Please check the examination details below before entering your candidate information

Candidate surname | Other names

Centre Number | Candidate Number

Pearson Edexcel International GCSE (9–1)

Friday 13 June 2025

Morning (Time: 1 hour 15 minutes)

Paper reference **4CH1/2C**

Chemistry
UNIT: 4CH1
PAPER: 2C

You must have:
Calculator

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **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*.
- Show all the steps in any calculations and state the units.

Information

- The total mark for this paper is 70.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question*.

Advice

- Read each question carefully before you start to answer it.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over

P 7 8 9 5 1 A 0 1 2 0

Pearson

GradeMax

The Periodic Table of the Elements

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

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

The Lanthanides (atomic numbers 58-71) and the Actinides(atomic numbers 90-103) have been omitted.

Cu and Cl have not been rounded to the nearest whole number.

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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 ⊠.

1 This question is about elements, compounds and mixtures.

(a) The box gives the names of some substances.

calcium	fluorine	helium	neon
petrol	silicon	water	

Choose a substance from the box to answer each of these questions.

(i) Give the name of a compound.

(1)

....

(ii) Give the name of a mixture.

(1)

....

(iii) Give the name of a diatomic molecule.

(1)

....

(iv) Give the name of a metal element.

(1)

....

(b) (i) Name the technique used to separate crude oil into fractions.

(1)

....

(ii) Give one use of the kerosene fraction.

(1)

....

....

(Total for Question 1 = 6 marks)

2 Magnesium reacts with dilute hydrochloric acid to form magnesium chloride and hydrogen.

The hydrogen is collected in a gas syringe.
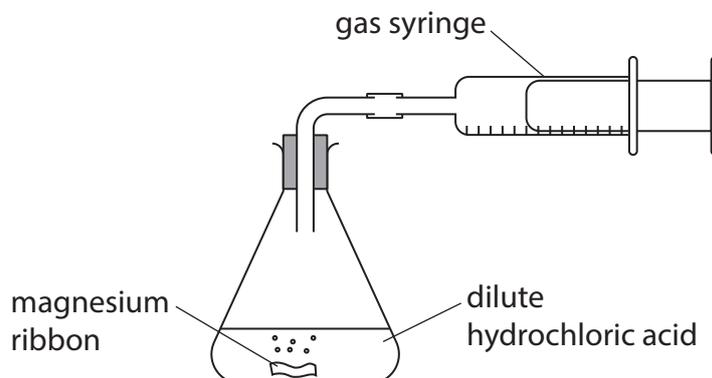
The reaction is exothermic and magnesium is in excess.

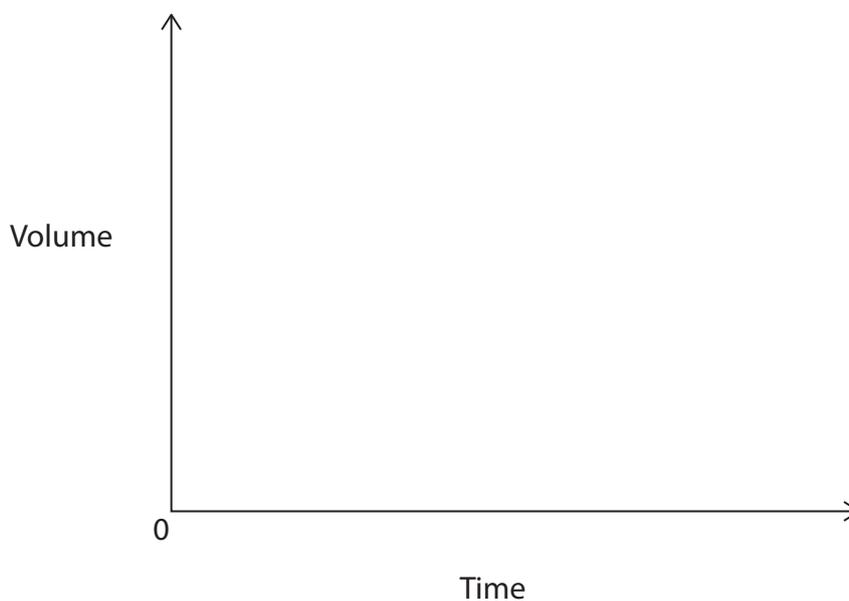(a) State what is meant by the term **exothermic**.

