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Wednesday 1 February 2012 – Afternoon

GCSE TWENTY FIRST CENTURY SCIENCE CHEMISTRY A

A322/02 Unit 2: Modules C4 C5 C6 (Higher Tier)

A336960112

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: 40 minutes

A322202

Candidate forename		Candidate surname	

Centre number						Candidate number				

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 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 **42**.
- The Periodic Table is printed on the back page.
- This document consists of **16** pages. Any blank pages are indicated.

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Answer **all** the questions.

1 Ben does some flame tests.

(a) He heats a **sodium** compound in a hot flame.

He then carries out the same test using a **potassium** compound.

What would Ben expect to **see** when he does the two tests?

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

The flames flash at different rates.	☐
The flames are different colours.	☐
The sodium compound burns much faster than the potassium compound.	☐
The heights of the flames are different in each test.	☐

[1]

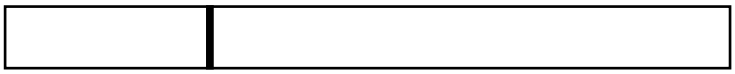
(b) Ben does some more flame tests.

He compares the flame test results for a potassium compound and a sodium compound.

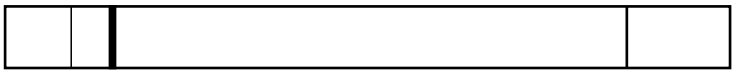
He looks at the flames from each compound using a spectroscope.

The diagrams show what Ben sees.

spectrum of sodium compound

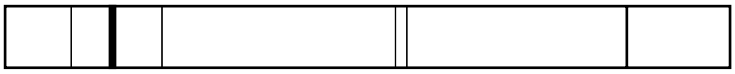


spectrum of potassium compound



Ben does the same test on a mixture of compounds. He does not know what the mixture contains.

spectrum for the mixture of compounds



Ben writes down a conclusion from the results of his tests.

> Conclusion
>
> The mixture contains potassium compounds but no sodium compounds. The mixture also contains a compound from another unknown element.

Explain how Ben's results support his conclusion.

.....

.....

.....

.....

.....

..... **[4]**

(c) Ben thinks that different elements have different spectra because their atoms have different numbers of electrons.

The table shows the number and arrangement of electrons in some atoms.

element	number of electrons	electron arrangement
.....	3	2.1
sodium (Na)	11	.....
potassium (K)	.....	2.8.8.1

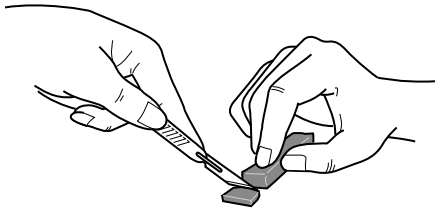
Complete the table by filling in the gaps. **[2]**

[Total: 7]

2 Lithium is a Group 1 metal. Some batteries contain lithium.

Amy wants to find out what happens if air or water react with lithium.

(a) Amy cuts a fresh piece of lithium.



The fresh surface of the lithium reacts with oxygen in the air.

(i) What does Amy see when the surface reacts with oxygen?

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

The surface bubbles and fizzes. ☐

A flame appears. ☐

The surface changes from shiny to dull. ☐

The piece of lithium gets smaller. ☐

[1]

(ii) When lithium reacts with oxygen, **lithium oxide** is made.

When lithium oxide is left in the air for a long time, it reacts with carbon dioxide to form **lithium carbonate**.

Complete the table of information by filling in the missing formulae.

name of compound	formula	formula of positive ion in compound	formula of negative ion in compound
lithium oxide		Li^+	O^{2-}
lithium carbonate	Li_2CO_3	Li^+	

[2]

(b) Amy drops a freshly cut piece of lithium into a beaker of water.

The lithium fizzes.

(i) A gas is made in the reaction.

What is the name of the gas?

Put a (ring) around the correct answer.

carbon dioxide **chlorine** **hydrogen** **oxygen** **nitrogen**

[1]

(ii) Amy adds an indicator to the solution in the beaker at the end of the reaction.

The indicator shows that the solution contains an alkali.

What is the name of the alkali?

..... **[1]**

(c) Amy does some research into another element, caesium.

Caesium is also used in some batteries.

She knows that caesium and lithium are both in Group 1.

(i) Which of the following statements about caesium and lithium are **true** and which are **false**?

Put a tick (✓) in one box in each row to show whether each statement is true or false.

	true	**false**
Both elements are in the same vertical column of the Periodic Table.		
They are both non-metal elements.		
The melting points of both elements are the same.		
An atom of caesium has the same number of protons as an atom of lithium.		
The elements have the same number of electrons in their outer shells.		

