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 40 minutes)

Paper reference **4WCH2/1CR**

Chemistry (Modular)

UNIT 2: 4WCH2
PAPER: 1CR

You must have:
Calculator, ruler

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 the calculations and state the units where required.

Information

- The total mark for this paper is 90.
- 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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P 8 1 5 6 1 A 0 1 2 8

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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
[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						

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 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 catalysts.

(a) Complete the sentences by writing a suitable word in each blank space.

(3)

If a catalyst is added to a reaction mixture,

the rate of reaction is .....

The activation energy for the reaction is .....

The amount of catalyst at the end of a reaction is .....

(b) A student investigates the effect of different catalysts on the rate of decomposition of a hydrogen peroxide solution.

The table shows the time taken to produce the same volume of oxygen gas using each catalyst.

Catalyst	P	Q	R
Time in seconds	30	14	22

Give the letter of the catalyst that gives the fastest rate of reaction.

(1)

.....

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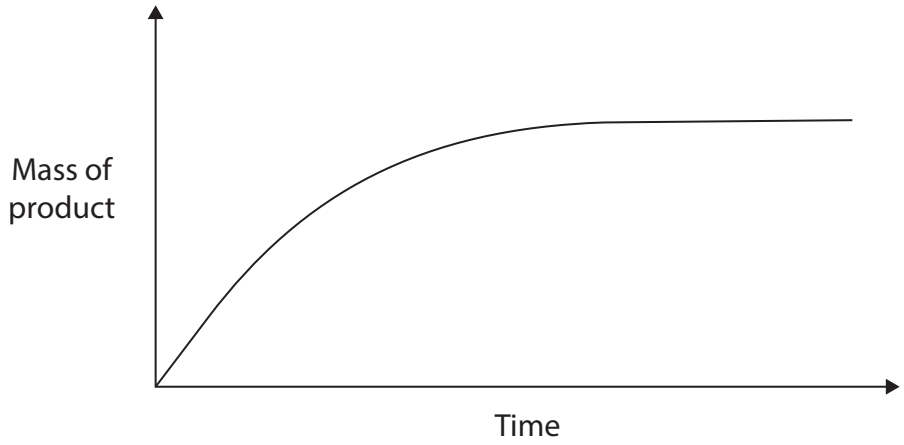
(c) The graph shows the mass of product at different times during a catalysed reaction.

Sketch the shape of the graph when the reaction is **not** catalysed.

(2)



(Total for Question 1 = 6 marks)

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2 The equation shows the reaction of zinc with dilute sulfuric acid.

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

(a) The reaction mixture contains hydrogen ions, sulfate ions and zinc ions.

Draw one straight line from each ion to its charge.

(3)

Ion	**Charge**
	3–
hydrogen	2–
	1–
sulfate	0
	1+
zinc	2+
	3+

(b) Calculate the volume of hydrogen gas produced when using 16.25 g of zinc.

[for Zn, $A_r = 65$]

[one mole of gas at rtp has a volume of 24 000 cm^3]

(2)

volume = ... cm^3

(Total for Question 2 = 5 marks)

