Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

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

Monday 22 May 2023

Morning (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.

Turn over ▶

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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 an experiment, powdered calcium hydroxide was added to dilute hydrochloric acid and the pH was measured.

The method used was

step 1 measure 200 cm^3 dilute hydrochloric acid into a beaker

step 2 add 0.1 g of powdered calcium hydroxide to the beaker

step 3 find the pH of the mixture

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

(a) State what should be done after **step 2** to make sure that any reaction is complete.

(1)

stir/ swirl/ shake (the beaker)

(b) Complete the word equation for the reaction.

(2)

calcium hydroxide + hydrochloric acid → calcium chloride (1) water (1)

(c) Which row of the table shows the state symbols for powdered calcium hydroxide and dilute hydrochloric acid in the balanced chemical equation?

(1)

		calcium hydroxide	hydrochloric acid
☒	**A**	aq	l
☒	**B**	l	aq
☒	**C**	s	aq
☒	**D**	s	l

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(d) The results of the experiment are shown in Figure 1.

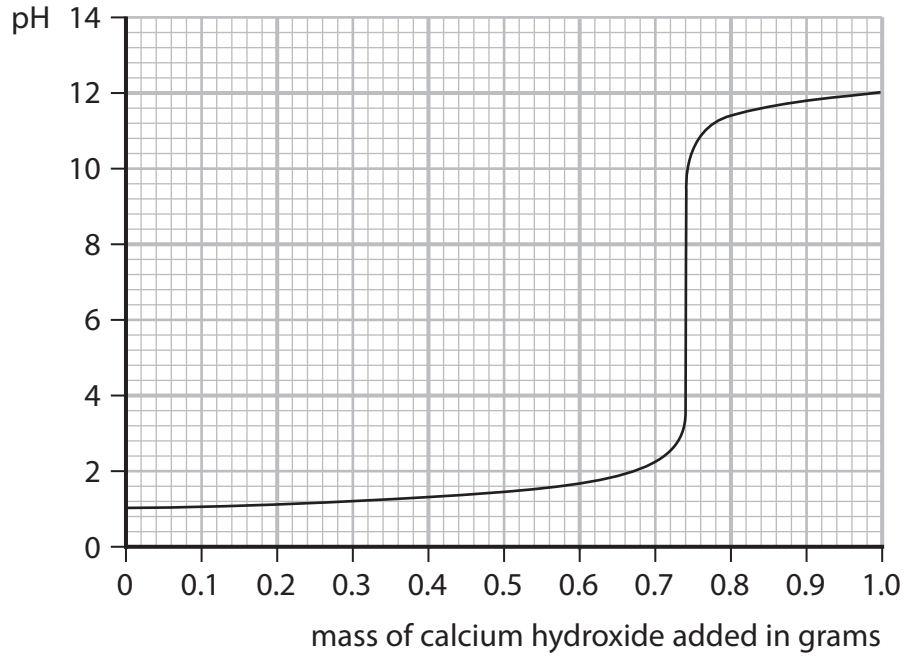

Figure 1

(i) Using Figure 1, give the pH of the acid at the start of the experiment.

(1)

pH = 1

(ii) Using Figure 1, give the mass of calcium hydroxide required to make a neutral mixture.

(1)

mass of calcium hydroxide = 0.74 (g) g

(iii) Explain why the pH starts at a low value and ends at a higher value.

(3)

START
• solution is acidic / acids have low pH / high {concentration/ amount} of H+ ions/ excess H+ ions
REACTION
• neutralisation/ H+ + OH- → H2O/ {the hydroxide/ alkali} reacts with the {acid/ H+}
END
• {amount/ concentration} of H+ ions has reduced/ {amount/ concentration} of OH- ions has increased / excess OH- ions/ (excess of) hydroxide ions have pH > 7

(Total for Question 1 = 9 marks)

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2 Figure 2 shows part of the reactivity series of metals.

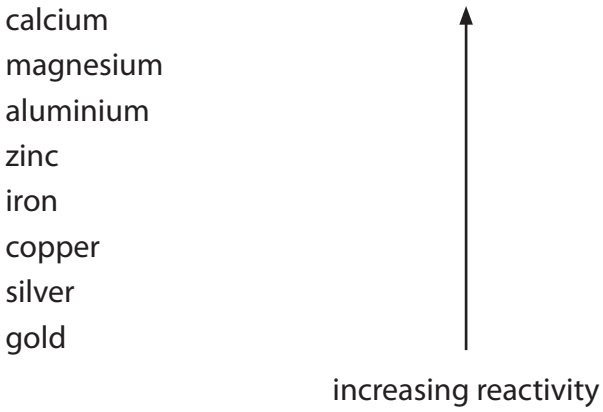

Figure 2

(a) Which metal reacts when added to cold water?

(1)

- ☒ **A** calcium
- ☒ **B** copper
- ☒ **C** gold
- ☒ **D** silver

(b) A student investigates the reactivity of four different metals.