[2]

(ii) Caesium reacts with cold water.

Predict how the reaction of caesium with water will be different from the reaction of lithium with water.

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

The caesium reaction takes a much longer time.	☐
A different gas is made in each reaction.	☐
The caesium reaction is much faster.	☐
The caesium reaction makes an acid.	☐
A different compound is made in each reaction.	☐

[1]

[Total: 8]

3 Joe finds some information about the bonding in different chemicals.

(a) The table shows some of the information he finds.

Complete the table by putting a tick (✓) in one box in each row to show the type of bonding in each chemical.

chemical	conducts electricity when solid	conducts electricity when molten	ionic	covalent	metallic
A	yes	yes			
B	no	yes			
C	no	no			

[2]

(b) Joe writes down some general statements about ionic and covalent compounds.

Put a tick (✓) in one box in each row to show whether each statement is **only true for ionic compounds** or **only true for covalent compounds** or **true for both**.

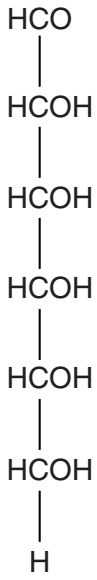
	only true for ionic compounds	only true for covalent compounds	true for both
conduct electricity when dissolved in water			
may have melting and boiling points below room temperature			
may have weak forces of attraction between molecules			
atoms are held together by forces between nuclei and shared electrons			
may be solids at room temperature			

[3]

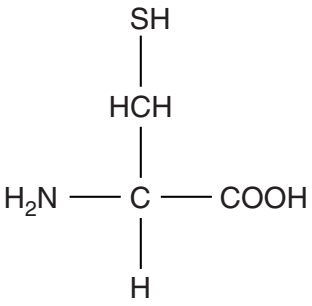
[Total: 5]

4 Sugars and amino acids are important molecules in living things.

The diagrams show the structure of a **sugar** and an **amino acid**.



sugar



amino acid

(a) Describe the **similarities** and **differences** between the two molecules.

.....

.....

.....

.....

.....

..... **[4]**

(b) The formula of the sugar in the diagram is $C_6H_{12}O_6$.

What is the formula of the amino acid?

formula ..... **[1]**

[Total: 5]

5 Copper is extracted from minerals. Different copper minerals contain different copper compounds.

The table shows the formulae of some compounds of copper in different minerals.

mineral	formula of compound	relative formula mass of compound	mass of copper in formula
cuprite	Cu_2O	143	127
malachite	$CuCO_3$	123.5	
tenorite	CuO		63.5

(a) Complete the table by filling in the missing masses. **[1]**

(b) Copper can be extracted from each of these compounds.

Draw straight lines to connect each **compound** to the correct **mass of copper that can be extracted from 1 kg** of the compound.

compound	mass of copper that can be extracted from 1 kg
Cu_2O	799 g
$CuCO_3$	514 g
CuO	888 g

[2]

(c) Copper is extracted by reduction.

Which of the following statements explains what happens during this reduction reaction?

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

Carbon removes oxygen from the copper compound. ☐

Small amounts of copper are produced. ☐

Copper gives up electrons. ☐

The mineral is melted down. ☐

[1]

[Total: 4]

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Turn over for Question 6

6 Rose does an experiment to make some zinc sulfate.

She reacts zinc metal with an acid.

(a) (i) Give the **name** and **formula** of the acid that reacts with zinc to make zinc sulfate.

name .....

formula ..... **[1]**

(ii) Give the **name** and **formula** of the gas that is made when zinc metal reacts with the acid.

name .....

formula ..... **[1]**

(b) Rose does five experiments to find out how changing the concentration of acid affects the rate of the reaction.

She uses the same mass of zinc in each test.

She uses different mixtures of acid and water in each test.

For each concentration, she measures the time taken for the reaction to make 10 cm^3 of gas.

The table shows her results.

experiment	**volume of acid in cm^3**	**volume of water in cm^3**	**time to collect 10 cm^3 gas in s**
1	50	0	5
2	40	10	9
3	30	20	12
4	20	30	16
5	10	40	21

(i) Which experiment uses the lowest concentration of acid?

experiment ..... **[1]**

(ii) How does the rate of reaction change when the concentration of the acid changes?

Explain how information in the table shows this.

.....

.....

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

(iii) Explain why changing the concentration of acid changes the rate of reaction.

Use ideas about particles colliding in your answer.

.....

.....

.....

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

(c) Rose wants to use a different solid instead of zinc metal.

Which of these solids react with the acid to make zinc sulfate?

