

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Pearson Edexcel
International GCSE (9–1)

Centre Number

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Candidate Number

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Monday 11 January 2021

Morning (Time: 2 hours)

Paper Reference **4CH1/1CR 4SD0/1CR**

Chemistry

Unit: 4CH1

Science (Double Award) 4SD0

Paper: 1CR

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.
- 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 ☒.

Information

- The total mark for this paper is 110.
- 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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1/1/1/




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The Periodic Table of the Elements

1	2	3	4	5	6	7	0	
7 Li lithium 3	9 Be beryllium 4	11 Na sodium 11	12 C carbon 6	13 Al aluminium 13	14 N nitrogen 7	15 O oxygen 8	16 F fluorine 9	17 Ne neon 10
19 K potassium 19	20 Ca calcium 20	23 Na sodium 11	24 Mg magnesium 12	27 Co cobalt 27	28 Ni nickel 28	29 Cu copper 29	30 Zn zinc 30	35 Br bromine 35
37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium 43	44 Ru ruthenium 44	45 Rh rhodium 45
55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77
87 Fr francium 87	88 Ra radium 88	89 Ac* actinium 89	104 Rf rutherfordium 104	105 Db dubnium 105	106 Sg seaborgium 106	107 Bh bohrium 107	108 Hs hassium 108	109 Mt meitnerium 109
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
199 Ac* actinium 89	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
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	199 Ac* actinium 89	209 Bi bismuth 83
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
285 U uranium 92	286 Pu plutonium 94	287 Am americium 95	288 Cm curium 96	289 Bk berkelium 97	290 Cf californium 98	291 Es einsteinium 99	292 Fm fermium 100	293 Mn mendelevium 101
311 Uu ununoctium 118	312 Uub unubium 119	313 Uut ununtrium 120	314 Uuq ununquadium 121	315 Uup ununpentium 122	316 Uuq ununquadium 121	317 Uuh ununhexium 122	318 Uuq ununquadium 121	319 Uuh ununhexium 122
327 Uu unseptentium 137	328 Uub unubium 119	329 Uut ununtrium 120	330 Uuq ununquadium 121	331 Uup ununpentium 122	332 Uuq ununquadium 121	333 Uuh ununhexium 122	334 Uuq ununquadium 121	335 Uuh ununhexium 122
359 Uu unnonium 158	360 Uub unubium 119	361 Uut ununtrium 120	362 Uuq ununquadium 121	363 Uup ununpentium 122	364 Uuq ununquadium 121	365 Uuh ununhexium 122	366 Uuq ununquadium 121	367 Uuh ununhexium 122
421 Uu unquadrum 184	422 Uub unubium 119	423 Uut ununtrium 120	424 Uuq ununquadium 121	425 Uup ununpentium 122	426 Uuq ununquadium 121	427 Uuh ununhexium 122	428 Uuq ununquadium 121	429 Uuh ununhexium 122
491 Uu unquadium 222	492 Uub unubium 119	493 Uut ununtrium 120	494 Uuq ununquadium 121	495 Uup ununpentium 122	496 Uuq ununquadium 121	497 Uuh ununhexium 122	498 Uuq ununquadium 121	499 Uuh ununhexium 122