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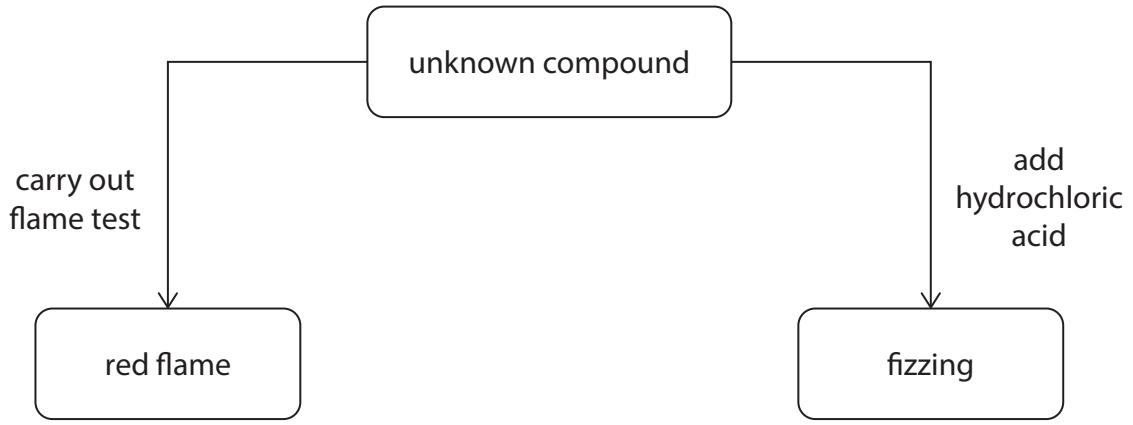
3 The flow chart shows the results of tests on an unknown compound.



(a) Identify the positive ion in the compound from the colour of the flame.

(1)

(b) Adding hydrochloric acid to the unknown compound causes fizzing because a gas is given off.

Describe a test on the gas that would confirm that the unknown compound contains carbonate ions.

(3)

(c) Deduce the formula of the unknown compound.

(1)

(Total for Question 3 = 5 marks)

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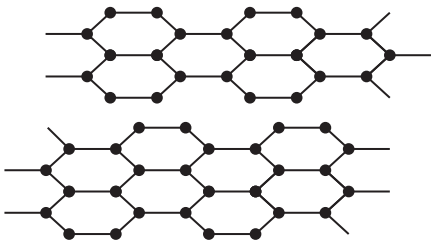
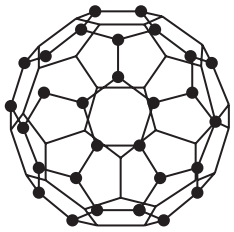
4 The table gives some information about the element carbon.

Name	Diagram	Structure
graphite		
C_{60} fullerene		

(a) Complete the table by giving the name of each structure.

(2)

(b) Graphite and C_{60} fullerene can be used as lubricants.

In graphite, the layers move over each other easily.

Suggest why C_{60} fullerene molecules move over each other easily.

(1)

.....

.....

(c) Graphite conducts electricity better than C_{60} fullerene.

Explain this difference.

(3)

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.....

(Total for Question 4 = 6 marks)

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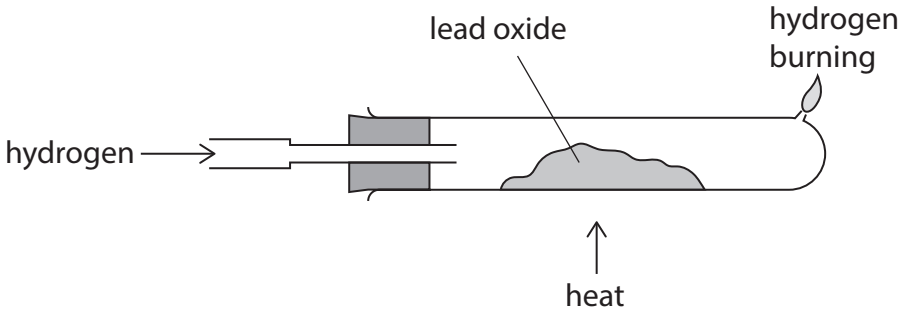
5 The element lead (Pb) forms different oxides.

(a) A scientist uses this equipment to find the masses of lead and oxygen in a sample of a lead oxide with the formula PbO.



The scientist finds the mass of the tube and its contents before and after heating.

(i) State how the scientist can find the mass of oxygen in the sample.

(1)

.....

.....

(ii) Describe what the scientist should do next to check that the reaction is complete.

(2)

.....

.....

.....

.....

(iii) Give the word equation for the reaction between hydrogen and this lead oxide.

