

Tuesday 9 June 2015 – Afternoon

GCSE TWENTY FIRST CENTURY SCIENCE CHEMISTRY A/ADDITIONAL SCIENCE A

A172/01 Modules C4 C5 C6 (Foundation Tier)

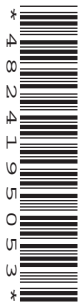
Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
None

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: 1 hour



Candidate forename		Candidate surname	
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Centre number						Candidate number				
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INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with a pencil (✎).
- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **24** pages. Any blank pages are indicated.
- A list of qualitative tests for ions is printed on page **2**.
- The Periodic Table is printed on the back page.

TWENTY FIRST CENTURY SCIENCE DATA SHEET

Qualitative analysis

Tests for ions with a positive charge

Ion	Test	Observation
calcium Ca^{2+}	add dilute sodium hydroxide	a white precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
copper Cu^{2+}	add dilute sodium hydroxide	a light blue precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
iron(II) Fe^{2+}	add dilute sodium hydroxide	a green precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
iron(III) Fe^{3+}	add dilute sodium hydroxide	a red-brown precipitate forms; the precipitate does not dissolve in excess sodium hydroxide
zinc Zn^{2+}	add dilute sodium hydroxide	a white precipitate forms; the precipitate dissolves in excess sodium hydroxide

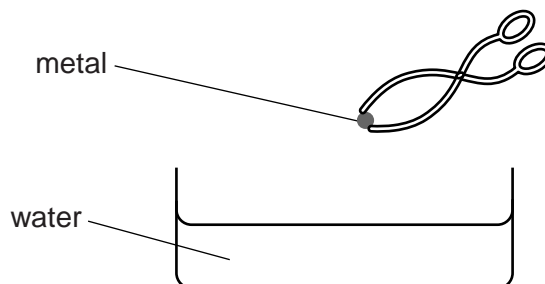
Tests for ions with a negative charge

Ion	Test	Observation
carbonate CO_3^{2-}	add dilute acid	the solution effervesces; carbon dioxide gas is produced (the gas turns lime water from colourless to milky)
chloride Cl^-	add dilute nitric acid, then add silver nitrate	a white precipitate forms
bromide Br^-	add dilute nitric acid, then add silver nitrate	a cream precipitate forms
iodide I^-	add dilute nitric acid, then add silver nitrate	a yellow precipitate forms
sulfate SO_4^{2-}	add dilute acid, then add barium chloride or barium nitrate	a white precipitate forms

Answer **all** the questions.

- 1 Jack investigates the reactions of some Group 1 metals with water.

He adds a small piece of each metal to water and measures how long it takes for the reaction to finish.



Jack does experiments using lithium, sodium and potassium.

He uses the same amount of metal and the same amount of water each time.

The table shows his results.

Metal	Time taken for the reaction to finish in s
lithium	35
sodium	12
potassium	5

- (a) What does the table show about the reactivity of the Group 1 metals?

Explain your answer.

.....

.....

..... [2]

- (b) Jack adds a small piece of potassium to water in a beaker.
 He adds some Universal Indicator to the water.
 He uses a thermometer to measure the temperature change during the reaction.
 He writes down his observations.

Draw straight lines to connect each **observation** with the correct **reason**.

Observation

Reason

Universal Indicator turns blue.

A flammable gas is made.

A flame appears around the potassium.

The reaction is exothermic.

The temperature of the water increases.

Potassium has a very low density.

Potassium stays on the surface of the water.

An alkali is made.

[2]

- (c) Potassium is stored in oil.

Jack leaves a piece of potassium out of the oil for a few minutes.
 He notices that the shiny surface of the potassium becomes dull very quickly.

What is the potassium reacting with?

Put a **ring** around the correct answer.

hydrogen

oxygen

nitrogen

chlorine

[1]

[Total: 5]

2 Abbi does some experiments to investigate the reactivity of Group 7 elements.

Group 7

F fluorine
Cl chlorine
Br bromine
I iodine

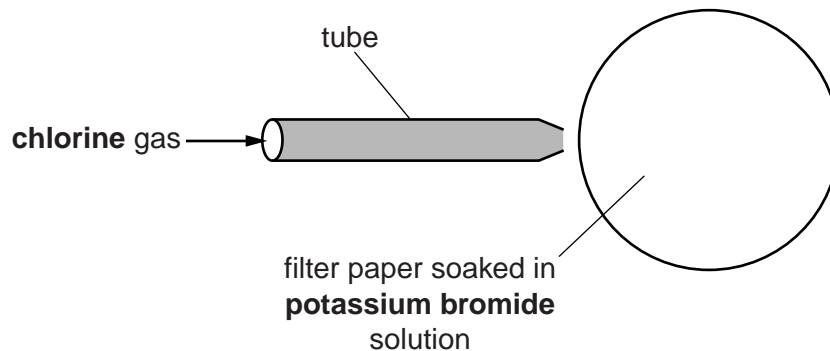
(a) For safety, Abbi does all of the experiments in a fume cupboard. Why is this necessary?

