Write your name here

Surname	Other names

Pearson Edexcel
Level 1/Level 2 GCSE (9-1)

Centre Number | | | | | |

Candidate Number | | | | |

Combined Science

Paper 4: Chemistry 2

Higher Tier

Sample Assessment Materials for first teaching September 2017
Time: 1 hour 10 minutes

Paper Reference
1SC0/2CH

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.*
- Calculators may be used.
- Any diagrams may NOT be accurately drawn, unless otherwise indicated.
- You must **show all your working out** with **your answer clearly identified** at the **end of your solution**.

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.
- There is a periodic table on the back cover of the paper.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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1/

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Pearson

Answer ALL questions. Write your answers in the spaces provided.

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 (a) Sodium has an atomic number of 11.

Which line in the table shows the correct numbers of protons, neutrons and electrons in a positively charged sodium ion, Na^+?

(1)

		number of		
		protons	**neutrons**	**electrons**
☒	**A**	10	12	11
☒	**B**	10	11	10
☒	**C**	11	10	11
☒	**D**	11	12	10

(b) Fluorine has an electronic configuration 2.7.

Fluorine gas exists as diatomic molecules.
In each molecule of fluorine, the two fluorine atoms are joined by a covalent bond.

Draw a dot and cross diagram to show the electrons in a molecule of fluorine, F_2.

Show outer electrons only.

(2)

(c) Sodium reacts with fluorine to form sodium fluoride, NaF.

Complete the balanced equation for this reaction.

(2)

2Na + ... → .....NaF

(d) Sodium fluoride is an ionic compound.

(i) Describe how a sodium atom and a fluorine atom interact to form a sodium ion, Na^+, and a fluoride ion, F^-.

(2)

(ii) Explain why sodium fluoride is able to conduct electricity when it is molten but not when it is solid.

(2)

(Total for Question 1 = 9 marks)

2 (a) A student investigated the rate of reaction between magnesium ribbon and excess dilute hydrochloric acid.

The word equation for the reaction is

magnesium + hydrochloric acid → magnesium chloride + hydrogen

The total volume of hydrogen evolved was measured every 10 seconds for 120 seconds.

The graph in Figure 1 shows the results obtained by the student.

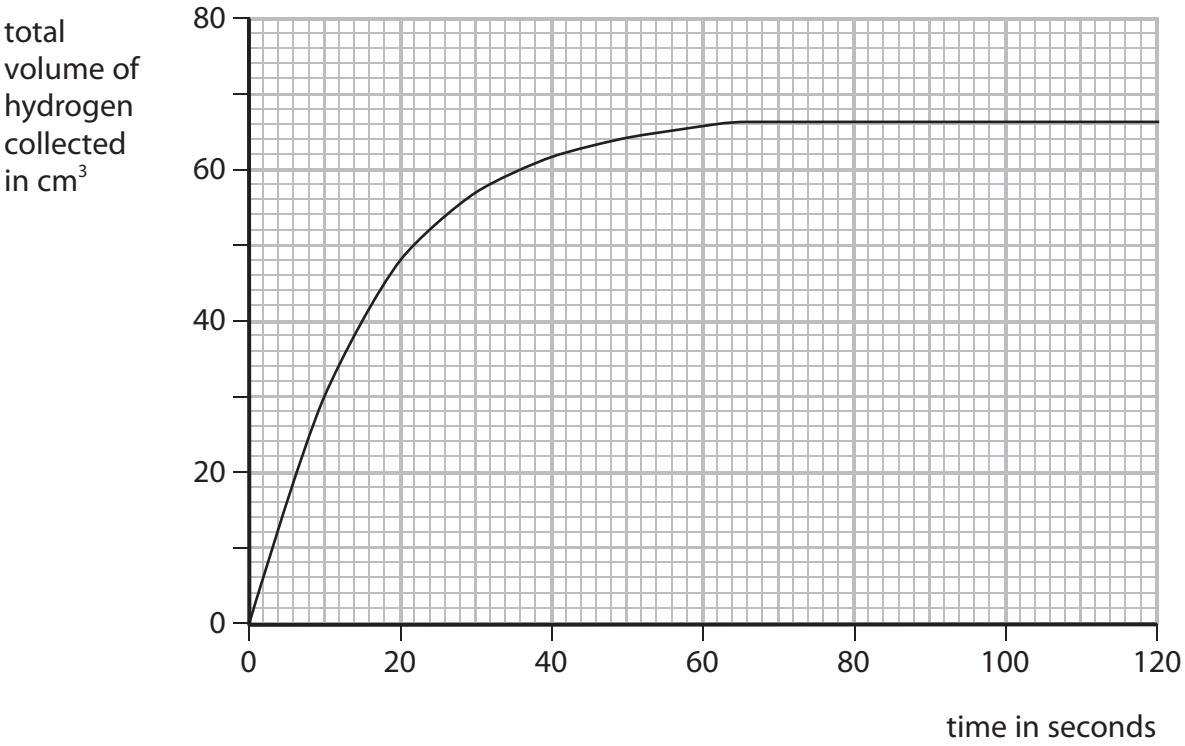

Figure 1

(i) Using the graph, give the time in seconds at which the reaction stopped.

