

Write your name here

Surname

Other names

Centre Number

Candidate Number

**Edexcel GCSE**

**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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**PEARSON**

# The Periodic Table of the Elements

1	2	3	4	5	6	7	0	
7 <b>Li</b> lithium 3	9 <b>Be</b> beryllium 4	11 <b>Na</b> sodium 11	12 <b>C</b> carbon 6	13 <b>Al</b> aluminium 13	14 <b>N</b> nitrogen 7	15 <b>O</b> oxygen 8	16 <b>F</b> fluorine 9	17 <b>Ne</b> neon 10
19 <b>K</b> potassium 19	20 <b>Ca</b> calcium 20	23 <b>Sc</b> scandium 21	24 <b>Ti</b> titanium 22	25 <b>V</b> vanadium 23	26 <b>Cr</b> chromium 24	27 <b>Mn</b> manganese 25	28 <b>Fe</b> iron 26	29 <b>Co</b> cobalt 27
37 <b>Rb</b> rubidium 37	38 <b>Sr</b> strontium 38	39 <b>Y</b> yttrium 39	40 <b>Zr</b> zirconium 40	41 <b>Nb</b> niobium 41	42 <b>Mo</b> molybdenum 42	43 <b>Tc</b> technetium 43	44 <b>Ru</b> ruthenium 44	45 <b>Rh</b> rhodium 45
55 <b>Cs</b> caesium 55	56 <b>Ba</b> barium 56	57 <b>La*</b> lanthanum 57	58 <b>Hf</b> hafnium 58	59 <b>Ta</b> tantalum 59	60 <b>W</b> tungsten 60	61 <b>Re</b> rhenium 61	62 <b>Os</b> osmium 62	63 <b>Ir</b> iridium 63
87 <b>Fr</b> francium 87	88 <b>Ra</b> radium 88	89 <b>Ac*</b> actinium 89	90 <b>Rf</b> rutherfordium 90	91 <b>Db</b> dubnium 91	92 <b>Sg</b> seaborgium 92	93 <b>Bh</b> bohrium 93	94 <b>Hs</b> hassium 94	95 <b>Mt</b> meitnerium 95
133 <b>Cs</b> caesium 55	137 <b>Ba</b> barium 56	139 <b>La*</b> lanthanum 57	178 <b>Hf</b> hafnium 72	181 <b>Ta</b> tantalum 73	184 <b>W</b> tungsten 74	186 <b>Re</b> rhenium 75	190 <b>Os</b> osmium 76	192 <b>Ir</b> iridium 77
193 <b>Bi</b> bismuth 83	207 <b>Pb</b> lead 82	209 <b>Po</b> polonium 84	210 <b>At</b> astatine 85	211 <b>Rn</b> radon 86	212 <b>Fr</b> francium 87	213 <b>Ac</b> actinium 88	214 <b>Th</b> thorium 89	215 <b>Pa</b> protactinium 90
115 <b>In</b> indium 49	119 <b>Sb</b> antimony 51	122 <b>Te</b> tellurium 52	127 <b>I</b> iodine 53	131 <b>Xe</b> xenon 54	132 <b>Ba</b> barium 56	137 <b>Rb</b> rubidium 37	138 <b>Sr</b> strontium 38	139 <b>Y</b> yttrium 39
112 <b>Cd</b> cadmium 48	108 <b>Ag</b> silver 47	106 <b>Pd</b> palladium 46	103 <b>Rh</b> rhodium 45	101 <b>Ru</b> ruthenium 44	96 <b>Mo</b> molybdenum 42	93 <b>Nb</b> niobium 41	91 <b>Zr</b> zirconium 40	89 <b>Y</b> yttrium 39
65 <b>Zn</b> zinc 30	63.5 <b>Cu</b> copper 29	59 <b>Ni</b> nickel 28	59 <b>Co</b> cobalt 27	56 <b>Fe</b> iron 26	55 <b>Mn</b> manganese 25	52 <b>Cr</b> chromium 24	48 <b>Ti</b> titanium 22	45 <b>Sc</b> scandium 21
70 <b>Ga</b> gallium 31	73 <b>Ge</b> germanium 32	75 <b>As</b> arsenic 33	79 <b>Se</b> selenium 34	73 <b>Ge</b> germanium 32	70 <b>Ga</b> gallium 31	65 <b>Zn</b> zinc 30	63.5 <b>Cu</b> copper 29	59 <b>Ni</b> nickel 28
27 <b>Al</b> aluminium 13	28 <b>Si</b> silicon 14	31 <b>P</b> phosphorus 15	32 <b>S</b> sulfur 16	35.5 <b>Cl</b> chlorine 17	32 <b>S</b> sulfur 16	28 <b>Si</b> silicon 14	27 <b>Al</b> aluminium 13	20 <b>Ne</b> neon 10
11 <b>B</b> boron 5	12 <b>C</b> carbon 6	14 <b>N</b> nitrogen 7	16 <b>O</b> oxygen 8	19 <b>F</b> fluorine 9	20 <b>Ca</b> calcium 20	23 <b>Sc</b> scandium 21	27 <b>Al</b> aluminium 13	4 <b>He</b> helium 2

