Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9–1)

Centre Number | | | | | |

Candidate Number | | | | |

Thursday 16 May 2019

Morning (Time: 1 hour 10 minutes) | Paper Reference **1SC0/1CH**

Combined Science

Paper 2: Chemistry 1

Higher Tier

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.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

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.*
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.
- There is a periodic table on the back cover of the paper.

Advice

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

Turn over ▶

P60245A

1/

P 6 0 2 4 5 A 0 1 1 6

Pearson

Answer ALL questions. Write your answers in the spaces provided.

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 ☒.

1 In Figure 1, the letters **A**, **E**, **G**, **J**, **X** and **Z** show the positions of six elements in the periodic table.

These letters are not the symbols of the atoms of these elements.

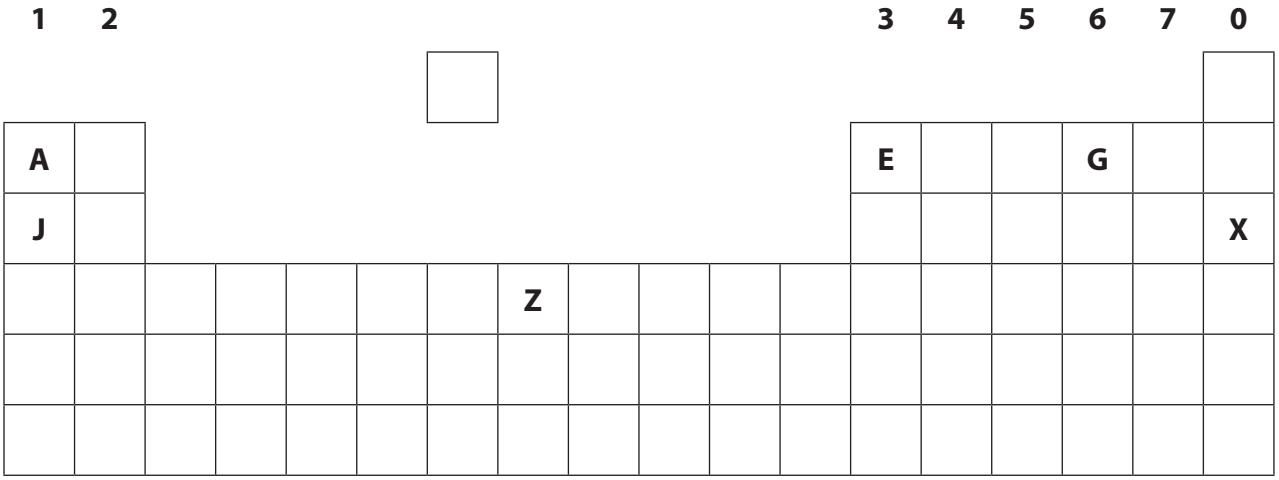

Figure 1

(a) Using the letters **A**, **E**, **G**, **J**, **X** and **Z**

(i) give the letters of the **two** elements that are non-metals

(1)

any two from
E, G and X

(ii) give the letters of **two** elements in period 2

(1)

any two from
A, E and G

(iii) give the letter of an element that normally forms an ion with a charge of +1.

(1)

A / J

(b) Element **E** has an atomic number of 5.
In a sample of **E** there are two isotopes. One isotope has a mass number of 10 and the other isotope has a mass number of 11.

(i) Explain, in terms of subatomic particles, what is meant by the term **isotopes**.

(2)

An explanation linking:

- (atoms with) same (number of) protons (1)
- (atoms with) different (number of) neutrons (1)

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(ii) All atoms of element **E** in this sample contain

(1)

☒ **A** 5 protons

☐ **B** 5 neutrons

☐ **C** 6 protons

☐ **D** 6 neutrons

(c) Element **X** has an atomic number of 18.

State the electronic configuration of an atom of element **X**.

(1)

2.8.8

(d) In an experiment, 3.5 g of element **A** reacted with 4.0 g of element **G** to form a compound.

Calculate the empirical formula of this compound.
(relative atomic masses: **A** = 7, **G** = 16)

You must show your working.

(3)

MP1 for dividing by atomic mass

A : G

$\frac{3.5}{7}$: $\frac{4.0}{16}$ (1)

MP2 for deriving ratio from MP1

0.5 : 0.25

OR

2 : 1 (1)

MP3 for ratio in MP2 to formula empirical formula A2G

empirical formula of this compound = ...

(Total for Question 1 = 10 marks)

2 (a) Water, acidified with sulfuric acid, is decomposed by electrolysis.
The water is decomposed to produce hydrogen and oxygen.

(i) A sample of hydrogen is mixed with air and ignited.

State what would happen.

(1)

(squeaky) pop / gas burns / water forms

(ii) Throughout the experiment the volume of hydrogen and the volume of oxygen are measured at two-minute intervals.

