

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

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## Pearson Edexcel International GCSE (9–1)

Time 1 hour 15 minutes

Paper

reference

**4CH1/2CR**

### Chemistry

Unit: 4CH1

PAPER: 2CR

**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.*
- 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 ►

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# The Periodic Table of the Elements

	1	2	3	4	5	6	7	0										
	7 <b>Li</b> lithium 3	9 <b>Be</b> beryllium 4	11 <b>Na</b> sodium 11	12 <b>Mg</b> magnesium 12	13 <b>Al</b> aluminium 13	14 <b>Si</b> silicon 14	15 <b>P</b> phosphorus 15	16 <b>S</b> sulfur 16	17 <b>Cl</b> chlorine 17	18 <b>Ar</b> argon 18								
	19 <b>K</b> potassium 19	20 <b>Ca</b> calcium 20	21 <b>Sc</b> scandium 21	22 <b>Ti</b> titanium 22	23 <b>V</b> vanadium 23	24 <b>Cr</b> chromium 24	25 <b>Mn</b> manganese 25	26 <b>Fe</b> iron 26	27 <b>Co</b> cobalt 27	28 <b>Ni</b> nickel 28	29 <b>Cu</b> copper 29	30 <b>Zn</b> zinc 30	31 <b>Ga</b> gallium 31	32 <b>Ge</b> germanium 32	33 <b>As</b> arsenic 33	34 <b>Se</b> selenium 34	35 <b>Br</b> bromine 35	36 <b>Kr</b> krypton 36
	37 <b>Rb</b> rubidium 37	38 <b>Sr</b> strontium 38	39 <b>Y</b> yttrium 39	40 <b>Zr</b> zirconium 40	41 <b>Nb</b> niobium 41	42 <b>Mo</b> molybdenum 42	43 <b>Tc</b> technetium [98]	44 <b>Ru</b> ruthenium 44	45 <b>Rh</b> rhodium 45	46 <b>Pd</b> palladium 46	47 <b>Ag</b> silver 47	48 <b>Cd</b> cadmium 48	49 <b>In</b> indium 49	50 <b>Sn</b> tin 50	51 <b>Sb</b> antimony 51	52 <b>Te</b> tellurium 52	53 <b>I</b> iodine 53	54 <b>Xe</b> xenon 54
	55 <b>Cs</b> caesium 55	56 <b>Ba</b> barium 56	57 <b>La*</b> lanthanum 57	72 <b>Hf</b> hafnium 72	73 <b>Ta</b> tantalum 73	74 <b>W</b> tungsten 74	75 <b>Re</b> rhenium 75	76 <b>Os</b> osmium 76	77 <b>Ir</b> iridium 77	78 <b>Pt</b> platinum 78	79 <b>Au</b> gold 79	80 <b>Hg</b> mercury 80	81 <b>Tl</b> thallium 81	82 <b>Pb</b> lead 82	83 <b>Bi</b> bismuth 83	84 <b>Po</b> polonium [209]	85 <b>At</b> astatine [210]	86 <b>Rn</b> radon [222]
	[223] <b>Fr</b> francium 87	[226] <b>Ra</b> radium 88	[227] <b>Ac*</b> actinium 89	[261] <b>Rf</b> rutherfordium 104	[262] <b>Db</b> dubnium 105	[266] <b>Sg</b> seaborgium 106	[264] <b>Bh</b> bohrium 107	[277] <b>Hs</b> hassium 108	[268] <b>Mt</b> meitnerium 109	[271] <b>Ds</b> darmstadtium 110	[272] <b>Rg</b> roentgenium 111	Elements with atomic numbers 112–116 have been reported but not fully authenticated						

1  
**H**  
hydrogen  
1

**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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**Answer ALL questions.**

Some questions must be answered with a cross ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

- 1 (a) Two substances are needed to cause iron to rust.

Name these two substances.

(2)

1 .....

2 .....

- (b) The box gives the names of some substances.

calcium	copper	gold
iodine	methane	zinc

Use words from the box to answer these questions.