.....

.....

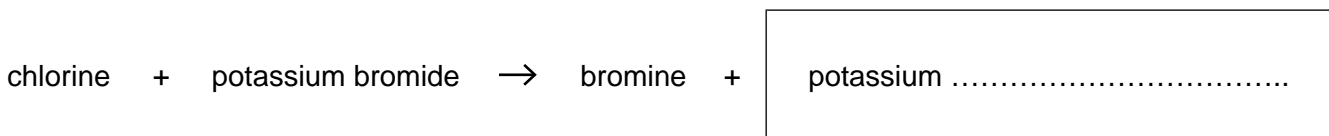
..... [1]

(b) Abbi passes chlorine gas over a filter paper soaked in potassium bromide solution. Chlorine gas is blown onto the filter paper down a tube.



The filter paper goes orange because bromine is made.

(i) Complete the word equation for this reaction.



[1]

(ii) What is the name for this type of reaction?

Put a ring around the correct answer.

- combustion displacement electrolysis neutralisation**

[1]

Turn over

7

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Turn over for the next question

3 Mendeleev developed the modern Periodic Table. Other scientists were involved.



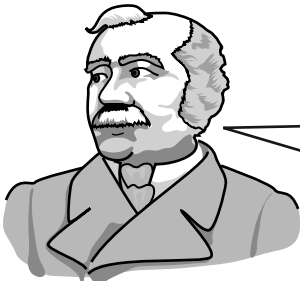
Mendeleev

I have developed a new way of arranging the elements in a table.



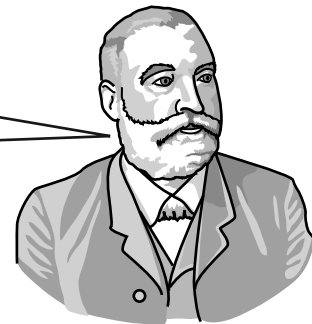
Scientist 2

There are gaps in the table and problems with the order of some elements. This does not work for all elements.



Scientist 3

I have discovered a new element. Its properties mean that it could go in one of the gaps in Mendeleev's table.



Scientist 4

I have discovered a different new element. The properties mean that it could go in a different gap.



Scientist 5

I am going to do the same experiments as Scientist 3 and Scientist 4, and look at the results.

(a) Which **two** scientists are doing a peer review?

Explain how what they say is peer review.

.....

.....

.....

..... [3]

(b) Mendeleev's ideas were supported by the discoveries of **Scientist 3** and **Scientist 4**.

Explain why.

.....

.....

.....

..... [2]

[Total: 5]

4 Liz collects some samples of rock.



She thinks that the samples contain limestone.

(a) Limestone rock is mainly calcium carbonate.

Liz tests the rock. She adds dilute acid and tests the gas given off using limewater.

What results does Liz expect if the rock contains **carbonate** ions? (See data sheet, page 2)

Put a tick (✓) in the boxes next to the **two** correct answers.

A blue precipitate is made.

The rock turns yellow.

The acid turns red.

The limewater turns milky.

Carbon dioxide is produced.

[1]

(b) Limestone is a solid mineral.

In which part of the Earth are solid minerals found?

Put a **ring** around the correct answer.

atmosphere

hydrosphere

lithosphere

[1]

(c) On Earth, limestone only forms in large amounts of water.

Scientists have sent space probes to Mars.

The space probes test rock on Mars to see if it contains limestone.

So far no limestone has been found.

Explain why the scientists are interested in collecting data about limestone on Mars.

.....

.....

..... [2]

[Total: 4]

5 Lee looks up some data about some molecular substances.

Substance	Formula	Relative formula mass	State at room temperature
nitrogen	N ₂	28
oxygen	32	gas
carbon dioxide	CO ₂	44	gas
water	H ₂ O	18	liquid

(a) Complete the table by filling in the blank spaces.

[2]

(b) All of the substances in the table are **molecular**.

What does molecular mean?

