Write your name here

Surname	Other names

Edexcel GCSE

Centre Number	Candidate Number

Chemistry/Additional Science

Unit C2: Discovering Chemistry

Higher Tier

Monday 21 May 2012 – Morning
Time: 1 hour

Paper Reference
5CH2H/01

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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P 4 0 2 4 6 A 0 1 2 0

PEARSON

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.

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Questions begin on next page.

Answer ALL questions

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Group 3

1 The elements in group 3 of the periodic table are boron, aluminium, gallium, indium and thallium.

(a) Elements can be classified as metals or non-metals.

Explain, using its position in the periodic table, whether indium is a metal or a non-metal.

(2)

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.....

.....

(b) Each aluminium atom has 13 electrons.

State the electronic configuration of an aluminium atom.

(1)

.....

(c) Boron has an atomic number of 5.
There are two isotopes of boron, boron-10 and boron-11.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

Every boron atom contains

(1)

☒ **A** five protons

☒ **B** five neutrons

☒ **C** eleven electrons

☒ **D** eleven neutrons

(ii) Explain what is meant by the term **isotopes**.

(2)

.....

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.....

.....

(iii) A sample of boron contains the two isotopes, boron-10 and boron-11.
The relative atomic mass of boron is 10.8

Give the reason why the relative atomic mass is closer to 11 than 10.

(1)

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.....

(Total for Question 1 = 7 marks)

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Patterns in properties

2 (a) Copper is a metal.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

Copper conducts electricity because particles in it move through the structure. These particles are

(1)

☒ **A** positive and negative ions

☒ **B** positive ions only

☒ **C** atoms

☒ **D** electrons

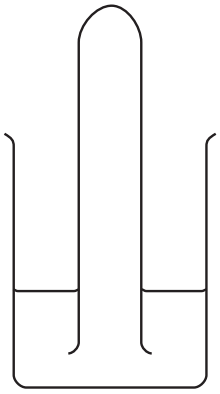
(ii) Copper forms coloured compounds.

Give the name of the type of metals that form coloured compounds.

(1)

.....

(b) A test tube was filled with hydrogen chloride gas.
The test tube was inverted in water and left.



The liquid level rose up to the top of the test tube.

Explain what was formed in the test tube after the water had entered.

(2)

(c) When chlorine is bubbled into potassium bromide solution, the solution turns orange.

Explain why this happens.

(2)

(d) Barium sulfate can be prepared as a white precipitate.

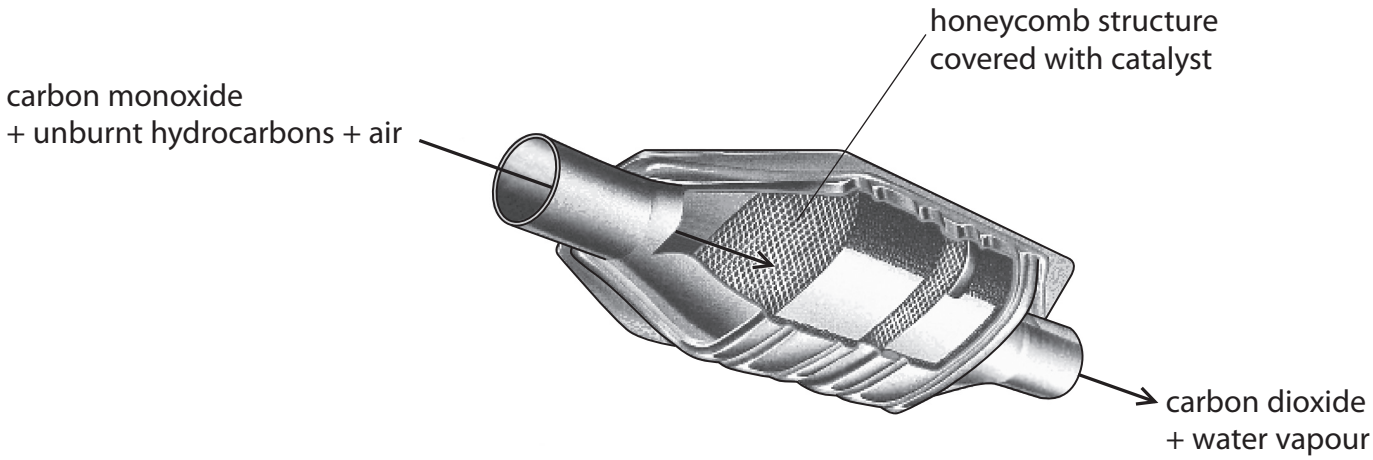
Describe how you could prepare a pure, dry sample of barium sulfate from barium chloride solution and sodium sulfate solution.

