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

Time 1 hour 10 minutes

Paper reference **1SC0/1CH**

Combined Science

PAPER 2

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 the question 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.
- Good luck with your examination.

Turn over ▶

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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 The scientist John Dalton lived over 200 years ago.

(a) John Dalton suggested an early model of atoms.

When Dalton first described atoms he said that

- all elements are made of atoms
- atoms are not formed of any smaller particles
- all atoms of the same element are identical.

Give two differences between Dalton's model of atoms and today's model of atoms.

(2)

1 atoms are formed of sub-atomic particles (1)

2 • atoms have a nucleus (1)

(b) Dalton also investigated different gases.

One of the gases that Dalton investigated was ethene.

The structure of one molecule of ethene is shown in Figure 1.

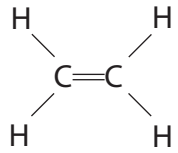

Figure 1

Give the molecular formula and the empirical formula of ethene.

(2)

molecular formula C2H4 (1)

empirical formula CH2 (1

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(c) Another gas that Dalton investigated was chlorine.

Chlorine gas reacts with water.
The two products are a solution of hydrogen chloride and the substance HClO.

(i) Complete the balanced equation for this reaction, including the three missing state symbols.

(3)

Cl2(g) (.....) + H2O(l) (.....) ⇌ HCl(aq) (.....) + HClO (aq)

(ii) Hydrogen chloride solution is acidic.

The formulae of four ions are shown in Figure 2.

H^+	H^-	Cl^+	Cl^-

Figure 2

Give the formula of the ion in Figure 2 that causes the hydrogen chloride solution to be acidic.

(1)

formula H+

(iii) An acid reacts with an alkali.

Give the name of this type of reaction.

(1)

Neutralization

(Total for Question 1 = 9 marks)

2 (a) A sample of potable water contains impurities.

Why is this sample of water potable even though it contains impurities?

(1)

- ☒ **A** the impurities have no smell
- ☒ **B** the impurities are colourless
- ☒ **C** the impurities are harmless
- ☒ **D** the impurities are soluble

(b) Waste water can be used to produce drinking water.
The processes used include sedimentation, filtration and chlorination.

(i) What is sedimentation?

(1)

- ☒ **A** the waste water is heated so the impurities evaporate
- ☒ **B** the waste water has an acid added to remove impurities
- ☒ **C** the impurities in the waste water settle to the bottom of their container
- ☒ **D** the impurities in the waste water are bleached

(ii) State why the waste water is filtered.

(1)

to remove {insoluble substances / solids}

(iii) State the reason for chlorination.

(1)

to kill {bacteria / microorganisms}

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(c) Some salts can be added to waste water to remove impurities.
In an experiment, different masses of salt **A** were added to 1000 cm^3 samples of waste water.
The experiment was repeated with salt **B**.
The percentages of impurities removed from the waste water are shown in Figure 3.

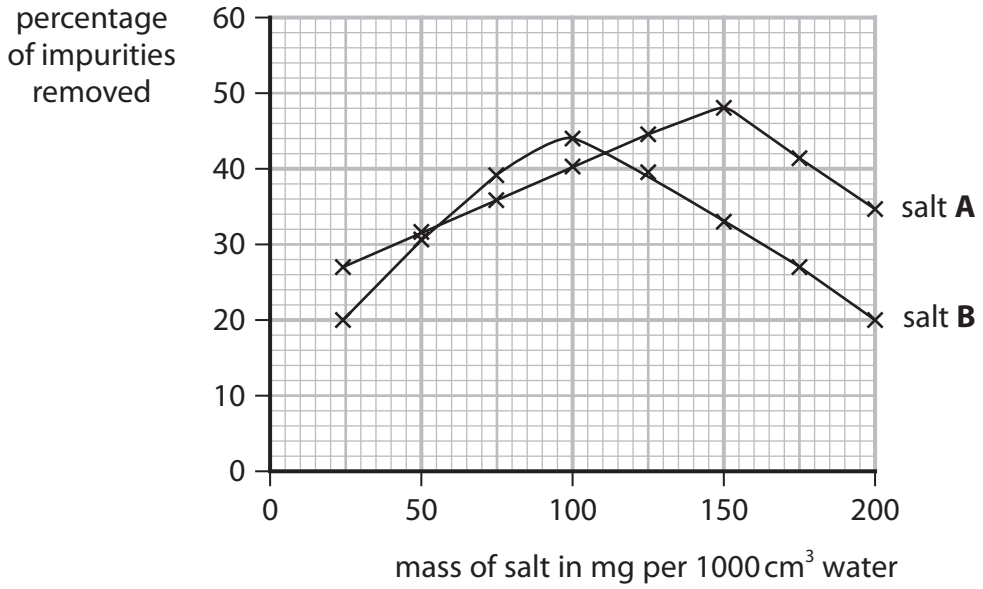

Figure 3

It was concluded that the best way to purify 1000 cm^3 of the waste water is to add 100 mg of salt **B**.