561 Uu unsexium 289	562 Uub unubium 119	563 Uut ununtrium 120	564 Uuq ununquadium 121	565 Uup ununpentium 122	566 Uuq ununquadium 121	567 Uuh ununhexium 122	568 Uuq ununquadium 121	569 Uuh ununhexium 122
621 Uu unvigintiium 354	622 Uub unubium 119	623 Uut ununtrium 120	624 Uuq ununquadium 121	625 Uup ununpentium 122	626 Uuq ununquadium 121	627 Uuh ununhexium 122	628 Uuq ununquadium 121	629 Uuh ununhexium 122
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1701 Uu unquadragintiium 420	1702 Uub unubium 119	1703 Uut ununtrium 120	1704 Uuq ununquadium 121	1705 Uup ununpentium 122	1706 Uuq ununquadium 121	1707 Uuh ununhexium 122	1708 Uuq ununquadium 121	1709 Uuh ununhexium 122
1761 Uu unquadragintiium 420	1762 Uub unubium 119	1763 Uut ununtrium 120	1764 Uuq ununquadium 121	1765 Uup ununpentium 122	1766 Uuq ununquadium 121	1767 Uuh ununhexium 122	1768 Uuq ununquadium 121	1769 Uuh ununhexium 122
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1881 Uu unquadragintiium 420	1882 Uub unubium 119	1883 Uut ununtrium 120	1884 Uuq ununquadium 121	1885 Uup ununpentium 122	1886 Uuq ununquadium 121	1887 Uuh ununhexium 122	1888 Uuq ununquadium 121	1889 Uuh ununhexium 122
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2001 Uu unquadragintiium 420	2002 Uub unubium 119	2003 Uut ununtrium 120	2004 Uuq ununquadium 121	2005 Uup ununpentium 122	2006 Uuq ununquadium 121	2007 Uuh ununhexium 122	2008 Uuq ununquadium 121	2009 Uuh ununhexium 122
2061 Uu unquadragintiium 420	2062 Uub unubium 119	2063 Uut ununtrium 120	2064 Uuq ununquadium 121	2065 Uup ununpentium 122	2066 Uuq ununquadium 121	2067 Uuh ununhexium 122	2068 Uuq ununquadium 121	2069 Uuh ununhexium 122
2121 Uu unquadragintiium 420	2122 Uub unubium 119	2123 Uut ununtrium 120	2124 Uuq ununquadium 121	2125 Uup ununpentium 122	2126 Uuq ununquadium 121	2127 Uuh ununhexium 122	2128 Uuq ununquadium 121	2129 Uuh ununhexium 122
2181 Uu unquadragintiium 420	2182 Uub unubium 119	2183 Uut ununtrium 120	2184 Uuq ununquadium 121	2185 Uup ununpentium 122	2186 Uuq ununquadium 121	2187 Uuh ununhexium 122	2188 Uuq ununquadium 121	2189 Uuh ununhexium 122
2241 Uu unquadragintiium 420	2242 Uub unubium 119	2243 Uut ununtrium 120	2244 Uuq ununquadium 121	2245 Uup ununpentium 122	2246 Uuq ununquadium 121	2247 Uuh ununhexium 122	2248 Uuq ununquadium 121	2249 Uuh ununhexium 122
2301 Uu unquadragintiium 420	2302 Uub unubium 119	2303 Uut ununtrium 120	2304 Uuq ununquadium 121	2305 Uup ununpentium 122	2306 Uuq ununquadium 121	2307 Uuh ununhexium 122	2308 Uuq ununquadium 121	2309 Uuh ununhexium 122
2361 Uu unquadragintiium 420	2362 Uub unubium 119	2363 Uut ununtrium 120	2364 Uuq ununquadium 121	2365 Uup ununpentium 122	2366 Uuq ununquadium 121	2367 Uuh ununhexium 122	2368 Uuq ununquadium 121	2369 Uuh ununhexium 122
2421 Uu unquadragintiium 420	2422 Uub unubium 119	2423 Uut ununtrium 120	2424 Uuq ununquadium 121	2425 Uup ununpentium 122	2426 Uuq ununquadium 121	2427 Uuh ununhex		