Put a tick (✓) in the box next to the correct answer.

many ions bonded together

a large structure of identical atoms

a small number of atoms bonded together

a structure of protons and electrons

[1]

(c) Lee looks at the data and has this idea.

I think that if a molecular substance has a relative formula mass of less than 100 it is always a gas.

Does the data in the table support Lee's idea?

Explain your reasoning.

.....

.....

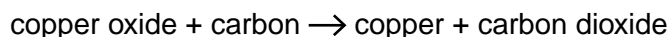
.....

..... [3]

[Total: 6]

6 Metals can be extracted from metal oxides by heating with carbon.

(a) The equation shows what happens when copper oxide is heated with carbon.



Why is this a reduction reaction?

Put a tick (✓) in the box next to the correct answer.

Too much carbon dioxide is made.

The copper oxide loses oxygen.

The mass gets higher.

The process is not very efficient.

[1]

(b) Large-scale metal extraction processes involve both costs and benefits.

(i) Companies choose metal extraction processes that use as little energy as possible.

Why does using less energy reduce the **cost to the company** and the **cost to the environment**?

Put a tick (✓) in the boxes next to the **three** correct answers.

Using less energy uses less fuel.

Some fuels are less flammable than others.

All fuels burn to give off energy.

Using more fuel gives off more pollutant gases.

Different types of fuel can be used for the process.

[2]

(ii) Give **two** examples of the ways that people **benefit** from large-scale metal extraction processes.

.....

.....

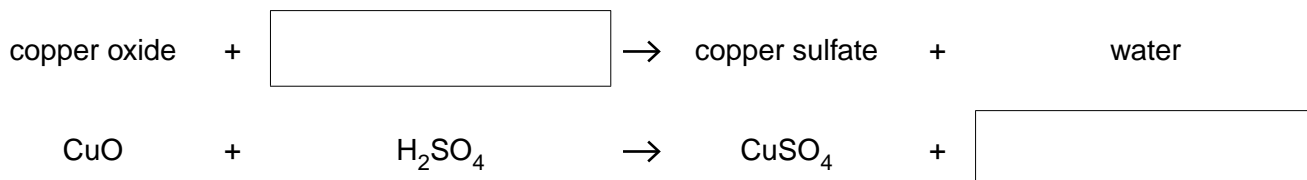
..... [2]

7 Sam works for a company that makes chemicals to kill fungi on plants.

One of the chemicals the company makes is copper sulfate.

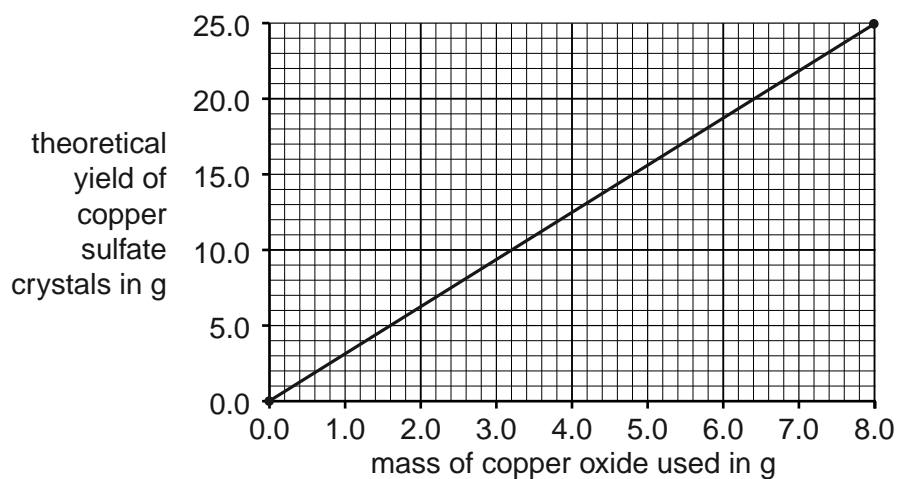
(a) Sam makes some copper sulfate from copper oxide.

Complete the **word** and **symbol** equation for the reaction.



[2]

(b) Sam draws a graph to show the theoretical yield of copper sulfate crystals that can be made from copper oxide.



(i) What mass of copper oxide would Sam need to make 10g of copper sulfate crystals?

..... [1]

(ii) The company makes the fungicide in large quantities.

Use your answer to (i) to work out how much copper oxide would be needed to make 5 kg of copper sulfate crystals.

..... [2]

- (iii) In practice, Sam finds that he makes a lower mass of copper sulfate crystals than he predicts.