The results are shown in Figure 2.

time in minutes	volume of hydrogen in cm^3	volume of oxygen in cm^3
0	0	0
2	4	2
4	8	4
6	12	6
8	16	8

Figure 2

Describe, using the data in Figure 2, what the results show about the volumes of hydrogen and of oxygen produced in this experiment.

(2)

A description to include

• volumes going up: (oxygen/ hydrogen/ gas) increase (with time) / volume (directly) proportional to time (1)

• quantitative comparing hydrogen and oxygen:
(volume of) hydrogen double (volume of) oxygen / ORA / 2:1 ratio (1)

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(b) Molten lead bromide is electrolysed.

The products of this electrolysis are

(1)

☒ **A** hydrogen and bromine

☒ **B** hydrogen and oxygen

☒ **C** lead and bromine

☒ **D** lead and oxygen

(c) Calcium nitrate and calcium carbonate are both ionic compounds.

Calcium nitrate mixed with water behaves as an electrolyte.
Calcium carbonate mixed with water does not behave as an electrolyte.

Explain, in terms of solubility and movement of ions, this difference in behaviour.

(2)

An explanation linking:

• (calcium) nitrate {is soluble/ dissolves}/ (calcium) carbonate {is insoluble/ does not dissolve} (1)

• so ions {free to move in solution / not free in solid} (1)

(d) When molten zinc chloride is electrolysed, zinc ions, Zn^{2+}, form zinc atoms.

Write the half equation for this reaction.

(2)

Zn2+ + 2e(-) ---> Zn (2)

(Total for Question 2 = 8 marks)

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3 (a) One way to extract metals from land contaminated with metal compounds is phytoextraction.
When plants grow they absorb metal ions through their roots.
The plants are harvested, dried and burned forming an ash.
The ash contains metal compounds.

Plants were grown in a piece of ground contaminated with nickel compounds.

(i) 1 kg of the ash from these plants contained 142.0 g of nickel compounds.

Calculate the percentage by mass of nickel compounds in the ash.

(3)

1kg = 1000g (1)

$\frac{142}{1000}$ (1)

x 100% =14(.2) (1)

percentage by mass = ...

(ii) Nickel is extracted from nickel compounds.

State an advantage of extracting nickel by phytoextraction rather than from its ore.

(1)

decontaminates ground / conserves {nickel / nickel ores / ores} / allows use of low-grade ore / specified environmental reason: e.g. less noise due to mining / carbon neutral / less carbon dioxide

(b) Some nickel ores contain nickel sulfide.

(i) In the first stage of extracting nickel from nickel sulfide, the nickel sulfide, NiS, is heated in air to form nickel oxide, NiO, and sulfur dioxide.

Write the balanced equation for this reaction.

(2)

$2NiS + 3O_2 \text{ -----> } 2NiO + 2SO_2$ (2)

(ii) In the final stage of the extraction process, a nickel compound is electrolysed to produce pure nickel.

An advantage of producing a metal by electrolysis is that

(1)

- ☒ **A** electrolysis uses a large amount of electricity
- ☒ **B** the metal produced by electrolysis is very pure
- ☒ **C** electrolysis is a very cheap method of extraction
- ☒ **D** electrolysis is the only method of extracting unreactive metals

(c) In a different method of obtaining nickel, the process produces a mixture of the liquids nickel tetracarbonyl and iron pentacarbonyl.

The boiling point of nickel tetracarbonyl is 43 °C.
The boiling point of iron pentacarbonyl is 103 °C.
These two liquids mix together completely.

Describe the process used to separate these two liquids.

(3)

A description including

• (simple/fractional) distillation (1)

• heat/ boil (1)

• nickel tetracarbonyl {{boils/evaporates} off first /

is obtained from top of column/ vapour is condensed by condenser} ORA (1)

(Total for Question 3 = 10 marks)

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4 (a) Hydrated copper sulfate, $CuSO_4.5H_2O$, is a blue solid.
Anhydrous copper sulfate, $CuSO_4$, is a white solid.

Heat energy is needed to convert hydrated copper sulfate to anhydrous copper sulfate.
This is a reversible reaction.

$$CuSO_4.5H_2O \rightleftharpoons CuSO_4 + 5H_2O$$

Devise an experiment to show that this is a reversible reaction.

(4)

A description including

DECOMPOSITION
• heat the (hydrated) {crystals / solid} (1)

• (solid) goes white/ steam is observed / water produced (1)

REVERSE REACTION

• add water / water rejoins / water reacts with anhydrous solid (1)

• (solid) goes blue (again) / heat is released (1)

(b) Hydrogen reacts with iodine to form hydrogen iodide.
Iodine gas is purple and hydrogen iodide gas is colourless.

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

Hydrogen and iodine are placed in a sealed container.
The container is left until equilibrium is reached.

The conditions are changed favouring the forward reaction.

Explain what you would **see**.