(3)

(Total for Question 2 = 9 marks)

Rates of reaction

3 The diagram shows a catalytic converter used in car exhaust systems.
Gases from the car engine pass into the catalytic converter.
In the catalytic converter, carbon monoxide and unburnt hydrocarbons are changed into carbon dioxide and water vapour.



(a) What type of reaction occurs in the catalytic converter?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** cracking

☒ **B** displacement

☒ **C** oxidation

☒ **D** precipitation

(b) It is important that the reactions in the catalytic converter happen quickly.

(i) Explain why the catalyst is spread onto the honeycomb structure rather than used as large pieces.

(2)

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.....

(ii) Hot gases from the engine pass over the catalyst.

Explain why the catalyst is more effective when the engine has been running for a short time rather than when the engine is first started.

(2)

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.....

(c) Carbon monoxide reacts with oxygen, O_2, to form carbon dioxide in the catalytic converter.

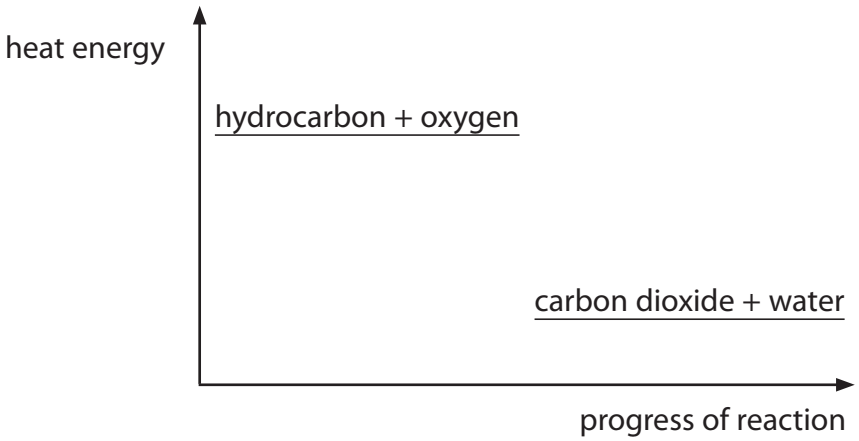
Write the balanced equation for this reaction.

(3)

.....

(d) In the catalytic converter, a hydrocarbon is converted to carbon dioxide and water.

The diagram shows the heat energies of the reactants and products in this reaction.



Explain what the diagram shows about the type of reaction occurring.

(2)

.....

.....

.....

.....

(Total for Question 3 = 10 marks)

Metal halides

4 (a) Copper(II) chloride contains copper ions, Cu^{2+}, and chloride ions, Cl^-.

(i) What is the formula of this copper chloride?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** CuCl

☒ **B** Cu_2Cl

☒ **C** $CuCl_2$

☒ **D** Cu_2Cl_2

(ii) In a reaction 0.64 g copper are reacted to produce copper chloride.
The theoretical yield of this reaction is 1.35 g copper chloride.

Explain what is meant by **theoretical yield**.

(2)

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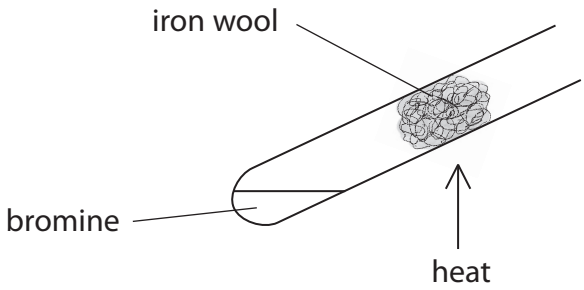
(b) Bromine reacts with hot iron wool to produce solid iron(III) bromide, $FeBr_3$.



(i) Write the balanced equation for the reaction between iron and bromine gas.
Include state symbols.