(1)

.....

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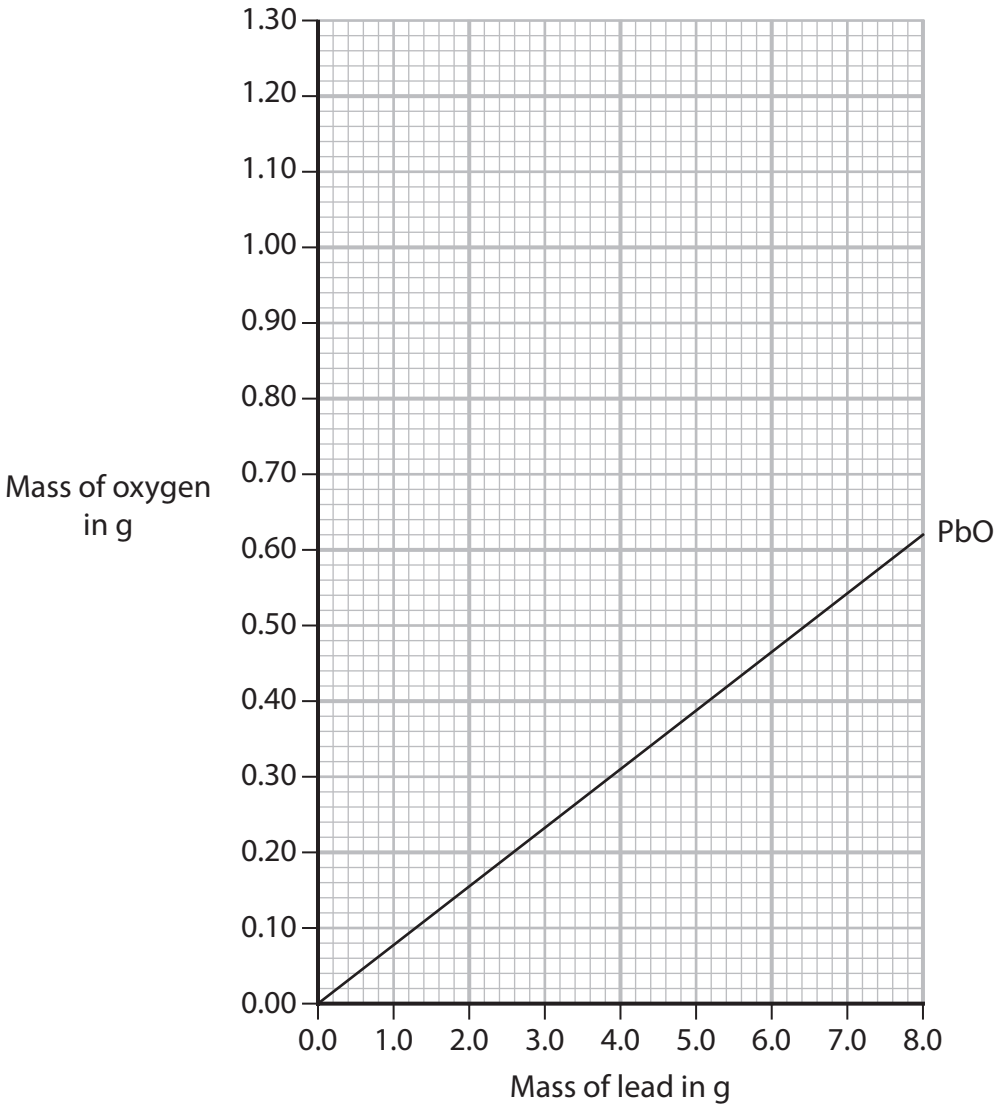
(b) The experiment in part (a) is repeated using different masses of PbO.

The graph shows the masses of lead and oxygen found in these experiments.



Determine the gradient of this graph.

(1)

gradient = ...