(2)

An explanation to include

• less purple / lighter/ paler / fades (1)

• because less iodine (1)

(c) Calculate the number of atoms combined in one mole of copper iodide, CuI_2.
(Avogadro constant = 6.02×10^{23})

(2)

$3 \times 6.02 \times 10^{23}$ (1)

• $= 1.8 \times 10^{24}$ (1)

number of atoms = ...

(Total for Question 4 = 8 marks)

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5 Pieces of zinc react with copper sulfate solution.
Zinc sulfate solution is colourless.

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

(a) Describe what you would **see** when an excess of zinc is added to copper sulfate solution and the mixture left until the reaction is complete.

(2)

Any two from:

• {(red-)brown / orange / pink} solid formed (1)

• (some) {grey/silver} solid remains (1)

• (blue solution) becomes colourless (1)

(b) This reaction is described as a redox reaction.

Explain, in terms of electrons, which particles have been oxidised and which particles have been reduced in this reaction.

(4)

An explanation linking

• zinc oxidised (1)

• because (zinc) lose electrons/ half equation (1)

• copper (ions) reduced (1)

• because copper (ions) gained electrons/ half equation (1)

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(c) The copper sulfate solution used has a concentration of 15.95 g dm^{-3}.

Calculate the number of moles of copper sulfate, $CuSO_4$, in 50.00 cm^3 of this solution.
(relative atomic masses: O = 16, S = 32, Cu = 63.5)

(3)

Mr = 63.5 + 32 + 4 x 16 (1) (=159.5)

mass of copper sulfate =
50/1000 x 15.95 (1) (= 0.7975 g)

moles = 0.7975/159.5 (1) (= 0.005 mol)

number of moles of copper sulfate = ... mol

(d) In another experiment, 0.043 mol of copper sulfate, $CuSO_4$, is used.

Calculate, to one decimal place, the minimum mass of zinc that must be added to react with all the copper sulfate.
(relative atomic mass: Zn = 65)

(2)

0.043 x 65 (1) (=2.795)

= 2.8 g (1)

mass = ... g

(Total for Question 5 = 11 marks)

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6 (a) **X** and **Y** are solutions of two different acids.
The concentration of acid in each solution, in mol dm^{-3}, is the same.
Solution **X** has a pH of 3.40 and solution **Y** has a pH of 4.40.

(i) State what could be used to measure these pH values of 3.40 and 4.40.

(1)

use pH meter/ pH probe (1)

(ii) What is the concentration of hydrogen ions in solution **X** compared with that in solution **Y**?

(1)

☒ **A** ten times lower

☒ **B** lower by a factor of 3.30/4.40

☒ **C** higher by a factor of 4.40/3.30

☒ **D** ten times higher

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(b) An experiment is planned to record the change in pH as a powdered base is added to 50 cm^3 dilute hydrochloric acid.

The method suggested is

step 1 add dilute hydrochloric acid up to the 50 cm^3 mark on a beaker

step 2 add one spatula of the base and stir

step 3 measure the pH of the mixture

step 4 repeat steps 2 and 3 until the pH stops changing.

(i) State how you could change the method so that the amounts of dilute hydrochloric acid and of the base can be measured more accurately.

(2)

dilute hydrochloric acid use measuring cylinder / pipette / burette (1)

base balance / scales / weigh out amount (1)

(ii) During the experiment the pH changes from 2 to 10.
If phenolphthalein indicator is added at the beginning of the experiment, a colour change occurs as the base is added.

State the colour change that occurs.

(1)

colour at start colourless

colour at end pink / magenta

(iii) Explain, in terms of the particles present, why the pH increases during the experiment.

(2)

An explanation linking

• {hydrogen ions/ H+} {reacted / neutralised} (1)

• {concentration falls/ fewer} H+ / {concentration rises/ more} OH- (1)

*(c) Some properties of four solids, **A**, **B**, **C** and **D**, are shown in Figure 3.

The solids, in no particular order, are copper carbonate, copper oxide, magnesium metal and sodium hydroxide.

	A	B	C	D
colour of solid	black	silver	white	green
observation when solid is added to water	black solid remains	a few bubbles appear on surface of solid	solid dissolves and forms colourless solution	green solid remains
pH of mixture of solid added to water	7	8	13	7
observation when solid is added to dilute sulfuric acid	on warming, solid disappears to form blue solution	effervescence solid disappears to form colourless solution	solid disappears to form colourless solution	effervescence solid disappears to form blue solution

Figure 3

Identify the solids **A**, **B**, **C** and **D**, explaining how the information in Figure 3 supports the identification of each solid.

(6)

A is copper oxide

• copper oxide is black

• copper oxide reacts with sulfuric acid to make {copper sulfate / blue solution} but no gas

• B is magnesium

• magnesium is silver coloured

• magnesium reacts/ bubbles with water

• magnesium reacts with sulfuric acid to give hydrogen / equation

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(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 60 MARKS

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.