1  
**H**  
hydrogen  
1

relative atomic mass  
atomic symbol  
name  
atomic (proton) number

Elements with atomic numbers 112-116 have been reported but not fully authenticated

\* 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)

.....

.....

**(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

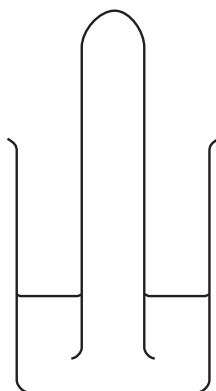
(ii) Copper forms coloured compounds.

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)

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

Explain why this happens.

(2)

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(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)

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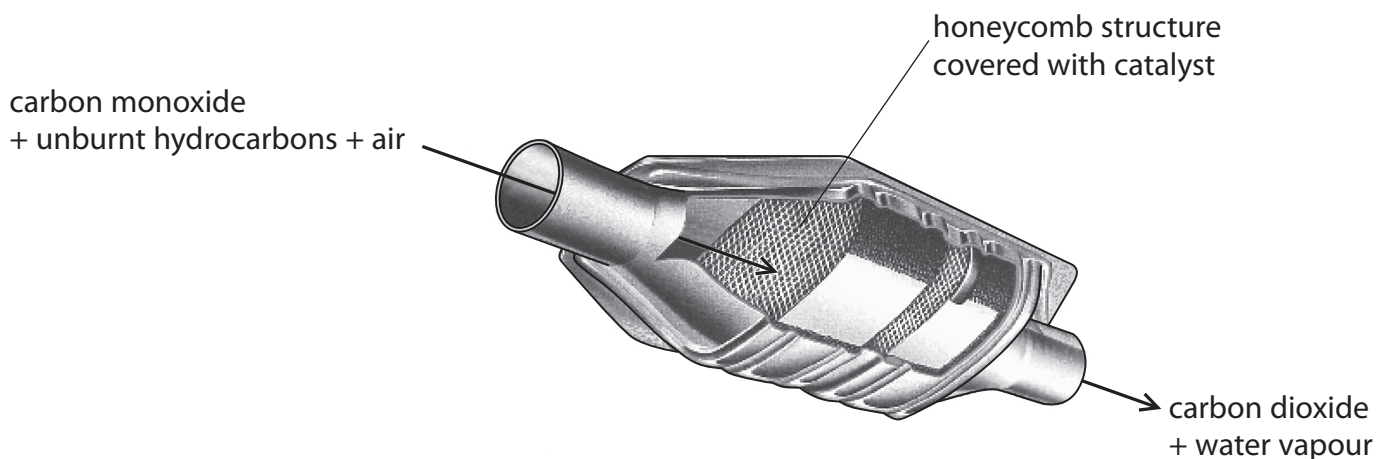
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**(Total for Question 2 = 9 marks)**