- (i) Give the name of a non-metallic element.

(1)

.....

- (ii) Give the name of a compound.

(1)

.....

- (iii) Give the name of the metal that is lowest in the reactivity series.

(1)

.....

**(Total for Question 1 = 5 marks)**

.....



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Turn over

2 Crude oil is a mixture of hydrocarbons.

(a) This passage is about the industrial separation of crude oil.

Complete the passage by adding the missing words.

(3)

Crude oil is ..... to form vapour.

The vapour is passed through a ..... column.

The refinery gases are collected at the top of the column because they have low

.....

(b) Bitumen is collected at the bottom of the column.

Give one use of bitumen.

(1)

(c) One of the hydrocarbons in crude oil is an alkane with this structural formula.



(i) Give the name of this alkane.

(1)

(ii) Calculate the relative molecular mass ( $M_r$ ) of this alkane.

(1)

$M_r =$  .....



(d) Catalytic cracking is used to convert long-chain alkanes into shorter-chain alkanes.

Give the name of the catalyst and the temperature used in catalytic cracking.

(2)

catalyst .....

temperature .....

(e) Catalytic cracking also produces alkenes.

Decane ( $C_{10}H_{22}$ ) can undergo cracking to give  $C_4H_{10}$  and two different alkenes.

Complete the equation for this cracking process.

(2)



**(Total for Question 2 = 10 marks)**



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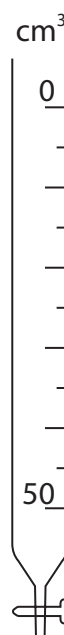
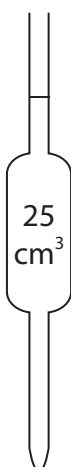
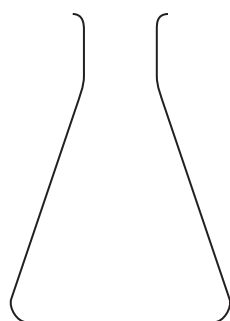


Turn over

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

The student uses these solutions and this apparatus.

- dilute sulfuric acid
- potassium hydroxide solution of concentration  $0.240 \text{ mol/dm}^3$
- methyl orange indicator



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(a) The student wants to find the volume of sulfuric acid needed to neutralise 25.0 cm<sup>3</sup> of the potassium hydroxide solution.

Describe how the student should do this titration.

Assume that all pieces of apparatus are clean and dry.

(6)

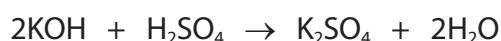
Area with horizontal dotted lines for writing the answer.



Turn over

- (b) The student needs  $15.00 \text{ cm}^3$  of sulfuric acid to neutralise  $25.0 \text{ cm}^3$  of the potassium hydroxide solution.

This is the equation for the reaction.



- (i) Calculate the amount, in moles, of KOH in  $25.0 \text{ cm}^3$  of potassium hydroxide solution of concentration  $0.240 \text{ mol/dm}^3$ .

(2)

amount of KOH = ..... mol

- (ii) Calculate the amount, in moles, of  $\text{H}_2\text{SO}_4$  in  $15.00 \text{ cm}^3$  of the sulfuric acid.

(1)

amount of  $\text{H}_2\text{SO}_4$  = ..... mol

- (iii) Calculate the concentration, in  $\text{mol/dm}^3$ , of the sulfuric acid.

(2)

concentration of sulfuric acid = .....  $\text{mol/dm}^3$

**(Total for Question 3 = 11 marks)**





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Turn over

4 This question is about alcohols, carboxylic acids and their reactions.

(a) The boxes give some information about a carboxylic acid.

Complete the boxes by giving the missing information.

(3)

structural formula	$\text{CH}_3\text{COOH}$
name	
	$\text{CH}_2\text{O}$
displayed formula	

(b) Ethanol can be oxidised to produce a carboxylic acid.

(i) Give the names of the two reagents used in this oxidation reaction.