(3)

.....

(ii) Calculate the relative formula mass of iron(III) bromide, $FeBr_3$.
(Relative atomic masses: Fe = 56, Br = 80)

(1)

.....

.....

relative formula mass = ...

(iii) Iron also reacts with iodine to form iron(II) iodide, FeI_2.

Calculate the percentage by mass of iron in iron(II) iodide.
(Relative formula mass FeI_2 = 310)

(2)

.....

.....

.....

percentage by mass of iron = ...%

(iv) Hydrogen peroxide reacts with some iron compounds.
The molecular formula of hydrogen peroxide is H_2O_2.

Give the empirical formula of hydrogen peroxide.

(1)

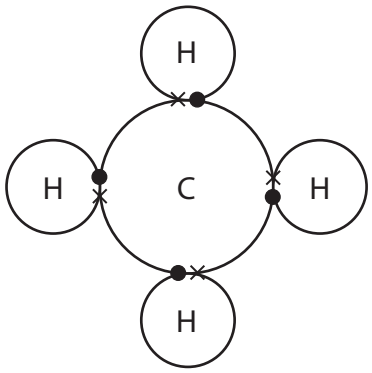
.....

(Total for Question 4 = 10 marks)

Covalent substances

5 Many substances exist as molecules.

(a) The diagram shows the outer shell electrons in a molecule of methane, CH_4.



(i) Each hydrogen atom is bonded to the carbon atom by a covalent bond.

Give the meaning of the term **covalent bond**.

(1)

.....

.....

.....

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

Methane is a typical simple molecular, covalent compound.

A property of methane is that

(1)

☒ **A** it has a high melting point

☒ **B** it is a good conductor of electricity

☒ **C** there are weak bonds in its molecule

☒ **D** it has a low boiling point

(b) Nitrogen and oxygen are gases in air.

Describe how samples of nitrogen and oxygen can be obtained from air.

(3)

*(c) Graphite is a form of the element carbon.
Graphite is a giant molecular, covalent substance.

Use the structure and bonding in graphite to explain why it is able to be used as a lubricant and as a conductor of electricity.

(6)

(d) Give a use of graphite that depends on its ability to conduct electricity.

(1)

(Total for Question 5 = 12 marks)

Sodium chloride

6 (a) The table shows some information about the atoms and the ions of chlorine and sodium.

Complete the table.

(3)

	symbol of		number of electrons in	
	atom	**ion**	**atom**	**ion**
chlorine	Cl	Cl^-	17	
sodium	Na			10

(b) When silver nitrate solution, $AgNO_3$, is added to sodium chloride solution a white precipitate is formed.

(i) Write the balanced equation for this reaction.

(2)

.....

(ii) Silver nitrate solution can be added to a solution to test for the presence of chloride ions.
In this test, dilute nitric acid is added to the solution, followed by the silver nitrate solution.
A white precipitate shows the presence of chloride ions.

Why must the dilute nitric acid be added to make this a reliable test?

Put a cross (☒) in the box next to your answer.

(1)

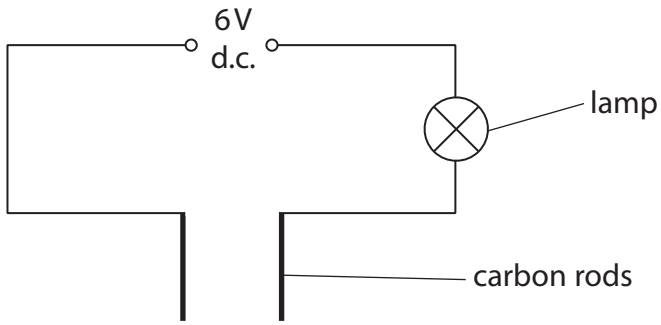
☒ **A** to dilute the solution of chloride ions

☒ **B** because the precipitate only forms if dilute nitric acid is added

☒ **C** to stop the white precipitate changing colour

☒ **D** to remove other ions that would also form a white precipitate

*(c) This circuit was used to test the ability of water, solid sodium chloride and sodium chloride solution to conduct electricity.



The results were

substance	conducts electricity
water	no
solid sodium chloride	no
sodium chloride solution	yes

Explain these results by referring to the structures of the substances.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

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