Answer ALL questions.

1 The box lists some substances.

air	bromine	carbon	copper	glucose
nitrogen	oxygen	sulfur	water	

Choose substances from the box to answer these questions.

Each substance may be used once, more than once or not at all.

(a) Name a metallic element. (1)

(b) Name a compound. (1)

(c) Name a mixture. (1)

(d) Name an element that is a gas at room temperature. (1)

(e) Name an element that forms a basic oxide. (1)

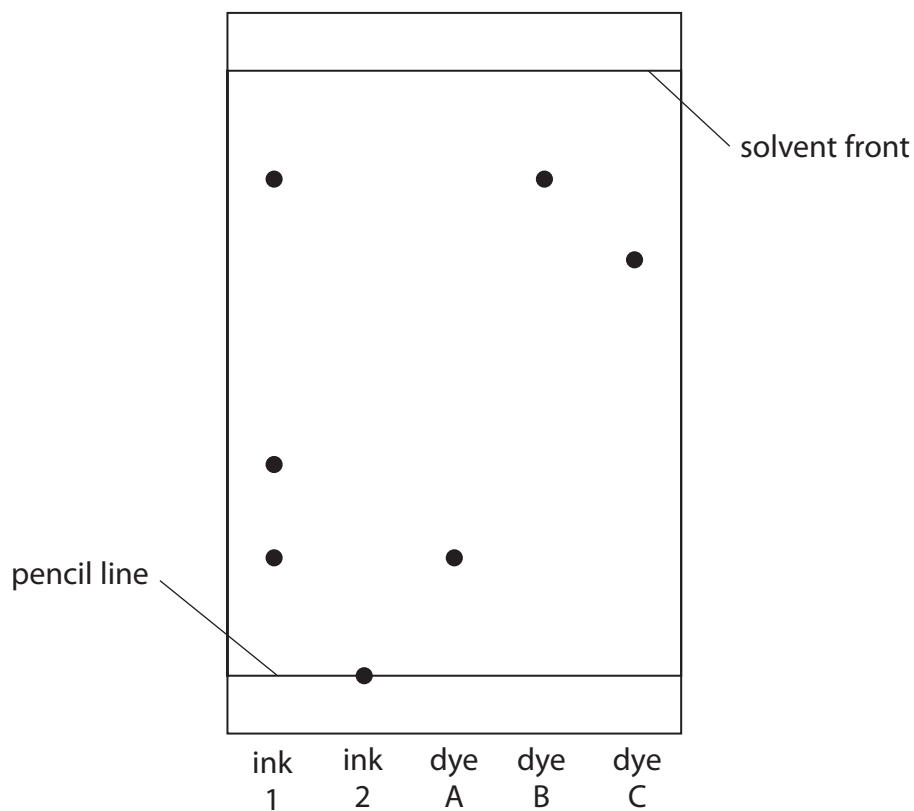
(f) Name two elements that are in the same group of the Periodic Table. (1)

(Total for Question 1 = 6 marks)



- 2 A student does a chromatography experiment using ink 1, ink 2, and three known dyes A, B and C. The student uses water as the solvent.

The diagram shows the student's chromatogram.



- (a) Deduce what conclusions can be made about the composition of ink 1.

(2)

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- (b) (i) Give one conclusion that can be made about ink 2.

(1)

.....

.....



(ii) Suggest how the student could change the experiment to find the composition of ink 2.

(1)

(c) Calculate the R_f value of dye C, giving your answer to 2 significant figures.

(3)

R_f value =

(Total for Question 2 = 7 marks)

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3 Crude oil is a mixture of organic compounds.

Most of these compounds are members of the same homologous series.

(a) State the name of this homologous series.

(1)

(b) An industrial process is used to separate crude oil into fractions.

(i) The process depends on a difference in a property of the fractions.

What is this property?

(1)

- A boiling point
- B density
- C melting point
- D solubility

(ii) The boxes give some uses of fractions and some names of fractions.

Draw one straight line from each use to its correct fraction.

(3)

Use	Fraction
	<input type="checkbox"/> bitumen
<input type="checkbox"/> fuel for aeroplanes	<input type="checkbox"/> diesel
<input type="checkbox"/> fuel for ships	<input type="checkbox"/> fuel oil
<input type="checkbox"/> surfacing roads	<input type="checkbox"/> gasoline
	<input type="checkbox"/> kerosene



(c) Fuels obtained from the fractions may contain impurities.

Explain how the combustion of a common impurity in fuels may cause an environmental problem.

(3)

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(d) Some of the fractions contain long-chain molecules which are not very useful.

(i) Give the name of the process used to convert long-chain molecules into more useful shorter-chain molecules.

(1)

.....

(ii) Give the catalyst and temperature used in the industrial process to convert long-chain molecules into shorter-chain molecules.

(2)

catalyst

temperature

(iii) When $C_{13}H_{28}$ is used in this process, three different molecules are formed.

Complete the equation for this reaction.

(2)



(Total for Question 3 = 13 marks)