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(c) The scientist reacts a different lead oxide (compound T) with hydrogen using the same equipment.

The table shows the scientist's results.

Mass of lead in g	Mass of oxygen in g
0.0	0.00
1.6	0.24
2.7	0.40
4.0	0.62
4.6	0.74
6.4	0.99
7.5	1.16

(i) Plot the results on the grid in part (b).

(1)

(ii) Draw a line of best fit.

(1)

(iii) Determine the empirical formula of compound T by comparing the two lines drawn on the grid.

(2)

empirical formula = ...

(Total for Question 5 = 9 marks)

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6 Chloroethene is used to make the polymer poly(chloroethene).

(a) Name the type of polymerisation that produces poly(chloroethene).

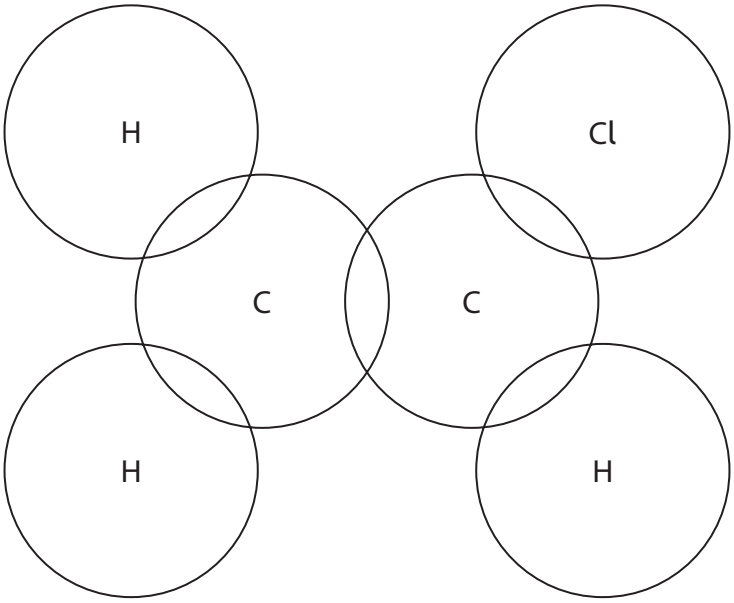
(1)

.....

(b) Complete the dot-and-cross diagram for chloroethene.

Show only the electrons in the outer shell of each atom.

(2)



(c) Draw the repeat unit of poly(chloroethene).

(2)

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(d) The relative molecular mass for a chain of poly(chloroethene) is 254 000

Calculate the number of carbon atoms in this polymer chain.

[for chloroethene, $M_r = 62.5$]

(2)

number of carbon atoms = ...

(e) Poly(chloroethene) is suitable for making underground water pipes because it is inert.

Explain a problem caused by poly(chloroethene) being inert.

(2)

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.....

(Total for Question 6 = 9 marks)

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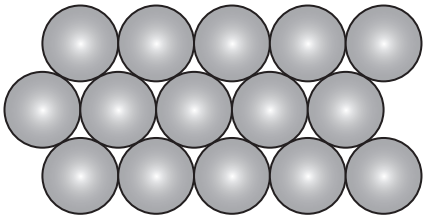
7 This question is about sodium metal and its compound sodium oxide.

(a) Describe how sodium metal can be produced from sodium oxide.

(2)

(b) The diagram shows the arrangement of particles in a pure metal.



Explain why pure metals are soft.

(2)

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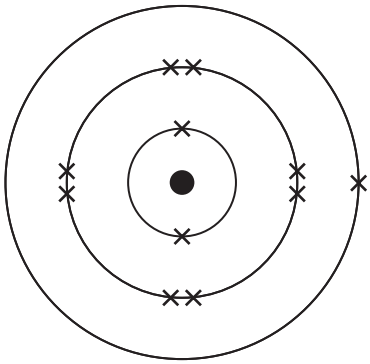
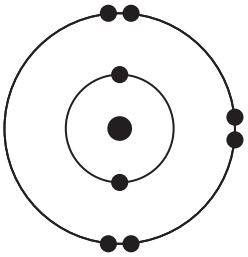
(c) The diagram shows the electronic structure of an atom of sodium and an atom of oxygen.



