

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

		Key							
		relative atomic mass atomic symbol name atomic (proton) number							
1	2	3	4	5	6	7	0		
7	9	11	12	13	14	15	16	17	
Li lithium 3	Be beryllium 4	Na sodium 11	Mg magnesium 12	Al aluminium 13	Si silicon 14	P phosphorus 15	S sulfur 16	Cl chlorine 17	Ar argon 18
19	20	21	22	23	24	25	26	27	28
K potassium 19	Ca calcium 20	Sc scandium 21	Ti titanium 22	V vanadium 23	Cr chromium 24	Mn manganese 25	Fe iron 26	Co cobalt 27	Ni nickel 28
37	38	39	40	41	42	43	44	45	46
Rb rubidium 37	Sr strontium 38	Y yttrium 39	Zr zirconium 40	Nb niobium 41	Mo molybdenum 42	[98] Tc technetium 43	Ru ruthenium 44	Rh rhodium 45	Pd palladium 46
55	56	57	58	59	60	61	62	63	64
Cs caesium 55	Ba barium 56	La* lanthanum 57	Hf hafnium 72	Ta tantalum 73	W tungsten 74	Re rhenium 75	Os osmium 76	Ir iridium 77	Pt platinum 78
83	84	85	86	87	88	89	90	91	92
Bi bismuth 83	Pb lead 82	Tl thallium 81	Hg mercury 80	[223] Fr francium 87	[226] Ra radium 88	[227] Ac* actinium 89	[261] Rf rutherfordium 104	[262] Db dubnium 105	[266] Sg seaborgium 106
122	123	124	125	126	127	128	129	130	131
Sb antimony 51	Sn tin 50	In indium 49	Cd cadmium 48	Ag silver 47	Au gold 79	Cu copper 29	Zn zinc 30	Ga gallium 31	Ge germanium 32
209	210	211	212	213	214	215	216	217	218
[210] At astatine 85	[209] Po polonium 84	[272] Rg roentgenium 111	[271] Ds darmstadtium 110	[268] Mt meitnerium 109	[277] Hs hassium 108	[264] Bh bohrium 107	[261] Rf rutherfordium 104	[227] Ac* actinium 89	[226] Ra radium 88
131	132	133	134	135	136	137	138	139	140
Xe xenon 54	I iodine 53	Te tellurium 52	Sb antimony 51	Sn tin 50	In indium 49	Cd cadmium 48	Ag silver 47	Au gold 79	Cu copper 29
[222] Rn radon 86	[210] At astatine 85	[209] Po polonium 84	209 Bi bismuth 83	207 Pb lead 82	204 Tl thallium 81	201 Hg mercury 80	197 Au gold 79	195 Pt platinum 78	192 Ir iridium 77
Elements with atomic numbers 112–116 have been reported but not fully authenticated									

* 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.



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)



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

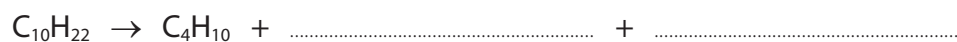
temperature

(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)



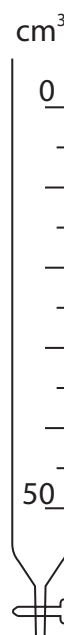
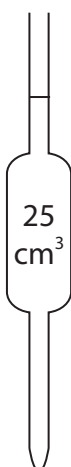
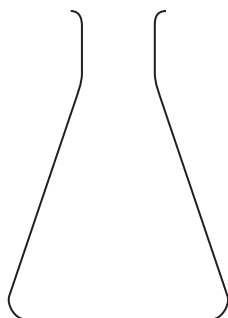
(Total for Question 2 = 10 marks)



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 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 cm³ of the potassium hydroxide solution.

Describe how the student should do this titration.

Assume that all pieces of apparatus are clean and dry.

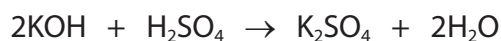
(6)

Area with horizontal dotted lines for writing the answer.



- (b) The student needs 15.00 cm^3 of sulfuric acid to neutralise 25.0 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 cm^3 of potassium hydroxide solution of concentration 0.240 mol/dm^3 .

(2)

amount of KOH = mol

- (ii) Calculate the amount, in moles, of H_2SO_4 in 15.00 cm^3 of the sulfuric acid.

(1)

amount of H_2SO_4 = mol

- (iii) Calculate the concentration, in mol/dm^3 , of the sulfuric acid.

(2)

concentration of sulfuric acid = mol/dm^3

(Total for Question 3 = 11 marks)



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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	CH ₃ COOH
name	
	CH ₂ 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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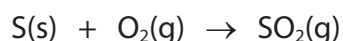
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5 This question is about three stages in the manufacture of sulfuric acid.

(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 dm^3 , of sulfur dioxide gas that can be produced at rtp.

[molar volume of sulfur dioxide gas at rtp = 24 dm^3]

[1 tonne = 10^6 g]

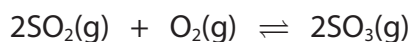
Give your answer in standard form.

(3)

maximum volume = 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.

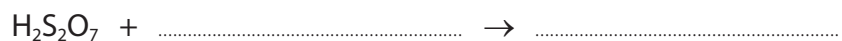
(1)

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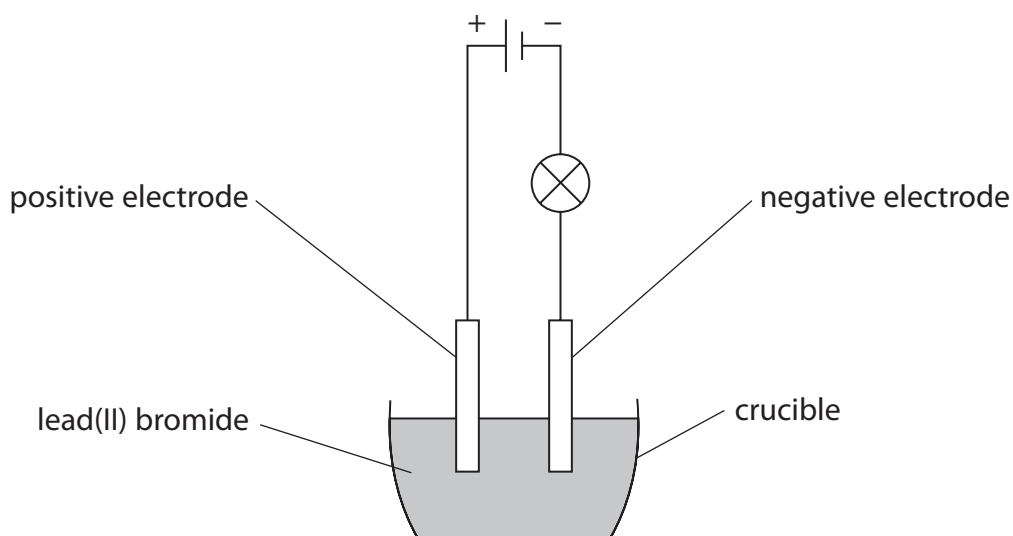
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- (b) The teacher then sets up a circuit in a fume cupboard using the pure, dry sample of lead(II) bromide.



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)

.....

(Total for Question 6 = 12 marks)

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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.

Bond	H—H	H—Cl
Bond energy in kJ/mol	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