(1)

..... s

(ii) Give the reason why the reaction stopped.

(1)

.....

.....

(iii) Use the graph to calculate the average rate of reaction during the first 20 seconds, in cm^3 of hydrogen produced per second.

(2)

.....

.....

.....

average rate of reaction = ... $cm^3 s^{-1}$

(iv) The experiment was repeated at a higher temperature, keeping all other conditions exactly the same.
This change caused the reaction to take place more quickly.

On the graph in Figure 1, sketch a line to show the results you would expect in this experiment.

(2)

(v) The rate of the reaction can be changed by adding a solid catalyst to the reaction mixture.

Which line in the table shows how the final volume of hydrogen produced and the mass of the catalyst change?

(1)

	change in final volume of hydrogen	change in mass of catalyst
☒ **A**	increases	no change
☒ **B**	no change	decreases
☒ **C**	no change	no change
☒ **D**	increases	decreases

(b) Complete the balanced equation for the reaction of magnesium with dilute hydrochloric acid forming magnesium chloride and hydrogen.

(2)

Mg + ... HCl → ..... + ...

(Total for Question 2 = 9 marks)

3 Figure 2 shows the percentage of different gases in the Earth's atmosphere.

gas	percentage of gas
nitrogen	78
oxygen	21
carbon dioxide	0.04
other gases	0.96

Figure 2

(a) This data can be shown on a pie chart.

Calculate the angle that should be used to show the segment for nitrogen on the pie chart.

You must show your working.

(2)

angle = ...

(b) The gases carbon dioxide, methane and water vapour in the atmosphere help to keep the Earth warm.

Describe how these gases help to keep the Earth warm.

(2)

(c) (i) Describe the test to show that a gas is oxygen.

(2)

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(ii) Some wet iron wool was placed in the bottom of a boiling tube.
The boiling tube was inverted over water to trap some air, as shown in Figure 3.

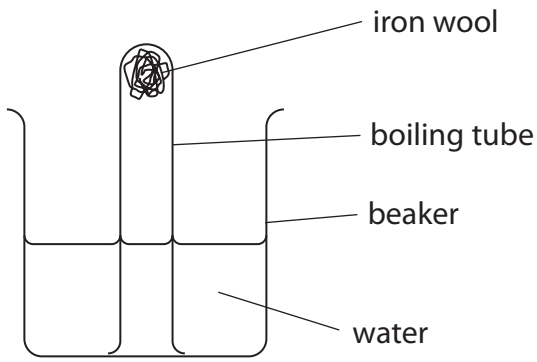

Figure 3

The apparatus was left to allow oxygen to react with the iron wool.

iron + oxygen → iron oxide

The volume of air in the boiling tube was measured at the beginning of the experiment and again at the end.

volume of gas at beginning of experiment = 49.7 cm^3
volume of gas at the end of the experiment = 42.5 cm^3

Calculate the percentage of air that reacted with the iron wool during the experiment.
Give your answer to three significant figures.

(3)

.....

.....

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.....

percentage of air reacted = ...

(Total for Question 3 = 9 marks)

4 (a) Crude oil is separated into fractions by fractional distillation.

Figure 4 shows a fractional distillation column and the fractions produced.

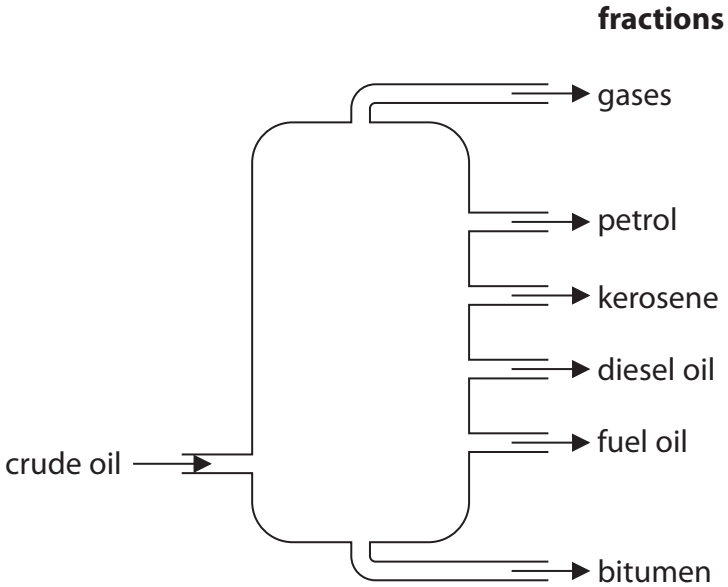

Figure 4

(i) Which of these fractions is the easiest to ignite?