### 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.

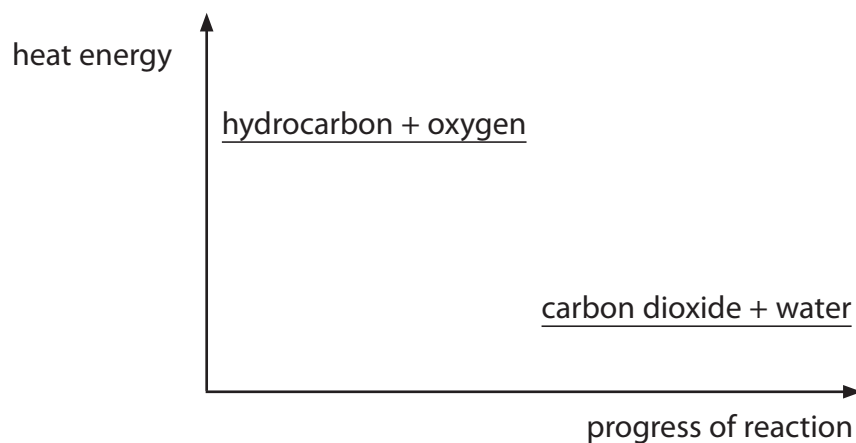
Write the balanced equation for this reaction.

(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)

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**(Total for Question 3 = 10 marks)**



### Metal halides

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

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

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

(1)

- A  $\text{CuCl}$
- B  $\text{Cu}_2\text{Cl}$
- C  $\text{CuCl}_2$
- D  $\text{Cu}_2\text{Cl}_2$

(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)

.....

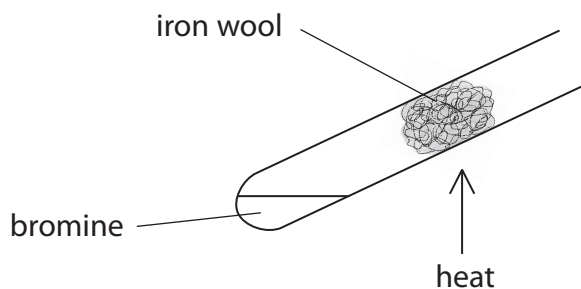
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(b) Bromine reacts with hot iron wool to produce solid iron(III) bromide,  $\text{FeBr}_3$ .



(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,  $\text{FeBr}_3$ . (Relative atomic masses: Fe = 56, Br = 80)

(1)

relative formula mass = .....

(iii) Iron also reacts with iodine to form iron(II) iodide,  $\text{FeI}_2$ .

Calculate the percentage by mass of iron in iron(II) iodide. (Relative formula mass  $\text{FeI}_2 = 310$ )

(2)

percentage by mass of iron = .....%

(iv) Hydrogen peroxide reacts with some iron compounds. The molecular formula of hydrogen peroxide is  $\text{H}_2\text{O}_2$ .

Give the empirical formula of hydrogen peroxide.

(1)

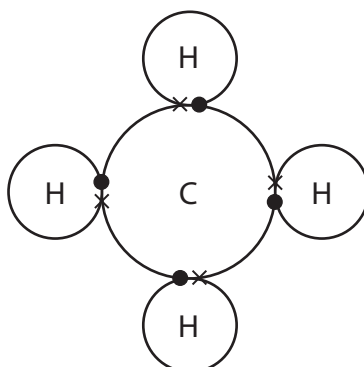
(Total for Question 4 = 10 marks)



## Covalent substances

5 Many substances exist as molecules.

(a) The diagram shows the outer shell electrons in a molecule of methane,  $\text{CH}_4$ .



(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





### 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 <sup>-</sup>	17	
sodium	Na			10

- (b) When silver nitrate solution, AgNO<sub>3</sub>, 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







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