Sodium



Oxygen

Describe, in terms of electrons, what happens when sodium reacts with oxygen.

(2)

.....

.....

.....

.....

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(d) The table shows the melting points of sodium and sodium oxide.

	melting point in °C
sodium	98
sodium oxide	1132

Explain why sodium and sodium oxide have different melting points.

In your answer you should refer to:

- the structures of sodium and sodium oxide
- the forces between the particles.

(5)

(Total for Question 7 = 11 marks)

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8 The reaction between chlorine and iodine monochloride (ICl) is reversible.

A teacher sets up an experiment to demonstrate this reaction.

Diagram 1 shows the start of the experiment.

start of experiment

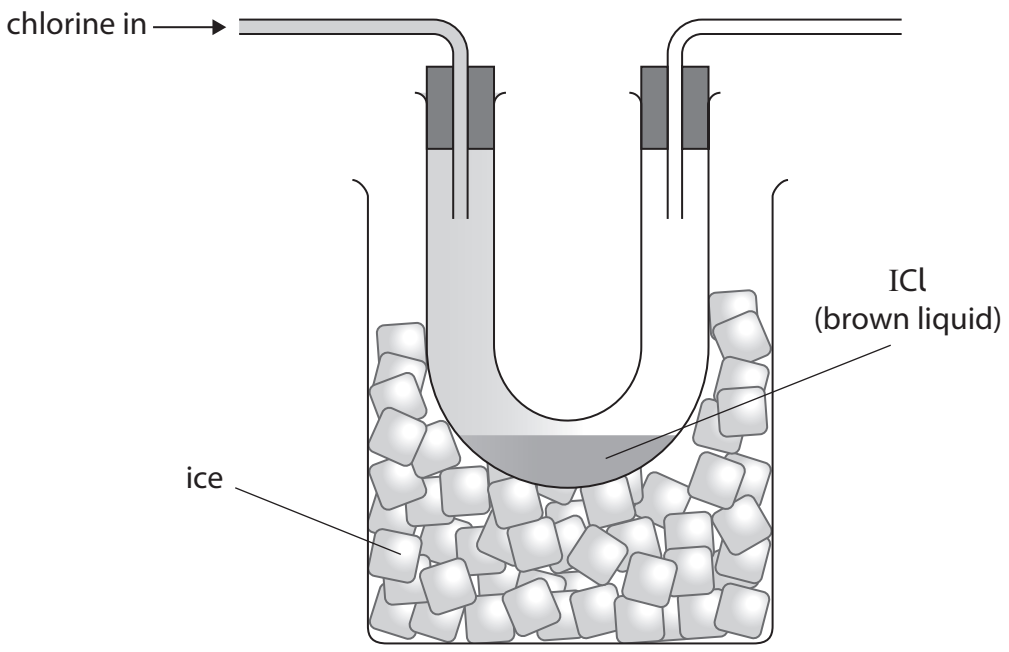

Diagram 1

Diagram 2 shows the same experiment ten minutes later.

