Write your name here

Surname	Other names

Pearson Edexcel GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Chemistry/Additional Science

Unit C2: Discovering Chemistry

Higher Tier

Monday 22 January 2018 – 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 5 7 5 8 2 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 ☒.

Salts

1 (a) A student was asked to prepare a pure, dry sample of strontium carbonate.

To make the strontium carbonate, the student mixed strontium nitrate solution with sodium carbonate solution.

$$\text{strontium nitrate} + \text{sodium carbonate} \rightarrow \text{strontium carbonate} + \text{sodium nitrate}$$

A precipitate of solid strontium carbonate formed in the mixture.

The student then
filtered the mixture
washed the solid strontium carbonate with deionised water
put the solid in a warm place.

(i) Suggest why the student filtered the mixture.

(1)

.....

.....

(ii) Explain why the student washed the solid with deionised water rather than tap water.

(2)

.....

.....

.....

.....

(iii) Suggest why the student put the strontium carbonate in a warm place.

(1)

.....

.....

(b) Sodium chloride is an ionic compound.

Which row of the table correctly shows the ability of sodium chloride to conduct electricity when solid, molten and in solution?

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

(1)

	ability of sodium chloride to conduct electricity when		
	solid	**molten**	**in solution**
☒ **A**	conducts	does not conduct	does not conduct
☒ **B**	does not conduct	conducts	conducts
☒ **C**	conducts	conducts	does not conduct
☒ **D**	does not conduct	does not conduct	conducts

(c) Copper chloride, copper carbonate and copper nitrate are three salts of copper.

(i) Which row of the table correctly shows the solubility of these three salts?

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

(1)

	copper chloride	**copper carbonate**	**copper nitrate**
☒ **A**	soluble	soluble	insoluble
☒ **B**	soluble	insoluble	soluble
☒ **C**	insoluble	insoluble	soluble
☒ **D**	insoluble	soluble	insoluble

(ii) Copper nitrate contains copper ions, Cu^{2+}, and nitrate ions, NO_3^-.

Give the formula of copper nitrate.

(1)

.....

(iii) Give the flame colour expected when a flame test is carried out on copper chloride.

(1)

.....

(Total for Question 1 = 8 marks)

Metals

2 Transition metals and alkali metals are two types of metal.

(a) Which of the following is a property of transition metals but not of alkali metals?

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

(1)

☒ **A** form coloured compounds

☒ **B** good conductors of electricity

☒ **C** soft

☒ **D** low boiling points

(b) Describe, in terms of the particles present, the structure of metals.

(3)

(c) Explain how metals conduct electricity.

(2)

(d) The alkali metals are in group 1 of the periodic table.
There is an increase in reactivity of the alkali metals from lithium to potassium.

Explain this increase in reactivity in terms of the structures of the atoms of these elements.

(3)

.....

.....

.....

.....

.....

.....

(Total for Question 2 = 9 marks)

Atoms

3 Boron is in group 3 of the periodic table.

(a) An atom of boron has an atomic number of 5 and a mass number of 11.

In each of the following complete the sentence by putting a cross (☒) in the box next to your answer.

(i) The number of protons in this boron atom is

(1)

☒ **A** 3

☒ **B** 5

☒ **C** 6

☒ **D** 11

(ii) The number of neutrons in this boron atom is

(1)

☒ **A** 3

☒ **B** 5

☒ **C** 6

☒ **D** 11

(iii) The number of electrons in the outer shell of a boron atom is

(1)

☒ **A** 3

☒ **B** 5

☒ **C** 6

☒ **D** 11

(b) A sample of boron contains two isotopes.

(i) Explain the meaning of the term **isotopes**.

(2)

(ii) The sample of boron contains

19.7% of boron-10
80.3% of boron-11

Use this information to show that the accurate relative atomic mass of boron in this sample is 10.8.

(3)

(c) The formula of boron oxide is B_2O_3.

Calculate the percentage by mass of boron in boron oxide, B_2O_3.
(relative atomic masses: B = 11, O = 16)

(3)

percentage of boron = ...

(Total for Question 3 = 11 marks)

Quantitative chemistry

4 (a) In an experiment, iron was reacted with chlorine to produce iron(III) chloride, $FeCl_3$.

(i) In this experiment, the theoretical yield of iron(III) chloride was 5.00 g.
The actual yield of the experiment was 3.25 g.

Calculate the percentage yield of iron(III) chloride in this experiment.

(2)

.....

.....

.....

.....

percentage yield = ...