4 When iron is left in damp air, rust forms on its surface.

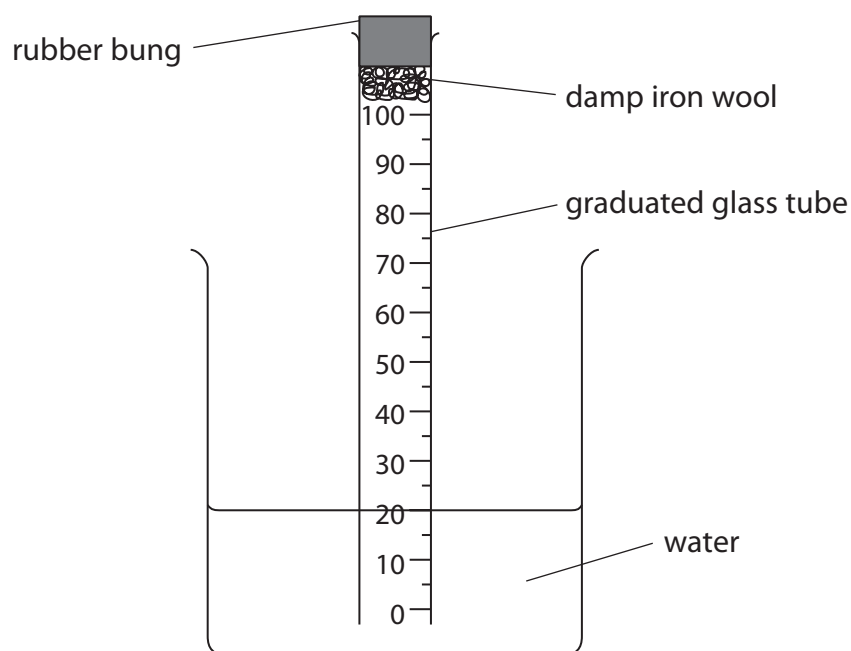
(a) (i) State the chemical name for rust.

(1)

(ii) Explain how a barrier method prevents rusting.

(2)

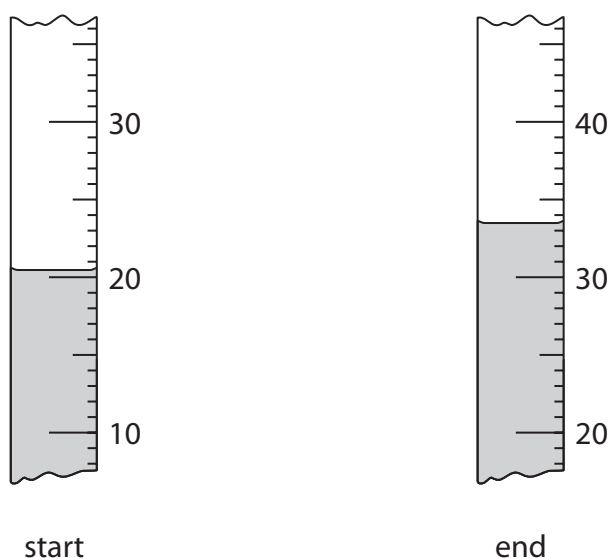
(b) A student uses this apparatus to find the approximate percentage by volume of oxygen in air.



This is the student's method.

- place a graduated glass tube in a beaker of water
- place some damp iron wool and a rubber bung in the top of the tube
- record the reading of the water level in the tube
- leave the apparatus for a few days
- record the reading of the water level again

The diagram shows the readings at the start and at the end of the experiment.



(i) Use the readings to complete the table, giving all values to the nearest 0.5 cm³.

(2)

reading at start in cm ³	20.5
reading at end in cm ³	
volume of oxygen used in cm ³	

(ii) The student uses these results to calculate the percentage by volume of oxygen in air.

Suggest why her calculated value is lower than the expected value.

(1)

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.....

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(c) The student repeats the experiment using the same apparatus.

These are her results for the second experiment.

volume of air in tube at start = 80.0 cm^3

reading at start = 20.0

reading at end = 35.5

Use the results to calculate the percentage by volume of oxygen in air.

(3)

percentage = %

(Total for Question 4 = 9 marks)



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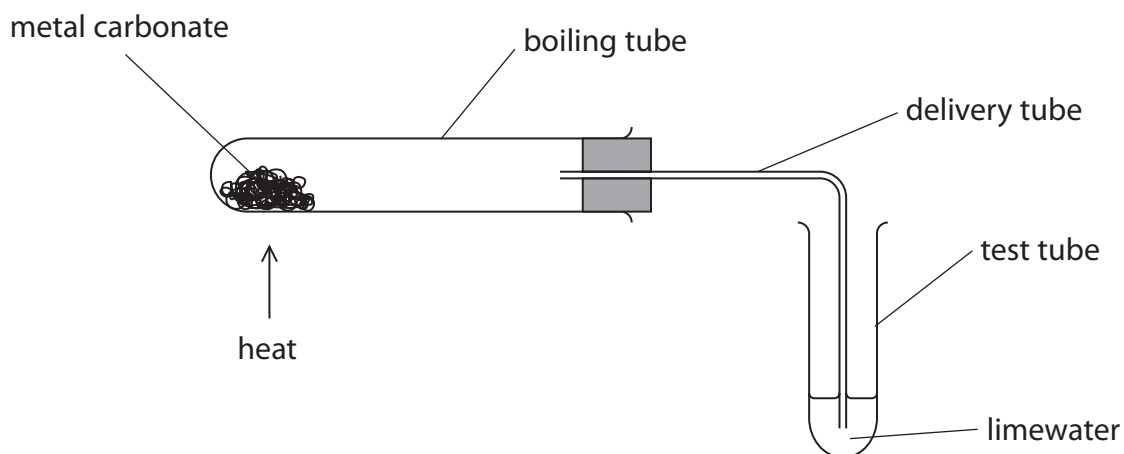
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5 A student uses this apparatus to investigate the effect of heat on different solid metal carbonates.