(1)

....

....

(b) Complete the chemical equation for the reaction.

(1)

$$Mg \ + \ 2HCl \ \rightarrow \ \text{...} \ + \ \text{...}$$

(c) Draw a sketch graph to show how the volume of hydrogen changes with time until the reaction has finished.

(2)

(d) Explain why increasing the temperature of the hydrochloric acid affects the rate of the reaction.

Refer to collision theory in your answer.

(4)

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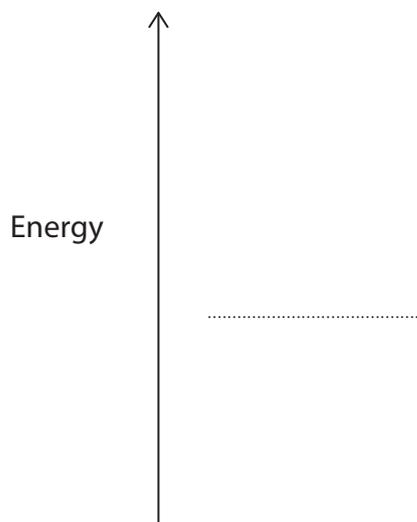
(e) Draw a reaction profile diagram for the reaction, showing ΔH and activation energy.

Label the reactants and products.

(5)

Energy

....

(Total for Question 2 = 13 marks)

3 This question is about Group 2 elements and their compounds.

(a) A sample of magnesium contains three isotopes.

Mass number of isotope	24	25	26
Percentage abundance (%)	76.5	10.5	13.0

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

(2)

....

....

....

....

(ii) Calculate the relative atomic mass (A_r) of magnesium.

Give your answer to one decimal place.

(3)

$A_r = $ ....

(b) Which of these compounds is an insoluble solid?

(1)

$\boxtimes$ **A** calcium nitrate

$\boxtimes$ **B** calcium sulfate

$\boxtimes$ **C** magnesium nitrate

$\boxtimes$ **D** magnesium sulfate
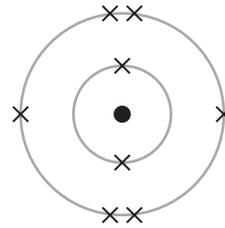
(c) Magnesium oxide is an ionic compound.

The diagrams show the atoms of magnesium and oxygen.
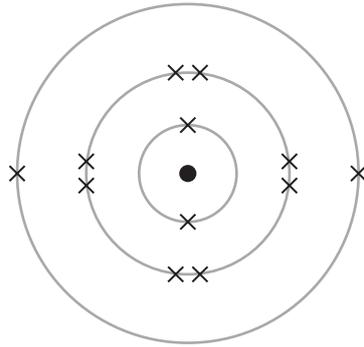
Mg   O

Draw diagrams to show the structure of each ion in magnesium oxide.

Include the charge on each ion.

(3)

(d) The table lists some substances and shows which substance conducts electricity.

Substance	Conducts electricity?
water	no
solid magnesium chloride	no
aqueous magnesium chloride	yes

Explain these observations.

Refer to structure and bonding in your answer.

(5)

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(e) A concentrated aqueous solution of magnesium chloride is electrolysed.

Chlorine forms at the positive electrode.

(i) Give the half-equation for the reaction at the positive electrode.

(1)

....

(ii) Give a reason why this reaction is classified as oxidation.

(1)

....

....

(Total for Question 3 = 16 marks)

4 This question is about the reactions of ethanol and ethanoic acid.

(a) (i) Ethanol reacts with potassium dichromate(VI) to form ethanoic acid.

Name the other reagent needed in this reaction.

(1)

....

(ii) State the colour change that occurs when ethanol reacts with potassium dichromate(VI).

(2)

from .... to ....

(b) Ethanoic acid reacts with solid sodium carbonate.

(i) Complete the chemical equation for this reaction.

(2)

$2CH_3COOH + Na_2CO_3 \rightarrow$ .... + ... + ...
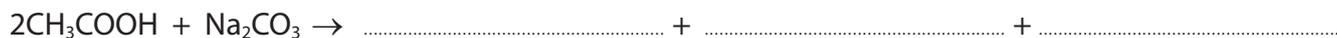
(ii) State two observations seen in this reaction.

