Write your name here

Surname	Other names

Edexcel GCSE

Centre Number	Candidate Number

Chemistry/Additional Science

Unit C2: Discovering Chemistry

Higher Tier

Thursday 13 June 2013 – 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 1 9 3 9 A 0 1 1 6

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.***

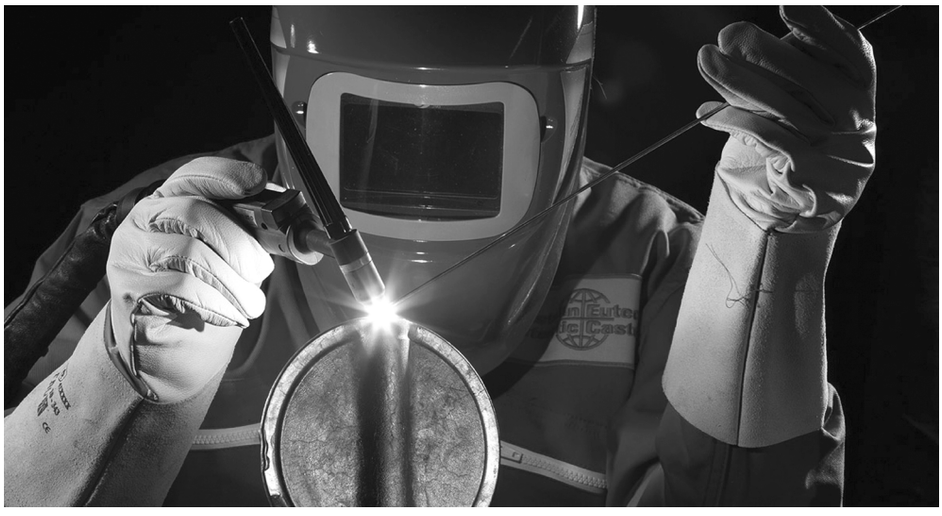
The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

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 ☒.

Metals and halogens

1 (a) Two pieces of metal can be joined by welding them together.



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

The structure of a metal is a lattice of

(1)

☐ **A** anions

☐ **B** anions and cations

☐ **C** cations in a sea of electrons

☐ **D** molecules in a sea of electrons

(ii) To join two pieces of metal by welding, they must be melted together.

State why a high temperature has to be used.

(1)

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.....

(iii) The pieces of metal are welded together in an atmosphere of argon.

Explain why an atmosphere of argon is used.

(2)

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(b) Some metals react with halogens.

Iron reacts with bromine, Br_2, to form iron(III) bromide, $FeBr_3$.

Write the balanced equation for this reaction.

(2)

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

At room temperature, iodine is a

(1)

☒ **A** brown gas

☒ **B** brown liquid

☒ **C** grey solid

☒ **D** purple gas

(d) When a halogen is added to a solution containing halide ions a displacement reaction may occur.

In the table

✓ shows a displacement reaction occurs

✖ shows a displacement reaction does not occur

halogen added	halide ion in solution		
	chloride ion	bromide ion	iodide ion
chlorine		✓	✓
bromine	✖		✓
iodine	✖	✖	

Use the information in the table to explain the order of reactivity of the three halogens.

(2)

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(Total for Question 1 = 9 marks)

Gases in the air

2 Nitrogen and oxygen are present in the air.

(a) In industry, nitrogen and oxygen are obtained from air.

(i) Give the name of the process used.

(1)

.....

(ii) State why the air is cooled before the start of the process.

(1)

.....

.....

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

Oxygen has a low boiling point because there are

(1)

☒ **A** weak covalent bonds between the oxygen atoms

☒ **B** weak covalent bonds between the oxygen molecules

☒ **C** weak forces of attraction between the oxygen atoms

☒ **D** weak forces of attraction between the oxygen molecules

(c) Another gas present in air is carbon dioxide, CO_2.
There are covalent bonds between the atoms in a molecule of carbon dioxide.

(i) Describe what is meant by a **covalent bond**.

(2)

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(ii) The electronic configuration of oxygen (atomic number 8) is 2.6.

Give the electronic configuration of carbon (atomic number 6).

(1)

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(iii) Draw a dot and cross diagram of a molecule of carbon dioxide.

Show outer electrons only.

(2)

(Total for Question 2 = 8 marks)

Making sodium carbonate

3 In industry sodium carbonate is made from sodium chloride solution and calcium carbonate in the Solvay Process.

(a) Describe the test to show that calcium carbonate contains carbonate ions.

(3)

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(b) Another product of the Solvay Process is calcium chloride.

Calculate the relative formula mass of calcium chloride, $CaCl_2$.
(Relative atomic masses: Ca = 40; Cl = 35.5)

(1)

.....

relative formula mass = ...

(c) The overall equation for the Solvay Process is

$$2NaCl + CaCO_3 \rightarrow Na_2CO_3 + CaCl_2$$

Calculate the maximum mass of sodium carbonate that could be formed by reacting 40 kg of calcium carbonate with an excess of sodium chloride solution.
(Relative formula masses: $CaCO_3$ = 100; Na_2CO_3 = 106)

(2)

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mass of sodium carbonate = ... kg

(d) Sodium carbonate was made in a laboratory experiment.
The theoretical yield of the experiment was 15.0 g.
The actual yield of the experiment was 10.4 g.