This is the student's method.

- use a spatula to put some metal carbonate in the boiling tube
- fit the delivery tube into position
- pour some limewater into the test tube
- start a timer and immediately begin to heat the metal carbonate
- record the time when a change first occurs in the limewater

The student repeats the method using different metal carbonates.

When a metal carbonate is heated a reaction sometimes occurs.

The equation for the reaction is



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(a) State the name given to this type of reaction.

(1)

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(b) State two variables that the student should control in this investigation.

(2)

1

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2

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(c) Suggest why bubbles appear in the limewater immediately after heating has started but before there is any change to the metal carbonate.

(1)

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(d) Explain the purpose of limewater in this investigation.

(2)

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(e) The table shows some of the results for the student's investigation.

Metal carbonate	Colour change of solid	Time taken for any change in limewater
calcium carbonate	remains white	90 seconds
sodium carbonate	remains white	no change
copper(II) carbonate		50 seconds

(i) State the colour change that occurs for copper(II) carbonate. (2)

from to

(ii) Give a chemical equation for this reaction of copper(II) carbonate. (1)

(f) (i) There is a relationship between the position of a metal in the reactivity series and how easily the metal carbonate reacts when heated.

Use the student's results and your own knowledge to deduce this relationship. (2)

(ii) State how you should extend the investigation to see if your deduction is correct. (1)

(Total for Question 5 = 12 marks)



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6 Zinc reacts with dilute hydrochloric acid to form hydrogen.

(a) (i) Give a chemical equation for this reaction.

(2)

(ii) Give a test for hydrogen gas.

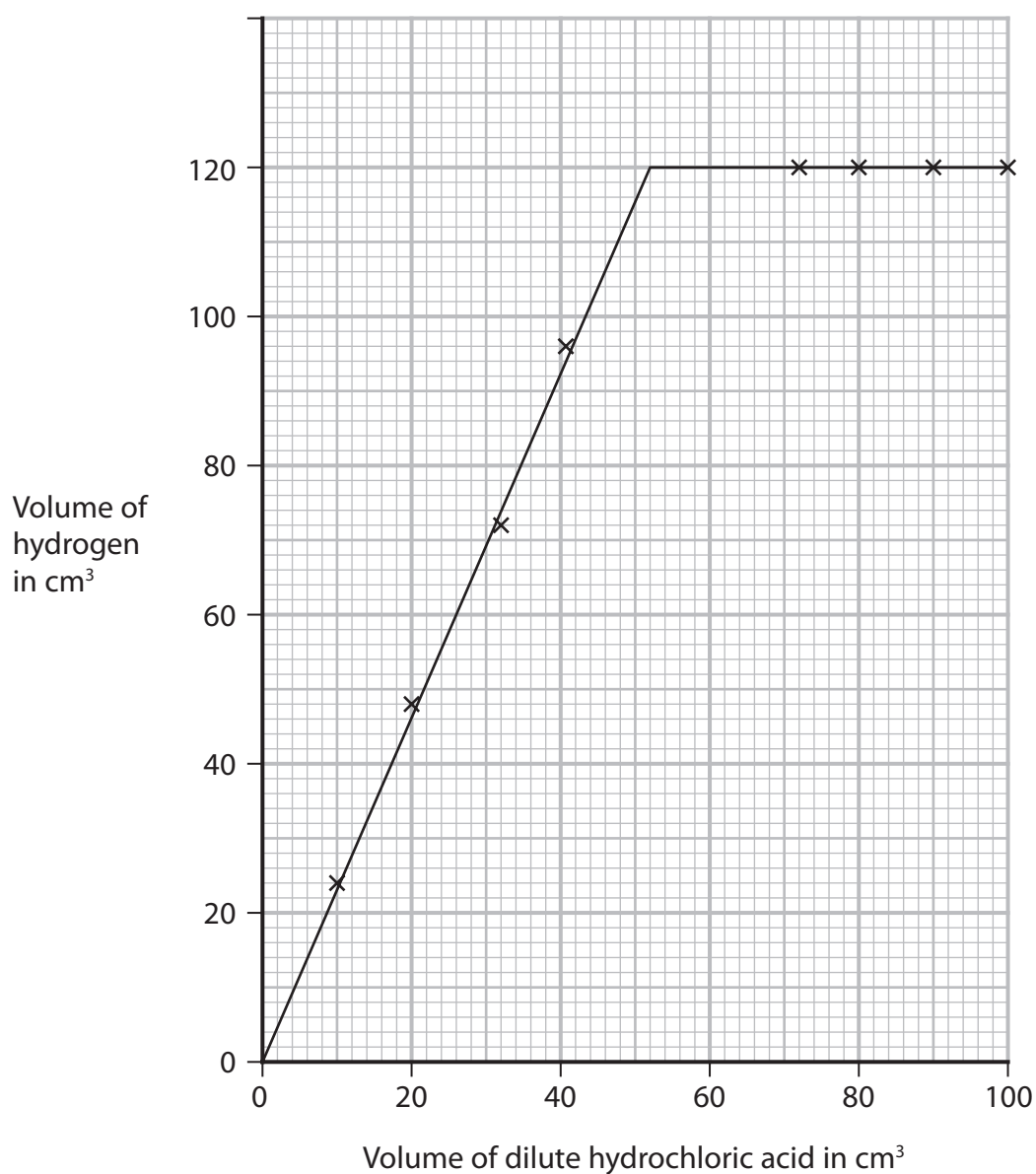
(1)

