
2. (i) add 1 cm ³ of sodium hydroxide solution (ii) add excess sodium hydroxide solution		zinc ions present
3. add some barium chloride solution		sulfate ions present
4. add some silver nitrate solution		chloride ions present

[5]

(ii) Write an ionic equation for the reaction which occurred in test 4.

[2]

(iii) Write the formulae of two different compounds which could be present in solution Z.

[2]

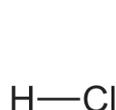
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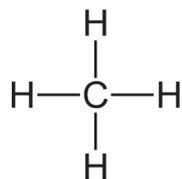


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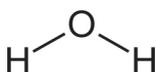
- 3 (a) Some covalent substances are shown below. They are labelled A, B, C, D, E and F.



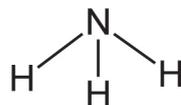
A



B



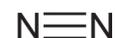
C



D



E



F

- (i) Which letter (A, B, C, D, E or F) represents methane? _____ [1]
- (ii) Which letter (A, B, C, D, E or F) represents ammonia? _____ [1]
- (iii) Which letter (A, B, C, D, E or F) represents a diatomic element? _____ [1]
- (iv) Write the chemical formula of D. _____ [1]
- (v) Draw dot and cross diagrams to show the bonding in C and E. Only outer shell electrons should be shown.

C

E

[2]



(vi) Explain why F has a low boiling point.

[3]

(vii) What is a covalent bond?

[2]

(viii) Substance A can be formed from the reaction between hydrogen and chlorine. Write a balanced symbol equation for the reaction.

[3]

(ix) Substance D reacts with substance A to form ammonium chloride. Write the formula for ammonium chloride.

[1]

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(b) When atoms form ions they lose or gain electrons.

The table below shows some information about six different ions.
Complete the table.

Ion	Atomic number	Mass number	Number of protons	Number of electrons	Number of neutrons
Mg^{2+}	12	24	12	10	12
O^{2-}	8				8
	19	39		18	
			30	28	35
Sc^{3+}		45	21		
	53	127		54	

[6]

(c) Mg^{2+} and O^{2-} ions are attracted to each other and form a compound.

(i) Name the compound.

_____ [1]

(ii) Explain why this compound has a high melting point and conducts electricity when molten.

_____ [3]





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4 Salts are ionic compounds which form during reactions of acids.

- (a) Sodium sulfate is a salt which may be prepared by reacting sodium hydroxide with sulfuric acid. Write a balanced symbol equation for this reaction.

_____ [3]

- (b) Copper(II) sulfate is a salt which may be prepared by reacting copper(II) oxide with sulfuric acid. Write a balanced symbol equation for this reaction.

_____ [2]



(d) To prepare pure crystals of copper(II) sulfate, a copper(II) sulfate solution was evaporated to half volume and allowed to cool and crystallise.

(i) Why is the solution not evaporated to dryness?

_____ [1]

(ii) Why do crystals form as the solution is cooled?

_____ [1]

(iii) State **two** methods of drying the crystals.

_____ [2]

(e) To determine the solubility of copper(II) sulfate in water at 20°C a saturated solution of copper(II) sulfate was evaporated to dryness.

The following results were obtained:

mass of evaporating basin = 21.45 g

mass of evaporating basin and saturated solution = 38.45 g

mass of evaporating basin and copper(II) sulfate after heating = 25.95 g

Calculate the mass of copper(II) sulfate after heating and the mass of water in the solution. Use these values to calculate the solubility of copper(II) sulfate in g/100 g at 20°C.

Solubility _____ g/100 g water [3]



- 5 (a) The following table shows details of three different calcium compounds. Complete the table.

(Relative atomic masses: H = 1; C = 12; O = 16; Ca = 40)

Substance	Mass	Relative formula mass	Moles
Ca(OH)_2	0.185 g		
$\text{Ca(HCO}_3)_2$	kg		20
$(\text{C}_{17}\text{H}_{35}\text{COO})_2\text{Ca}$	g		1.5

[6]



- (c) Calculate the loss in mass when all of the water of crystallisation is removed from 1.095 g of hydrated calcium chloride, $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$.

(Relative atomic masses: H = 1; O = 16; Cl = 35.5; Ca = 40)



Loss in mass = _____ g [6]

- (d) Calculate the percentage of water of crystallisation, by mass, in hydrated calcium chloride, $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$.

(Relative atomic masses: H = 1; O = 16; Cl = 35.5; Ca = 40)

Percentage = _____ % [2]

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Question Number	Marks
1	
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Total Marks	
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Examiner Number

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SYMBOLS OF SELECTED IONS

Positive ions

Name	Symbol
Ammonium	NH_4^+
Chromium(III)	Cr^{3+}
Copper(II)	Cu^{2+}
Iron(II)	Fe^{2+}
Iron(III)	Fe^{3+}
Lead(II)	Pb^{2+}
Silver	Ag^+
Zinc	Zn^{2+}

Negative ions

Name	Symbol
Carbonate	CO_3^{2-}
Dichromate	$\text{Cr}_2\text{O}_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogen carbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	HCOO^-
Nitrate	NO_3^-
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}

DATA LEAFLET

For the use of candidates taking
 Science: Chemistry,
 Science: Double Award
 or Science: Single Award

Copies must be free from notes or additions of any kind. No other type of data booklet or information sheet is authorised for use in the examinations.

SOLUBILITY IN COLD WATER OF COMMON SALTS, HYDROXIDES AND OXIDES

Soluble
All sodium, potassium and ammonium salts
All nitrates
Most chlorides, bromides and iodides EXCEPT silver and lead chlorides, bromides and iodides
Most sulfates EXCEPT lead and barium sulfates Calcium sulfate is slightly soluble

Insoluble
Most carbonates EXCEPT sodium, potassium and ammonium carbonates
Most hydroxides EXCEPT sodium, potassium and ammonium hydroxides
Most oxides EXCEPT sodium, potassium and calcium oxides which react with water

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