(ii) Give **two** reasons why the actual yield of an experiment is often less than the theoretical yield.

(2)

reason 1 .....

.....

reason 2 .....

.....

(iii) The equation for the reaction to produce iron(III) chloride is

$$2Fe + 3Cl_2 \rightarrow 2FeCl_3$$

Calculate the maximum mass of iron(III) chloride that can be produced by reacting 44.8 g of iron with excess chlorine.
(relative atomic masses: Cl = 35.5, Fe = 56
relative formula mass: $FeCl_3$ = 162.5)

(2)

maximum mass of iron(III) chloride = ... g

(b) A sample of an iron oxide was analysed.
The iron oxide contained 3.36 g of iron and 1.28 g of oxygen.

Calculate the empirical formula of this iron oxide.
(relative atomic masses: O = 16, Fe = 56)

You must show your working.

(3)

empirical formula = ...

(Total for Question 4 = 9 marks)

Simple and giant molecular covalent structures

5 (a) Germanium chloride exists as simple molecules, $GeCl_4$.

In a molecule of germanium chloride the germanium atom is joined to a chlorine atom by a covalent bond.

(i) Explain how an atom of germanium and an atom of chlorine form a covalent bond.

(2)

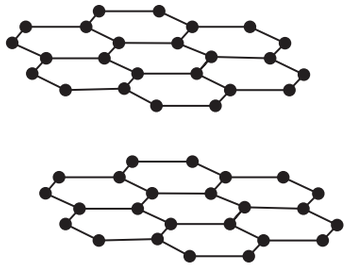
(ii) A germanium atom has 4 electrons in its outer shell.
A chlorine atom has 7 electrons in its outer shell.

Draw a dot and cross diagram to show the bonding in a molecule of germanium chloride, $GeCl_4$.
Show outer electrons only.

(2)

(b) Graphite can be used as a lubricant.

The diagram shows part of the structure of graphite.



Explain, in terms of its structure, why graphite is used as a lubricant.

(2)

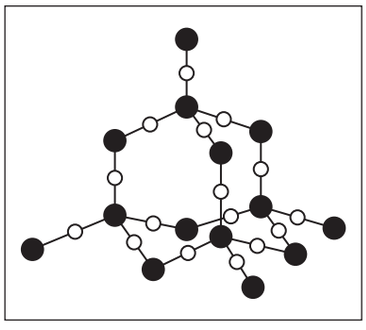
.....

.....

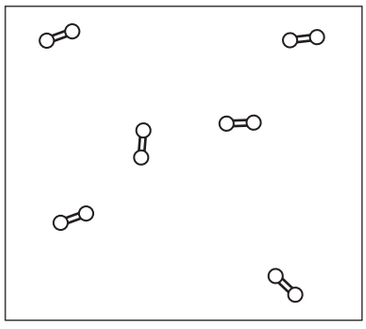
.....

.....

*(c) Diagrams of the structures of silicon oxide, SiO_2, and oxygen, O_2, are shown.



silicon oxide



oxygen

Silicon oxide is a solid with a high melting point of 1610 °C.
Oxygen is a gas: the boiling point of liquid oxygen is –183 °C.

Explain, in terms of bonding and structure, why oxygen is a gas at room temperature and pressure but silicon oxide is a solid with a very high melting point.

(6)

(Total for Question 5 = 12 marks)

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The reaction of calcium carbonate with dilute hydrochloric acid

6 (a) Calcium carbonate reacts with dilute hydrochloric acid to produce calcium chloride, carbon dioxide and water.

Write the balanced equation for this reaction.

(3)

.....

(b) Pieces of calcium carbonate were reacted with some dilute hydrochloric acid.

The table shows the initial and final temperatures of the reaction mixture.

initial temperature = 25 °C
final temperature = 27 °C

Explain what the results show about the type of reaction occurring.

(2)

.....

.....

.....

.....

*(c) A student carried out two further experiments with pieces of calcium carbonate and dilute hydrochloric acid.

The same mass of calcium carbonate and the same sized pieces of calcium carbonate were used in both experiments.

The results are shown in the table.

	experiment 1	**experiment 2**
concentration of hydrochloric acid / mol dm^{-3}	0.5	1.5
temperature / °C	25	50
rate of reaction	slower	faster

Explain why the rate of reaction in experiment 2 is faster than the rate of reaction in experiment 1 by considering the effect of the changes in concentration and temperature.
In your answer you should refer to the frequency and energy of collisions between particles.

(6)

(Total for Question 6 = 11 marks)

TOTAL FOR PAPER = 60 MARKS

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