(b) A student investigates the reaction between pieces of zinc and dilute hydrochloric acid.

In each experiment, he uses the same mass of zinc but a different volume of the acid.

He collects the hydrogen and measures its volume in each experiment.

The graph shows the student's results.



(i) Use the graph to find the minimum volume of acid needed to react with all of the zinc.

(1)

(ii) The student repeats the investigation, using hydrochloric acid of double the original concentration.

Determine the volume of hydrogen that would be collected using 15 cm³ of this acid.

Show your working on the graph.

(2)

volume = cm³

(c) Explain how increasing the concentration of the hydrochloric acid affects the rate of reaction.

(3)

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(d) The rate of reaction could also be affected by changing the temperature of the hydrochloric acid, or by using a catalyst.

Explain one other way in which the rate of reaction between zinc and hydrochloric acid can be affected.

(3)

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(Total for Question 6 = 12 marks)



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7 The formation of ions and covalent bonds involves electrons.

The table gives the electronic configurations of atoms of hydrogen, lithium and chlorine.

Element	Electronic configuration of atom
hydrogen	1
lithium	2.1
chlorine	2.8.7

(a) Describe the different roles of electrons in the formation of

- ions in lithium chloride
- covalent bonds in hydrogen chloride

(3)

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(b) Explain why lithium chloride has a higher melting point than hydrogen chloride.
Refer to structure and bonding in your answer.

(5)

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(Total for Question 7 = 8 marks)



- 8 (a) (i) Organic compounds can exist as isomers.

Explain what is meant by the term **isomers**.

(2)

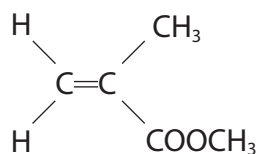
- (ii) Organic compound Q reacts with bromine, without the presence of ultraviolet radiation, to form the compound $C_4H_8Br_2$

Draw the displayed formulae of two isomers of Q.

(2)

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- (b) An acrylic polymer can be formed from molecules with this structure.



- (i) A student describes the molecule as an unsaturated hydrocarbon.

Explain whether this is a correct description.

(2)

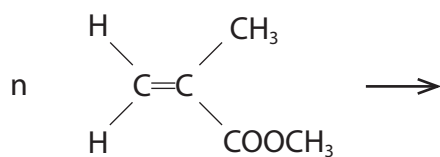
- (ii) Name the type of polymerisation that occurs in the formation of the polymer.

(1)



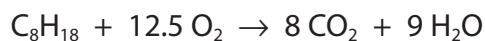
(iii) Complete the equation for the polymerisation reaction.

(2)



(c) Octane is a compound in petrol.