(2)

1 .....

2 .....

(ii) Which of these colour changes occurs during the reaction?

(1)

- A** green to orange
- B** orange to green
- C** red to yellow
- D** yellow to red



(c) Alcohols and carboxylic acids can be heated together to form esters.

- (i) State why it is better to heat the mixture using a water bath rather than directly with a Bunsen burner flame.

(1)

- (ii) An ester has the structural formula  $\text{CH}_3\text{CH}_2\text{COOCH}_3$

Which of these is the name of this ester?

(1)

- A ethyl methanoate
- B methyl ethanoate
- C methyl propanoate
- D propyl methanoate

**(Total for Question 4 = 8 marks)**

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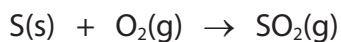


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Turn over

5 This question is about three stages in the manufacture of sulfuric acid.

(a) In stage 1, sulfur is burned in oxygen to form sulfur dioxide gas.



(i) State one environmental problem caused by the release of sulfur dioxide into the atmosphere.

(1)

(ii) A mass of 6.4 tonnes of sulfur is burned to produce sulfur dioxide gas.

Calculate the maximum volume, in  $\text{dm}^3$ , of sulfur dioxide gas that can be produced at rtp.

[molar volume of sulfur dioxide gas at rtp =  $24 \text{ dm}^3$ ]

[1 tonne =  $10^6 \text{ g}$ ]

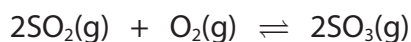
Give your answer in standard form.

(3)

maximum volume = .....  $\text{dm}^3$



(b) In stage 2, sulfur dioxide is reacted with oxygen to form sulfur trioxide gas.



The yield of sulfur trioxide is approximately 98%.

(i) A catalyst is used in this reaction.

Explain how a catalyst increases the rate of a reaction.

(2)

(ii) The temperature is kept constant.

Give a reason why increasing the pressure would increase the yield of sulfur trioxide.

(1)

(iii) Suggest why it is not necessary to increase the pressure in stage 2.

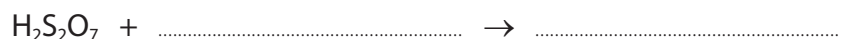
(1)

(c) In stage 3, the sulfur trioxide is reacted with concentrated sulfuric acid to form a liquid called oleum,  $\text{H}_2\text{S}_2\text{O}_7$

The oleum is then added to water to form concentrated sulfuric acid.

Complete the chemical equations for these two reactions.

(2)



(d) Sulfuric acid reacts with ammonia to form ammonium sulfate,  $(\text{NH}_4)_2\text{SO}_4$

Calculate the percentage by mass of nitrogen in ammonium sulfate.

$[M_r \text{ of } (\text{NH}_4)_2\text{SO}_4 = 132]$

(2)

percentage = ..... %

**(Total for Question 5 = 12 marks)**



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6 A teacher prepares the insoluble salt lead(II) bromide ( $\text{PbBr}_2$ ) by mixing solutions of lead(II) nitrate and sodium bromide.

(a) Describe what the teacher should do next to obtain a pure, dry sample of lead(II) bromide.

(3)