The student adds an equal-sized piece of each metal to separate test tubes containing dilute hydrochloric acid.

The student's observations for zinc and copper are recorded in Figure 3.

metal	observations
magnesium	
zinc	bubbles produced at a steady rate test tube feels slightly warm
iron	
copper	no reaction

Figure 3

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(i) Use the information in Figure 2 and in Figure 3 to predict the observations for the reactions of magnesium and of iron with dilute hydrochloric acid.

(2)

magnesium

many bubbles / bubbles produced quickly / bubbles vigorously
OR
test tube feels hot / warm / warmer than with zinc (1)

iron

few bubbles / bubbles produced slowly / some bubbles
OR
test tube feels very slightly warm

(ii) When metals react with acids, hydrogen gas is produced.

Describe the test to show that the gas is hydrogen.

(2)

apply lighted splint (to the gas)
• (squeaky) pop

(iii) When magnesium reacts with hydrochloric acid, magnesium chloride and hydrogen are formed.

Complete the balanced equation for the reaction.

(2)

$Mg + \underline{2}\ HCl \rightarrow MgCl_2 + \underline{H2}$

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(c) An excess of magnesium is added to some dilute hydrochloric acid of pH 2.
The mass of hydrogen gas produced is measured.

The experiment is repeated with excess magnesium but with the same volume of dilute hydrochloric acid of pH 1.

(i) State how many times greater the concentration of hydrogen ions is in the acid of pH 1 than in the acid of pH 2.

(1)

ten (times) / 10 (x) / (x) 10

(ii) With the acid of pH 2, the mass of hydrogen gas produced when the reaction is complete is 0.005 g.

Predict the mass of hydrogen gas produced in the reaction with acid of pH 1.

(1)

mass = 0.05 (g) g

(Total for Question 2 = 9 marks)

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3 (a) Ammonia is manufactured in the Haber process by the reversible reaction between nitrogen and hydrogen.

(i) Write the balanced equation for the reversible reaction between nitrogen and hydrogen to make ammonia, NH_3.

(3)

N2 + 3H2 ⇌ 2NH3

(ii) Which row shows the typical conditions of temperature and pressure used in the Haber process?

(1)

		temperature in °C	pressure in atmospheres
☒	**A**	250	100
☒	**B**	250	200
☒	**C**	450	500
☒	**D**	450	200

(iii) In the Haber process, iron is added to the vessel where the nitrogen and hydrogen react.

State the purpose of the iron.

(1)

catalyst/ increase rate of reaction(s)/ lower activation energy/ increase rate of attainment of equilibrium

(iv) The reaction between nitrogen and hydrogen to make ammonia can reach dynamic equilibrium.

The reaction gives out heat.

Explain how the position of equilibrium changes if the temperature is decreased.

(2)

moves in exothermic direction

• moves {right/ forwards / towards ammonia/ to products}

• to oppose the temperature reduction / to release heat / to increase the temperature

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(b) Compound **A** is a dark brown gas.

Compound **B** is a colourless gas.

Two molecules of **A** combine to form one molecule of **B** in a reversible reaction.

You are given

- a sealed glass tube containing an equilibrium mixture of **A** and **B**
- a beaker
- a kettle
- some ice

At room temperature, the equilibrium mixture is a pale brown colour.

Devise an experiment to show how the position of equilibrium of this reaction is affected by temperature.

The sealed tube must **not** be opened.

(3)

METHOD OF HEATING AND COOLING
• put tube into hot water (1)
• then into cold water/ add cold water/ add ice
OBSERVATIONS
• colour goes darker
AND
colour goes lighter/ colourless

(Total for Question 3 = 10 marks)

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4 A student investigates the mass of copper produced when copper chloride solution in a beaker is electrolysed using inert electrodes.

(a) Where is copper formed during the electrolysis?

(1)

- ☒ **A** at the anode
- ☒ **B** at the bottom of the beaker
- ☒ **C** at the cathode
- ☒ **D** on the surface of the electrolyte

(b) The student investigated the change in the mass of copper formed when the current was altered.

The results are shown in Figure 4.

current in A	mass of copper formed in g
0.0	0.000
0.2	0.040
0.4	0.080
0.6	0.118
0.8	0.158
1.0	0.196

Figure 4

(i) State and explain the trend shown in these results.

(3)

• as current increases mass increases / the mass is proportional to the current
• because the higher the current the more electrons (per second)
• so more copper ions {are reduced/ gain electrons/ are discharged}

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(ii) Describe how, after the power supply has been switched off, the mass of copper formed can be measured.

(2)

• (rinse and) dry {electrode / cathode}
• measure mass of {electrode/ cathode} (on a balance) (and subtract original mass)

(c) In another experiment, 74 mg of copper is formed.

Calculate the number of copper atoms in 74 mg of copper.