Use the information about salt **A** and salt **B** in Figure 3 to evaluate this conclusion.

(3)

An answer including

- best amount of A is 150 (mg) (1)
- 150 mg A removes more than 100 (mg) B (1)
- so it is better to use salt A than salt B (1)

(d) Waste water may contain phosphate ions, PO_4^{3-}.

Aluminium ions react with phosphate ions to form aluminium phosphate.

Complete the ionic equation for the formation of aluminium phosphate in this reaction.

(2)

Al3+ + PO_4^{3-} → AlPO4

(Total for Question 2 = 9 marks)

3 This question is about electrolysis.

(a) A sample of molten potassium bromide is electrolysed.

What are the two products formed?

(1)

- ☒ **A** hydrogen and oxygen
- ☒ **B** hydrogen and bromine
- ☒ **C** potassium and oxygen
- ☒ **D** potassium and bromine

(b) Zinc chloride and zinc carbonate contain ions.

Zinc chloride mixed with water can be electrolysed.
Zinc carbonate mixed with water cannot be electrolysed.

Explain this difference.

(2)

An explanation linking

• zinc chloride soluble and zinc carbonate insoluble (1)

• so ions free to move only in zinc chloride solution / comparison with zinc carbonate (1)

(c) In the electrolysis of sodium chloride solution, bubbles of a colourless gas form at the cathode.
This gas, when mixed with air, burns with a squeaky pop.

(i) Identify this gas.

(1)

hydrogen / H2

(ii) Explain how this gas is formed at the cathode.

(2)

An explanation linking

• hydrogen ions attracted to cathode/negatively charged electrode (1)

• (two) hydrogen ions {gain (two) electrons /are reduced / form hydrogen molecules} / correct half equation (2H+ + 2e(-) ---> H2) (1)

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(d) A solution of copper sulfate in a beaker is electrolysed using copper electrodes.

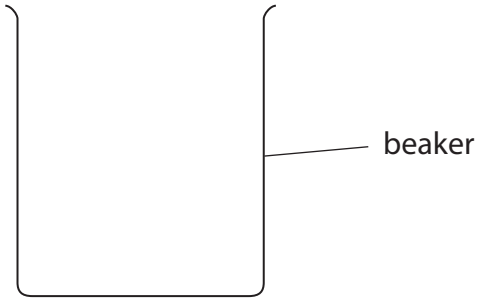
(i) Draw a labelled diagram to show how this experiment would be set up.

The beaker has been drawn for you.

(2)

Diagram to show

- electrodes in solution (1)
- wires and power supply connected to give a complete circuit (1)



(ii) During the electrolysis, the anode gets smaller, the cathode gets larger and the solution remains the same shade of blue.

Give the reason for each of these observations.

(3)

the anode gets smaller smaller because copper atoms form ions (and go into solution) / oxidation of Cu atoms (1)

the cathode gets larger larger because copper atoms are formed (from ions in the solution) / reduction of Cu2+ (1)

the solution remains the same shade of blue

- solution: the same number of ions enter and leave solution (1)

(Total for Question 3 = 11 marks)

4 (a) Copper carbonate reacts with dilute nitric acid.

(i) During the reaction the copper carbonate powder completely disappears.

State what can be deduced about the amount of acid used.

(1)

the acid is in excess

(ii) During the reaction, the pH of the mixture changed from 2 to 6.

By what factor has the concentration of the hydrogen ions in the mixture changed?

(1)

☒ **A** × 10 000

☒ **B** × 4

☒ **C** × ¼

☒ **D** $\times \frac{1}{10\,000}$

(b) Using different reactants, a solution of copper sulfate was prepared.

Describe what should be done to obtain copper sulfate crystals from this copper sulfate solution.

(2)

A description to include

• heat solution (to evaporate water and concentrate the salt solution) (1)

• leave to cool (1)

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(c) When chloride ions are added to a pale blue solution containing copper ions, the mixture turns yellow.

This is a reversible reaction.

pale blue solution + chloride ions $\rightleftharpoons$ yellow solution + water

What effect does the removal of chloride ions have on the colour of the yellow mixture?

(1)

- ☒ **A** does not change colour
- ☒ **B** turns blue
- ☒ **C** turns colourless
- ☒ **D** turns darker yellow

(d) Hydrated copper sulfate has the formula $CuSO_4.5H_2O$.
The formula tells us that each mole of copper sulfate contains 5 moles of water.

A sample of $CuSO_4.5H_2O$ was heated gently until all the water was removed to form anhydrous copper sulfate, $CuSO_4$.

$$CuSO_4.5H_2O \rightarrow CuSO_4 + 5H_2O$$

The mass of water formed was 4.5 g.

Calculate the mass of hydrated copper sulfate that was heated.