The equation for the complete combustion of octane is



(i) The fuel tank of a car contains 50.0 dm³ of octane.

Calculate the mass, in kg, of carbon dioxide formed if all the octane in the fuel tank undergoes complete combustion.

[mass of 1 dm³ of octane = 700 g]

(5)

mass =kg

(ii) State an environmental problem caused by carbon dioxide.

(1)

(Total for Question 8 = 15 marks)



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9 Lithium, sodium and potassium are the first three elements in Group 1 of the Periodic Table.

(a) Suggest why these three elements are all stored in paraffin oil.

(1)

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(b) Caesium, Cs, is below potassium in Group 1.

(i) Give a similarity and a difference between the reactions of potassium with water and caesium with water.

(2)

similarity.....

.....

difference.....

.....

(ii) Give the chemical equation for the reaction between caesium and water.

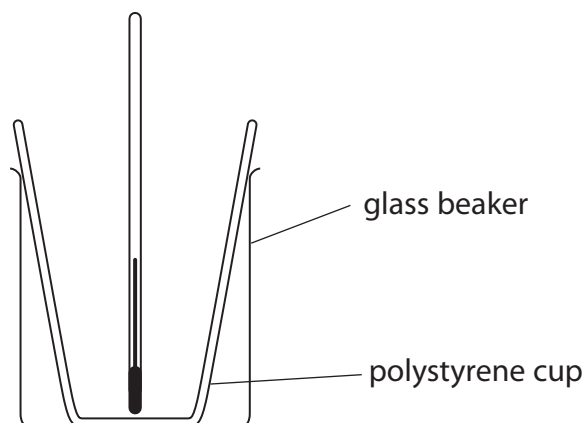
(2)

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- (c) A student investigates the temperature change in the reaction between dilute acids and solutions of Group 1 hydroxides.

He uses this apparatus.



This is the student's method.

- measure the temperature of 50 cm^3 of hydrochloric acid
- pour the acid into a polystyrene cup
- add 50 cm^3 of sodium hydroxide solution to the acid
- measure the maximum temperature of the mixture

- (i) Suggest what could be added to the apparatus to improve the experiment.

(1)

- (ii) Explain a change to the method that would improve the accuracy of the experiment.

(2)



(d) These are the student's results.

temperature of hydrochloric acid = 19.9°C

maximum temperature of mixture = 26.5°C

(i) Calculate the energy change, Q , in joules for this reaction.

[mass of 1.0 cm^3 of mixture = 1.0 g]

[for the mixture, $c = 4.2\text{ J/g}^{\circ}\text{C}$]

(3)

$Q = \dots\dots\dots\text{ J}$

(ii) In the student's reaction between hydrochloric acid and sodium hydroxide, 0.050 mol of water forms.

Calculate the molar enthalpy change, ΔH , in kJ/mol for this reaction.

(2)

$\Delta H = \dots\dots\dots\text{ kJ/mol}$

(Total for Question 9 = 13 marks)



10 This question is about salts.

(a) Soluble salts can be prepared by the reaction between a metal oxide and an acid.

The equation for this type of reaction is



(i) State the name given to this type of reaction. (1)

(ii) State, in terms of protons, what happens in this reaction. (1)

(b) (i) A student is given 50 cm³ of dilute sulfuric acid and a bottle of solid copper(II) carbonate.

Describe the method that the student should use to prepare a saturated solution of copper(II) sulfate.

In your answer, refer to the pieces of apparatus that the student should use. (5)



(ii) The student produces dry crystals of hydrated copper(II) sulfate from the saturated solution.

He calculates that 6.40 g of dry crystals should be formed.

The mass of dry crystals he actually obtains is 1.80 g less than he calculated.

Calculate the student's percentage yield.

Give your answer to one decimal place.

(3)

percentage yield = %

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DO NOT WRITE IN THIS AREA



(c) (i) Gypsum is hydrated calcium sulfate.

A sample of gypsum contains 79% of calcium sulfate by mass.

Calculate the value of x in $\text{CaSO}_4 \cdot x\text{H}_2\text{O}$

[M_r of $\text{CaSO}_4 = 136$ M_r of $\text{H}_2\text{O} = 18$]

(3)

$x = \dots\dots\dots$

(ii) Describe a test for calcium ions in the sample of gypsum.

(2)

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(Total for Question 10 = 15 marks)

TOTAL FOR PAPER = 110 MARKS