(i) Calculate the percentage yield of sodium carbonate in this experiment.

(2)

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.....

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.....

percentage yield = ...

(ii) Suggest **two** reasons why the actual yield was less than the theoretical yield.

(2)

reason 1 .....

.....

reason 2 .....

.....

(Total for Question 3 = 10 marks)

Atomic structure and the periodic table

4 (a) The table shows the number of electrons, neutrons and protons in particles P, Q, R, S, T and V.

particle	number of		
	electrons	neutrons	protons
P	1	0	1
Q	3	4	3
R	8	8	8
S	13	14	13
T	18	16	16
V	18	20	20

(i) Which particle is a negatively charged ion?

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

(1)

☒ **A** P

☒ **B** S

☒ **C** T

☒ **D** V

(ii) Which particles are atoms of metals?

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

(1)

☒ **A** P and R

☒ **B** Q and R

☒ **C** Q and S

☒ **D** Q, S and V

(b) Each element has an atomic number.

(i) State what is meant by **atomic number**.

(1)

(ii) The atomic number of boron is 5.
Boron exists as two isotopes boron-10 and boron-11.

Use this information to explain why boron-10 and boron-11 are isotopes.

(2)

(c) (i) Explain what is meant by the term relative atomic mass.

(2)

(ii) A sample of boron contains
19.7% of boron-10.
80.3% of boron-11.

Use this information to calculate the relative atomic mass of boron.

(3)

(Total for Question 4 = 10 marks)

Ionic compounds and their identification

5 (a) Sodium chloride is a metal chloride which is soluble in cold water.

(i) Give the name of a metal chloride which is insoluble in cold water.

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

(1)

☒ **A** copper chloride

☒ **B** lead chloride

☒ **C** magnesium chloride

☒ **D** potassium chloride

(ii) Sodium chloride has a melting point of 801 °C.

Explain why the melting point of sodium chloride is high.

(2)

(iii) Describe how you would test for the presence of chloride ions in a solution of sodium chloride.

(3)

*(b) Magnesium has an electronic configuration of 2.8.2.
Oxygen has an electronic configuration of 2.6.

Explain, in terms of their electronic configurations, how magnesium and oxygen atoms react to form the ionic compound magnesium oxide, MgO, and include a description of the structure of solid magnesium oxide.

(6)

(Total for Question 5 = 12 marks)

Reactions

6 (a) A student investigated the rate of a reaction.
The student investigated the reaction between zinc and dilute sulfuric acid.
The products are zinc sulfate, $ZnSO_4$, and hydrogen.

(i) Write the balanced equation for this reaction.

(2)

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*(ii) The student carried out two experiments.
The same mass of zinc and the same sized pieces of zinc were used in each experiment.

The results are shown in the table.

	experiment 1	**experiment 2**
concentration of sulfuric acid / mol dm^{-3}	0.5	1.5
temperature / °C	20	40
rate of reaction	slow	fast

Evaluate these results, explaining the reasons why the rate of reaction in experiment 2 is faster than the rate of reaction in experiment 1.
In your answer you should refer to the frequency and energy of collisions between particles.

(6)

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(b) Zinc is reacted with copper sulfate solution.
The equation for the reaction is

$$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$$

(i) What type of reaction is this?

(1)

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

☒ **A** decomposition

☒ **B** displacement

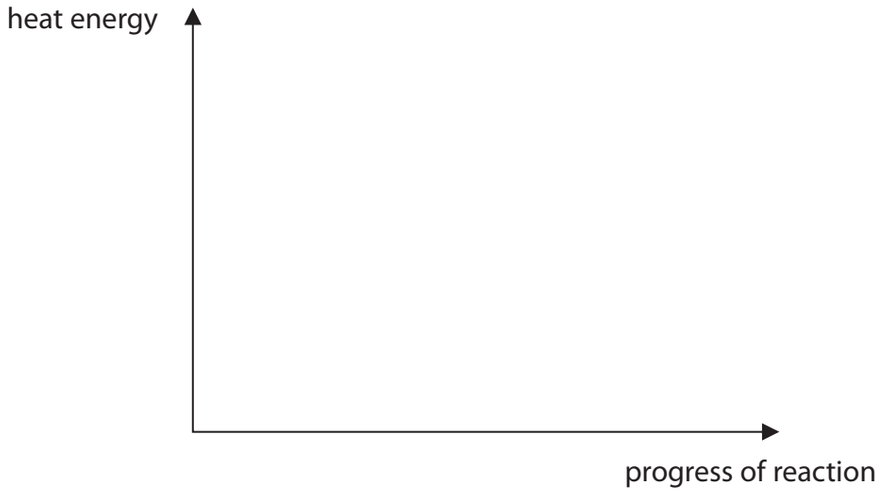
☒ **C** dissolving

☒ **D** neutralisation

(ii) This reaction is exothermic.

On the diagram below draw labelled lines to show the relative energies of the reactants and products in this reaction.

(2)



(Total for Question 6 = 11 marks)

TOTAL FOR PAPER = 60 MARKS

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