(relative atomic masses: H = 1.0, O = 16.0;
relative formula mass: $CuSO_4.5H_2O$ = 249.5)

(4)

5 H2O : 1 CuSO4.5H2O (1)

5 x 18 : 249.5 (1)

mass CuSO4.5H2O = 249.5 / 90 x 4.5 (= 12.475 g) (1)

mass of $CuSO_4.5H_2O$ = 12.475 g

(Total for Question 4 = 9 marks)

5 (a) The order of reactivity of copper, magnesium and zinc can be determined by the displacement reactions between these metals and solutions of their salts.

You are provided with

- samples of the three metals
- solutions of copper sulfate, magnesium sulfate and zinc sulfate.

Describe the experiments that can be done to determine the order of reactivity of these metals by displacement reactions.

(3)

A description to include

• place separate pieces of each metal into solutions of each of salt (in spotting tray/container) (1)

• observe changes in appearance/colour of {metal/solution} (1)

• the more reactive metal shows the greater number of reactions (1)

(b) Metals can be extracted from ores found in the Earth's crust.

Explain why aluminium cannot be extracted from its ore by heating with carbon but can be extracted by electrolysis.

(2)

aluminium is more reactive than carbon (so electrolysis required) (1)

• carbon cannot remove the oxygen / there is no reaction between carbon and aluminium oxide / carbon cannot displace aluminium (1)

(c) Titanium is extracted from its ore in several stages.

In the first stage, titanium chloride is formed as a gas.

The gas is cooled to form liquid titanium chloride containing **dissolved** impurities.

Suggest how pure titanium chloride could be separated from the impurities.

(1)

(simple) distillation

(d) In another stage, the pure titanium chloride, $TiCl_4$, is reacted with 500 moles of magnesium, an excess.

$$TiCl_4 + 2Mg \rightarrow Ti + 2MgCl_2$$

(i) Calculate the number of moles in 45 000 grams of titanium chloride.

(relative atomic masses: Cl = 35.5, Ti = 48.0)

(2)

Mr TiCl4 = 48.0 + (4 x 35.5) (1) (= 190)

moles of TiCl4 = 45 000/190 = 236.8 (1)

number of moles titanium chloride = ...

(ii) Show that the 500 moles of magnesium added is an excess.

(1)

(minimum) moles of Mg needed = 236.8 x 2 = 473.6 (1)

500 moles of Mg added > minimum 473.6 moles required

(e) After this reaction, there is a mixture of the solids magnesium, titanium and magnesium chloride.

Titanium does not react with dilute hydrochloric acid.

Suggest a simple method to separate titanium from the mixture.

(2)

• add dilute hydrochloric acid (to solid mixture sample to react with the magnesium to form magnesium chloride solution) (1)

• filter the mixture (to remove titanium) / filter off the titanium (1)

(Total for Question 5 = 11 marks)

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6 (a) An ion of element **X** can be represented as

$$^{125}\mathbf{X}^{2-}$$

This ion of element **X** has 54 electrons.

Calculate the number of protons and the number of neutrons in this ion.

(2)

number of protons 52

number of neutrons 73

(b) A sample of silicon contains isotopes.

(i) State, in terms of subatomic particles, how atoms of these isotopes are the same.

(1)

(isotopes of same element) have the same number of protons

(ii) This sample of silicon contains three isotopes.

92% of the atoms are silicon-28
5% of the atoms are silicon-29
3% of the atoms are silicon-30

Calculate the relative atomic mass of silicon in this sample.

(2)

total mass of 100 atoms =

(28 x 92) + (29 x 5) + (30 x 3) (1) (= 2811)

relative atomic mass = $\frac{2811}{100}$ (= 28.11) (1)

relative atomic mass = 28.11

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*(c) Figure 4 shows some properties of three substances, **A**, **B** and **C**.

substance	melting point in °C	ability to conduct electricity	
		solid	molten
A	1180	poor	good
B	1538	good	good
C	115	poor	poor

Figure 4

Deduce, using the information in Figure 4, the structure and bonding of substances **A**, **B** and **C**, explaining their properties in terms of their structure and bonding.

(6)

Substance A

• giant ionic structure

• (high melting point) strong electrostatic attractions between ions

• due to a lot of energy required to overcome strong forces

• (electrical conductivity) in solid ions strongly attracted in lattice ions cannot move, so poor conductor when solid

• when molten ions free to move, so good conductor when molten

Substance B

• metallic structure

• (high melting point) strong attraction between metal ions and delocalised electrons

• due to a lot of energy required to overcome strong forces between particles in solid

• (electrical conductivity) in solid delocalised electrons

• free to move throughout metallic lattice, so good conductor when solid

• delocalised electrons and ions free to move when molten, so good conductor when molten

Substance C

- covalent simple molecular
- (low melting point) weak intermolecular forces/ attractions between molecules
- little energy needed to separate molecules, so low melting point
- (electrical conductivity) in solid and when molten no delocalised electrons or ions to carry charge, so poor conductor

(Total for Question 6 = 11 marks)

TOTAL FOR PAPER = 60 MARKS

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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

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The elements with atomic numbers from 58 to 71 are omitted from this part of the periodic table.***

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