(1)

- ☒ **A** diesel oil
- ☒ **B** gases
- ☒ **C** kerosene
- ☒ **D** petrol

(ii) Which of these fractions is the least viscous?

(1)

- ☒ **A** bitumen
- ☒ **B** diesel oil
- ☒ **C** kerosene
- ☒ **D** petrol

(iii) A fuel oil fraction contains sulfur as an impurity.

Explain how burning this fuel oil can cause problems in the environment.

(3)

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*(b) Methane is a fuel burnt in gas-fired boilers.
It is important that plenty of air is available as the fuel burns.

Explain why it is important that plenty of air is available as the fuel burns in gas-fired boilers.

(6)

(Total for Question 4 = 11 marks)

5 Chlorine is a halogen.

(a) Describe the test to show that a gas is chlorine.

(2)

(b) Chlorine reacts with potassium iodide solution to form potassium chloride solution and iodine.

$$Cl_2 + 2KI \rightarrow 2KCl + I_2$$

(i) State what would be **seen** when this reaction occurs.

(1)

(ii) Write the ionic equation for this reaction.

(3)

(iii) Explain, in terms of their electronic configurations, why chlorine is more reactive than iodine.

(2)

(iv) Explain why this reaction is an example of a redox reaction.

(4)

(Total for Question 5 = 12 marks)

6 (a) A student investigated the change in temperature when sodium hydroxide solution was mixed with dilute hydrochloric acid in a beaker.

The student took the temperature of the solutions before the reaction and of the mixture after the reaction.

temperature of solutions before the reaction = 23.0 °C
temperature of the mixture after the reaction = 24.7 °C

(i) Explain how these results show that the reaction is exothermic.

(2)

.....

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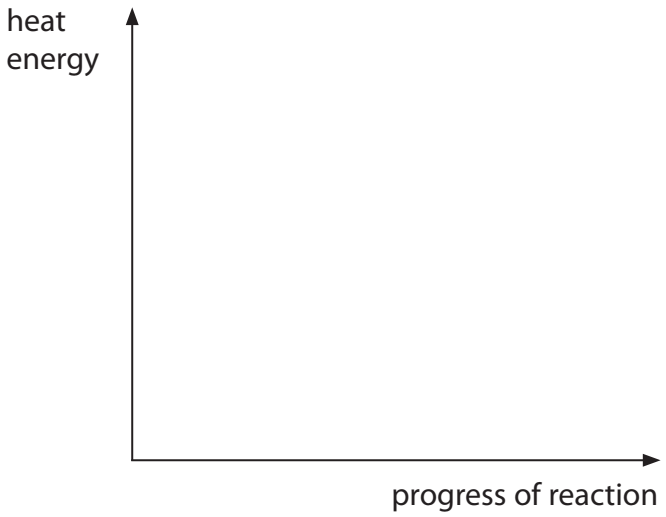
(ii) As a reaction progresses reactants become products.

On the axes below, draw labelled lines to show the relative heat energies of the reactants and products in this exothermic reaction.

(2)



(iii) In the experiment, the temperature rise is less than expected.

State one way that the student could improve the experiment so that the temperature rise was closer to the expected value.

(1)

.....

.....

.....

.....

(iv) When the reaction takes place there is a heat energy change.
This is the result of heat energy changes that take place when bonds are broken and when bonds are formed.

Which row of the table shows the heat energy changes that occur when bonds are broken and when bonds are formed?

(1)

	bonds broken	bonds formed
☒ **A**	heat energy is released	heat energy is released
☒ **B**	heat energy is released	heat energy is required
☒ **C**	heat energy is required	heat energy is released
☒ **D**	heat energy is required	heat energy is required

(b) Methane reacts with chlorine to form chloromethane and hydrogen chloride.

$$CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$$

Energies of bonds are shown in Figure 5.

bond	energy of bond / kJ mol^{-1}
C—H	413
Cl—Cl	243
C—Cl	346
H—Cl	432

Figure 5

Use the information in Figure 5 for the following calculation.

Calculate the overall change in heat energy when 1 mol methane, CH_4, reacts with 1 mol chlorine, Cl_2, to form 1 mol of chloromethane, CH_3Cl, and 1 mol hydrogen chloride, HCl, in this reaction, stating, with a reason, whether the reaction is endothermic or exothermic.

(4)

energy change ..... kJ mol^{-1}

(Total for Question 6 = 10 marks)

TOTAL FOR PAPER = 60 MARKS

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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

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The elements with atomic numbers from 58 to 71 are omitted from this part of the periodic table.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.