ten minutes later

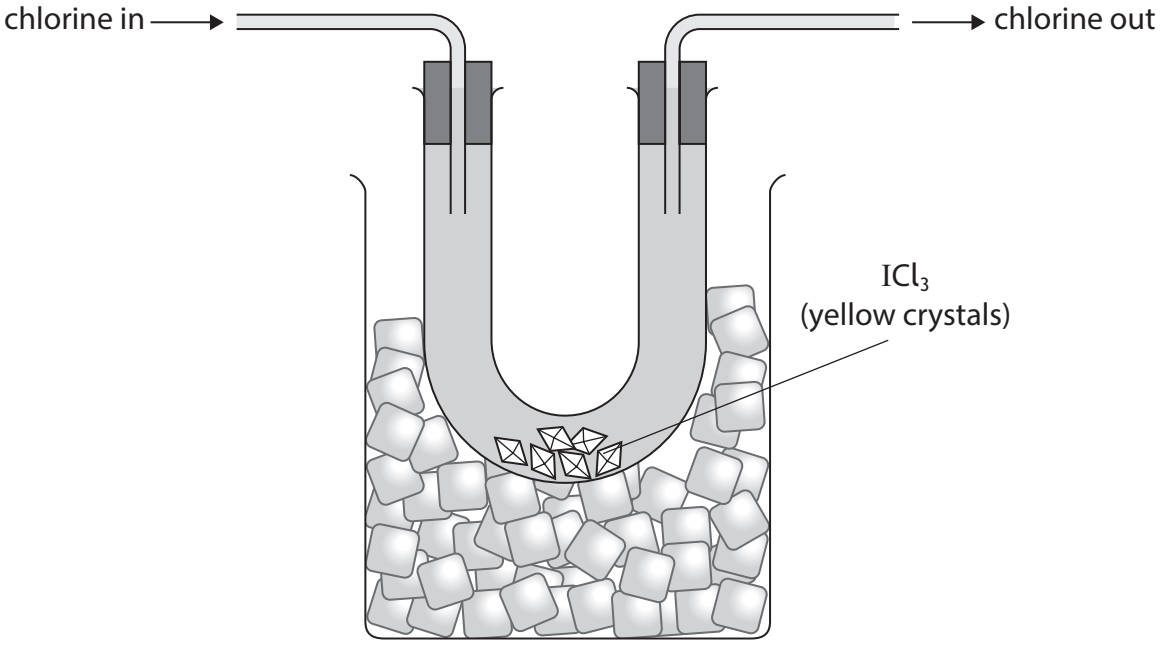

Diagram 2

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(a) Describe a test for chlorine.

(2)

(b) Give a chemical equation, including state symbols, to show that the reaction between chlorine and iodine monochloride is reversible.

(2)

(c) (i) Suggest one change that the teacher could make to reverse the reaction.

(1)

(ii) Describe what would be observed during the reverse reaction.

(2)

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(d) The teacher chose to carry out the experiment using ice rather than at room temperature.

Explain the effect of using ice on the rate of reaction.

(4)

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(e) The maximum mass of ICl_3 that could be made in this experiment is 4.67 g.

The actual amount of ICl_3 that the teacher obtains is 6.40×10^{-3} mol.

Calculate the percentage yield of ICl_3 in the teacher's experiment.

[for I, $A_r = 127$ for Cl, $A_r = 35.5$]

(3)

percentage yield = ... %

(Total for Question 8 = 14 marks)

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9 This question is about halogens.

(a) Which halogen has the palest colour?

(1)

- ☒ **A** astatine
- ☒ **B** bromine
- ☒ **C** chlorine
- ☒ **D** fluorine

(b) Iodine is a solid at room temperature and pressure, but turns into a gas when heated with a Bunsen burner.

Which row shows the melting point and boiling point of iodine?

(1)

	Melting point in °C	Boiling point in °C
☒ **A**	–102	–34
☒ **B**	–7	59
☒ **C**	114	184
☒ **D**	1538	2861

(c) The equation shows the reaction of aluminium with bromine.

$$2Al + 3Br_2 \rightarrow 2AlBr_3$$

Calculate the maximum mass of aluminium bromide produced from 5.60 g of bromine.

[for Br_2, $M_r = 160$ for $AlBr_3$, $M_r = 267$]

(3)

maximum mass = ... g

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(d) A student has three solutions labelled X, Y and Z.

Each solution contains a different halogen, either chlorine, bromine or iodine.