Put (rings) around the **three** correct answers.

zinc chloride **zinc carbonate** **zinc nitrate** **zinc oxide** **zinc hydroxide**

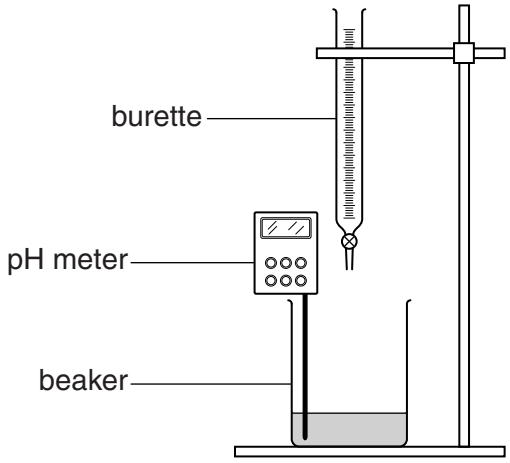
[2]

[Total: 9]

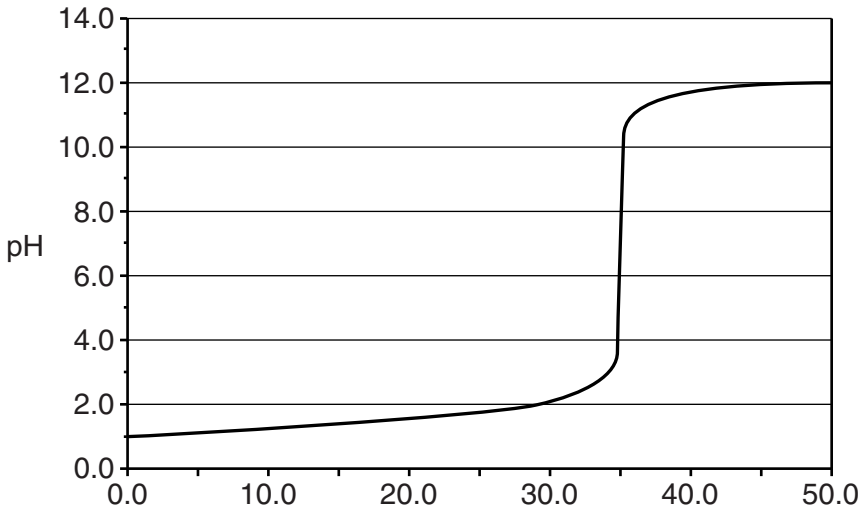
7 Liz does a titration.

She puts 20 cm^3 of hydrochloric acid in a beaker and adds potassium hydroxide solution from a burette.

She measures the pH of the solution in the beaker using a pH meter.



The graph shows her results.



(a) (i) What are the pHs of the hydrochloric acid and the potassium hydroxide solution that Liz used in the titration?

pH of hydrochloric acid .....

pH of potassium hydroxide solution ..... **[1]**

(ii) What volume of potassium hydroxide solution exactly neutralises the hydrochloric acid?

volume ..... cm^3 **[1]**

(b) Liz does more titrations using samples of two different concentrations of hydrochloric acid, **A** and **B**.

She uses the same potassium hydroxide solution each time.

These are her results.

	A	**B**
volume of hydrochloric acid used in cm^3	20	20
volume of potassium hydroxide solution used to neutralise the acid in cm^3	15	10

Which of the following statements about these titrations is true?

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

A is more concentrated than **B**. ☐

Some of the hydrochloric acid in sample **B** did not react with the potassium hydroxide solution. ☐

The total volume of solution at the end of the titration is higher for **B** than for **A**. ☐

Potassium chloride and carbon dioxide are made in both titrations. ☐

[1]

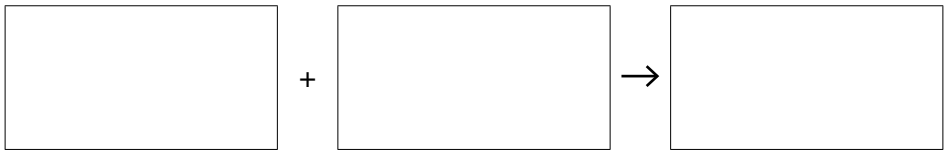
(c) All neutralisation reactions can be shown by a single ionic equation.

The equation shows the ions from the acid reacting with the ions from the alkali.

Complete the **ionic** equation for neutralisation by filling in the boxes.

Choose formulae from this list.

H^+ **H_2** **H_2O** **Na^+** **NaOH** **O_2** **OH^-**



[1]

[Total: 4]

END OF QUESTION PAPER

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **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						

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.