Which statements can explain why this happens?

Put a tick (✓) in the boxes next to the **two** correct answers.

There are impurities in the copper oxide.

Sam adds too much acid.

Sam has not dried his crystals thoroughly.

Some chemicals are lost during the experiment.

The rate of the reaction was too fast.

[2]

[Total: 7]

- 8 Acid rain contains a dilute solution of sulfuric acid.

Acid rain causes some lakes to become too acidic, killing fish and other wildlife.

- (a) What can be used to measure acidity?

Put a tick (✓) in the boxes next to the **two** correct answers.

- | | |
|----------------------|--------------------------|
| a gas syringe | <input type="checkbox"/> |
| Universal Indicator | <input type="checkbox"/> |
| a measuring cylinder | <input type="checkbox"/> |
| a pH meter | <input type="checkbox"/> |

[1]

- (b) A water company treats a lake with calcium hydroxide to neutralise acidity.

What is the pH when the water is neutral?

Put a (ring) around the correct answer.

1 4 7 9 14

[1]

- (c) The water company measures the temperature of the surface of the lake after neutralisation.

They find that the temperature has increased.

Why do some reactions cause an increase in temperature?

Put a tick (✓) in the box next to the correct answer.

- | | |
|--|--------------------------|
| Some reactions give out energy. | <input type="checkbox"/> |
| Some reactions are endothermic. | <input type="checkbox"/> |
| Reactions need energy to start. | <input type="checkbox"/> |
| Reactions are faster at higher temperatures. | <input type="checkbox"/> |

[1]

(d) The calcium hydroxide is dropped into the lake from a helicopter.

The calcium hydroxide is a fine powder and not large pieces.

What effect does using a fine powder rather than large pieces have on the rate of the reaction?

Explain your answer.

.....

.....

.....

..... [2]

[Total: 5]

9 Joe does some experiments to investigate the rate of a reaction.

(a) He measures the time taken for the reaction to finish at different temperatures.

Temperature in °C	Time taken for reaction to finish in s
20	45
30	25
40	15
50	8

Explain what the results show about the rate of reaction.

.....
..... [2]

- (b) Joe investigates the effect of some catalysts on the reaction. He writes down which metal ion is in each catalyst.

He measures the time taken for the reaction to finish when each catalyst is used.

	Experiment	Metal ion in catalyst	Formula	Time taken for reaction to finish in s
	1	no catalyst		45
Group 1 elements	2	sodium	Na ⁺	45
	3	potassium	K ⁺	45
Other elements	4	cobalt	Co ²⁺	15
	5	iron	Fe ³⁺	22

Joe talks about his results with Eve.



Joe

I think that Group 1 elements do not work as catalysts.



Eve

I think the higher the charge on the metal ion, the better the catalyst works.

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The Periodic Table of the Elements

	1	2	3	4	5	6	7	0										
	7 Li lithium 3	9 Be beryllium 4	11 Na sodium 11	12 Mg magnesium 12	13 Al aluminium 13	14 Si silicon 14	15 P phosphorus 15	16 S sulfur 16	17 Cl chlorine 17	18 Ar argon 18								
	19 K potassium 19	20 Ca calcium 20	21 Sc scandium 21	22 Ti titanium 22	23 V vanadium 23	24 Cr chromium 24	25 Mn manganese 25	26 Fe iron 26	27 Co cobalt 27	28 Ni nickel 28	29 Cu copper 29	30 Zn zinc 30	31 Ga gallium 31	32 Ge germanium 32	33 As arsenic 33	34 Se selenium 34	35 Br bromine 35	36 Kr krypton 36
	37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium 43	44 Ru ruthenium 44	45 Rh rhodium 45	46 Pd palladium 46	47 Ag silver 47	48 Cd cadmium 48	49 In indium 49	50 Sn tin 50	51 Sb antimony 51	52 Te tellurium 52	53 I iodine 53	54 Xe xenon 54
	55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77	78 Pt platinum 78	79 Au gold 79	80 Hg mercury 80	81 Tl thallium 81	82 Pb lead 82	83 Bi bismuth 83	84 Po polonium 84	85 At astatine 85	86 Rn radon 86
	[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106	[264] Bh bohrium 107	[277] Hs hassium 108	[268] Mt meitnerium 109	[271] Ds darmstadtium 110	[272] Rg roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

1 H hydrogen 1

Key
relative atomic mass
atomic symbol
name
atomic (proton) number

* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.