(2)

1 ....

....

2 ....

....

(c) A student prepares the ester, ethyl ethanoate, by reacting ethanol with ethanoic acid.

This is the student's method.

- mix equal amounts of ethanol and ethanoic acid in a boiling tube

- add a few drops of concentrated sulfuric acid

- place the boiling tube in a hot water bath for several minutes

(i) State the role of sulfuric acid in this reaction.

(1)

....

....

(ii) State why the student heats the mixture in a water bath instead of directly with a Bunsen burner flame.

(1)

....

....

(iii) State how the student would know that ethyl ethanoate has formed.

(1)

....

....

(iv) Draw the displayed formula of ethyl ethanoate.

(2)

(Total for Question 4 = 12 marks)

5 A student does a titration to find the concentration of a solution of sulfuric acid.

This is the student's method.

- fill a burette with sulfuric acid and record the reading

- transfer 25.0 cm^3 of potassium hydroxide solution to a conical flask

- add a few drops of methyl orange to the conical flask

- place the conical flask on a white tile

- swirl the flask continuously while adding sulfuric acid from the burette

- keep adding sulfuric acid until the end-point has been reached

- record the rough reading at the end-point

(a) (i) Name the most suitable piece of apparatus for measuring 25.0 cm^3 of potassium hydroxide solution.

(1)

....

(ii) State why the student places the conical flask on a white tile.

(1)

....

....

(b) The diagram shows the final burette reading.

32 —

33 —

The initial burette reading is given in the table.

Complete the table, giving both values to the nearest 0.05 cm^3.

(2)

final burette reading	
initial burette reading	4.15
volume of sulfuric acid added in cm^3	

(c) The student repeats the titration more accurately four times.

The table shows their results.

titration number	1	2	3	4
volume of sulfuric acid added in cm^3	27.40	27.65	27.30	27.35
concordant results				

Concordant results are those within 0.20 cm^3 of each other.

(i) Place ticks (✓) in the table to show which results are concordant.

(1)

(ii) Use the concordant results to calculate the mean volume of sulfuric acid added.

(1)

mean volume of sulfuric acid = ... cm^3

(d) Another student also does the titration.

(i) The student uses 25.0 cm^3 of potassium hydroxide solution with a concentration of 0.500 mol/dm^3.

The mean volume of sulfuric acid added is 26.50 cm^3.

This is the equation for the reaction.

$$2KOH(aq) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + 2H_2O(l)$$

Calculate the concentration of the sulfuric acid.

(3)

concentration of sulfuric acid = ... mol/dm^3

(ii) The student repeats the titration without the methyl orange indicator.

They add exactly 26.50 cm^3 of sulfuric acid to the potassium hydroxide solution.

Describe how the student could obtain pure, dry potassium sulfate crystals from the reaction mixture.

(4)

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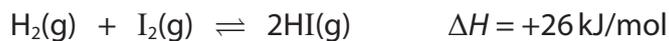
(Total for Question 5 = 13 marks)

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6 Hydrogen reacts with iodine vapour to form hydrogen iodide, HI

This is the equation for the reaction.

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g) \qquad \Delta H = +26\,kJ/mol$$

(a) (i) Give the test for hydrogen.

(1)

....

....

(ii) State what the symbol $\rightleftharpoons$ represents.

(1)

....

(b) In a sealed container at equilibrium, the reaction conditions are 500°C and 2 atm.

(i) The temperature of the reaction mixture is increased to 600°C, but the pressure is kept at 2 atm.

Explain the effect, if any, on the yield of hydrogen iodide at equilibrium.

(2)

....

....

....

....

(ii) The pressure of the reaction mixture is decreased to 1 atm but the temperature is kept at 500°C.

Explain the effect, if any, on the yield of hydrogen iodide at equilibrium.

(2)

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....

(c) An excess of hydrogen reacts with 50.8 g of iodine.

At equilibrium, the yield of hydrogen iodide is 80%.

Calculate the volume, in cm^3, of hydrogen iodide produced at rtp.

Give your answer in standard form.

[at rtp, molar volume = 24 000 cm^3]

(4)

volume of hydrogen iodide = ... cm^3

(Total for Question 6 = 10 marks)

TOTAL FOR PAPER = 70 MARKS

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