(relative atomic mass Cu = 63.5; Avogadro constant = 6.02×10^{23})

(3)

7.015 x 1020 with or without working scores 3
• mass copper in g = 74
1000
= 0.074 / 7.4 x 10-2 g
• amount of copper = 0.074
63.5
= 0.001165…./ 1.165…. x 10-3 mol
• number of atoms = 0.001165…. x 6.02 x 1023
= 7.015 x 1020

number of atoms = ...

(Total for Question 4 = 9 marks)

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5 Crystals of copper sulfate are prepared by reacting copper oxide, a base, with dilute sulfuric acid.

(a) Name the other product of this reaction.

(1)

Water

(b) During the experiment, a spatula measure of copper oxide, a black powder, is added to warm, dilute sulfuric acid in a beaker.

When the mixture is stirred, the black powder disappears and the mixture turns pale blue.

The student then adds more copper oxide until the maximum amount of copper sulfate is formed without wasting copper oxide.

Explain how the student knows when to stop adding copper oxide.

(3)

OBSERVATION

• when some powder remains in the beaker

(c) The reaction produces an aqueous solution of copper sulfate.

What is the best way to obtain crystals of copper sulfate from an aqueous solution?

(1)

☒ **A** pour the solution through filter paper in a funnel

☒ **B** heat the solution with a Bunsen burner until dry

☒ **C** heat the solution using a water bath

☒ **D** leave the solution in a cold, damp place

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(d) When some water is removed from the aqueous solution of copper sulfate, crystals of copper sulfate are made.

Describe how the arrangement and movement of the particles change as crystals are formed from a solution.

(3)

SOLUTION
• (the ions) are (freely) moving
• (the ions) are randomly arranged
SOLID
• (the ions) are fixed/ not moving/ vibrating
• (the ions) are in a regular arrangement/ lattice/ giant structure

(e) In this reaction, copper oxide, CuO, forms copper sulfate, $CuSO_4$.

Explain, in terms of electrons, whether the copper in copper oxide has been oxidised, has been reduced, or has not been oxidised or reduced.

(2)

• the copper (ions are) neither oxidised nor reduced

• the copper (ions) do not lose or gain electrons/ Cu2+ present at start and end

(f) In another experiment, a copper sulfate solution with a concentration of 39.875 g dm^{-3} is used.

Calculate the mass of copper sulfate dissolved in 0.300 dm^3 of this solution.

(1)

11.9625 with or without working scores 1
11.9625

mass = ... g

(Total for Question 5 = 11 marks)

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6 (a) Figure 5 shows the structure of a molecule of compound **S**.

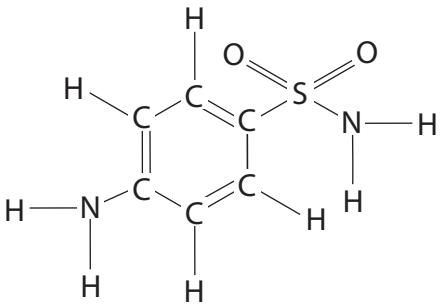

Figure 5

(i) Use Figure 5 to deduce the empirical formula of compound **S**.

(1)

C6H8N2SO2

(ii) The melting points of three samples of **S** are shown in Figure 6.

sample	melting point in °C
A	160–164
B	166
C	163–165

Figure 6

State whether each of these samples, **A**, **B** and **C**, is pure or impure and justify your answers using the information in Figure 6.

(3)

• B is pure and A is impure and C is impure
• B has a sharp/ single melting point
• A and C have melting points {over a range / lower than (the sharp melting point of) B}

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(b) A scientist uses chromatography in an investigation of compound **S**.

In the conditions used, compound **S** has an R_f value of 0.22.

Calculate the distance the spot of compound **S** moves if the solvent front has moved by 2.4 cm.

(2)

0.528/ 0.53 with or without working scores 2

• distance = Rf x solvent front distance/ 0.22 x 2.4

• = 0.528/ 0.53 (cm)

distance = ... cm

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*(c) A solution of sodium chloride in water needs to be separated to obtain a sample of pure, dry sodium chloride and a sample of pure water.

Figure 7 shows the boiling points of sodium chloride and water.

substance	boiling point in °C
sodium chloride	1465
water	100

Figure 7

Explain this difference in boiling points in terms of the structure and bonding of sodium chloride and water and how this difference is used to choose a method to separate sodium chloride solution into pure, dry sodium chloride and pure water.

(6)

SODIUM CHLORIDE
• ionic compound
• giant lattice
• positive (sodium) ions and negative (chloride) ions
• strong electrostatic attraction between ions
• lots of energy to overcome attraction/ bonds
WATER
• simple covalent/ molecular
• strong covalent bonds between atoms in a molecule
• weak forces between molecules
• little energy needed to overcome the intermolecular forces
SEPARATION
• use distillation – with condenser or simple apparatus: delivery tube into test tube in ice water
• water has much lower boiling point
• water will distil but sodium chloride will not
• water collected after being condensed
• sodium chloride remains in flask

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(Total for Question 6 = 12 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.

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