The student decides to use displacement reactions to identify which halogen is in each solution.

The student uses this method.

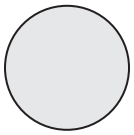
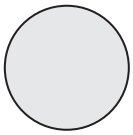
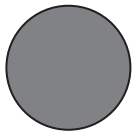
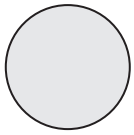
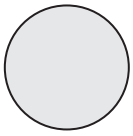
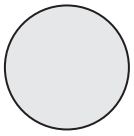
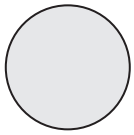
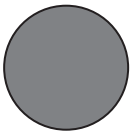
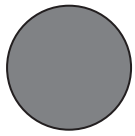
Step 1 pour samples of solution X into three different test tubes

Step 2 add a different potassium halide solution to each test tube

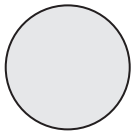
Step 3 record whether the solution in the test tube becomes paler or darker in colour

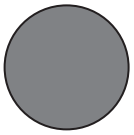
Repeat steps 1 to 3 for solution Y and for solution Z.

The table shows the student's results.

	Addition of potassium chloride solution	**Addition of potassium bromide solution**	**Addition of potassium iodide solution**
Solution X			
Solution Y			
Solution Z			

Key to results

 solution turns paler

 solution turns darker

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Explain how the results show which halogen is in solution X, which halogen is in solution Y and which halogen is in solution Z.

In your answer, refer to:

- what the colour change indicates
- the order of reactivity of the halogens.

(6)

(Total for Question 9 = 11 marks)

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10 This question is about alcohols, carboxylic acids and esters.

(a) Acidified potassium dichromate(VI) solution changes colour when it oxidises another compound.

State the colour changes that occur, if any, when acidified potassium dichromate(VI) is added to separate samples of ethanol and ethanoic acid.

(2)

(b) A student makes different esters using this method.

Step 1 add ten drops of an alcohol to a boiling tube

Step 2 add ten drops of a carboxylic acid

Step 3 add five drops of concentrated sulfuric acid

Step 4 warm the mixture in a beaker of hot water for ten minutes

(i) Explain one safety precaution that the student should take in step 2 and step 3.

(2)

(ii) Explain one reason why the mixture must **not** be warmed using a Bunsen burner in step 4.

(2)

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(iii) What is the distinctive smell of an ester?

(1)

- ☒ **A** bleach
- ☒ **B** fruity
- ☒ **C** smoky
- ☒ **D** vinegar

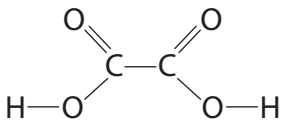
(iv) One ester has the structural formula $CH_3CH_2COOCH_2CH_3$

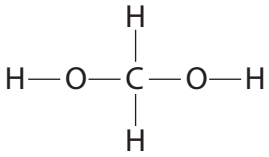
Name this ester.

(1)

(c) Ethanedioic acid and methanediol react together to form a polymer.

These are the displayed formulae of ethanedioic acid and methanediol.





Draw the repeat unit of the polymer.

(2)

QUESTION 10 CONTINUES ON NEXT PAGE

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(d) This is the equation for the reaction between ethanedioic acid and sodium hydroxide.

$$HOOCCOOH + 2NaOH \rightarrow (COO)_2Na_2 + 2H_2O$$

A beaker contains 30 cm^3 of 0.40 mol/dm^3 ethanedioic acid solution.

A student adds 70 cm^3 of 0.20 mol/dm^3 sodium hydroxide solution to the ethanedioic acid.

After this addition, the ethanedioic acid is not fully neutralised.

Calculate the mass of ethanedioic acid that remains in the beaker after the reaction.

[for ethanedioic acid, $M_r = 90$]

(4)

mass = ... g

(Total for Question 10 = 14 marks)

(TOTAL FOR PAPER = 90 MARKS)

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