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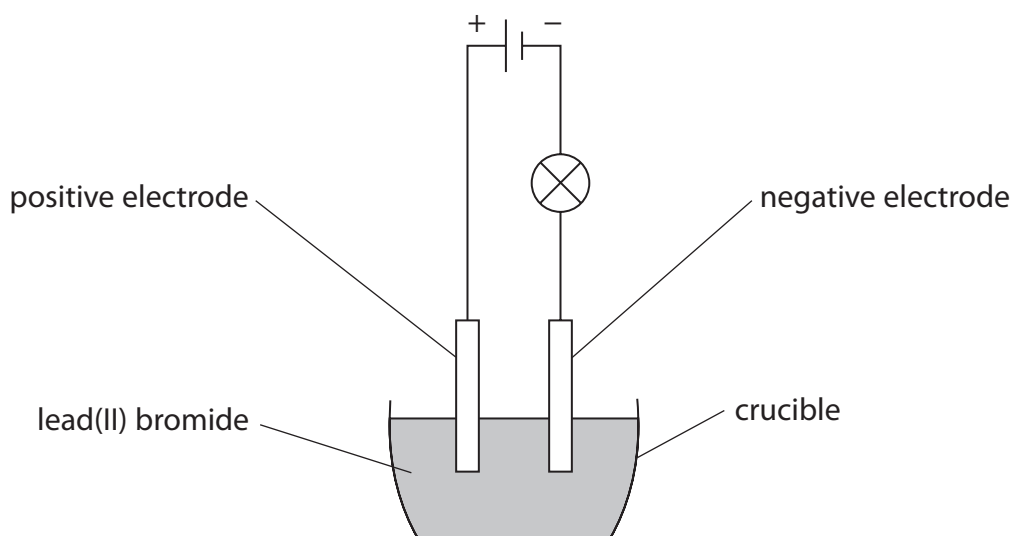
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Turn over

- (b) The teacher then sets up a circuit in a fume cupboard using the pure, dry sample of lead(II) bromide.



Explain why the lamp does not light when the lead(II) bromide is solid.

(2)

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.....

- (c) The teacher heats the lead(II) bromide.

When the lead(II) bromide is molten, the lamp lights and bromine forms at the positive electrode.

- (i) State what observation would be made at the positive electrode.

(1)

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.....





(ii) Explain how bromide ions in the molten lead(II) bromide become bromine molecules at the positive electrode.

(4)

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(d) Write an ionic half-equation for the reaction that occurs at the negative electrode.

Include state symbols in your equation.

(2)

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**(Total for Question 6 = 12 marks)**

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Turn over

7 The reaction between hydrogen and chlorine is exothermic.

This is the equation for the reaction.



(a) State the meaning of the term **exothermic**.

(1)

(b) The table gives the bond energies for the H—H and H—Cl bonds.

<b>Bond</b>	H—H	H—Cl
<b>Bond energy in kJ/mol</b>	436	431

Use the equation and information from the table to calculate the bond energy of the Cl—Cl bond.

(4)

bond energy = ..... kJ/mol



(c) Explain why this reaction is exothermic.

Refer to bond-breaking and bond-making in your answer.

(3)

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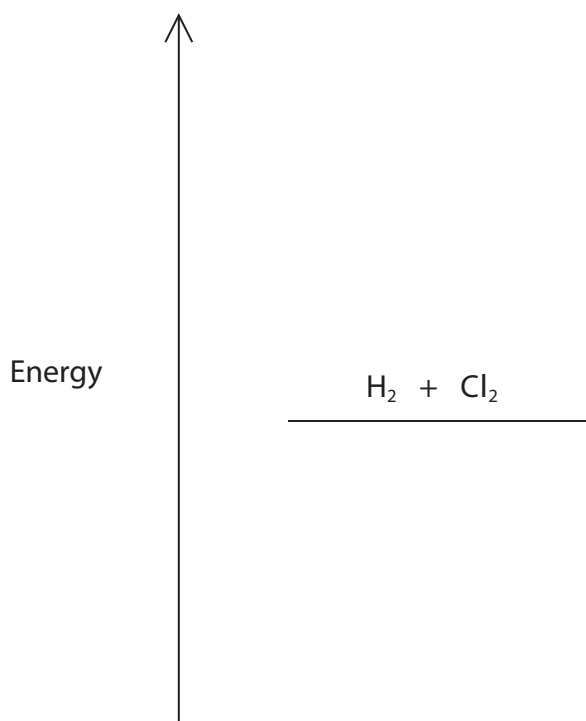
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(d) Complete the reaction profile diagram to show the position of the products, the enthalpy change ( $\Delta H$ ) and the activation energy ( $E_a$ ) for the reaction.

(4)



(Total for Question 7 = 12 marks)

TOTAL FOR PAPER = 70 MARKS



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