Paper Reference(s) 1SC0/2CH
Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Combined Science

Paper 5

Higher Tier

Total Marks

Wednesday 10 June 2020 – Morning

Time: 1 hour 10 minutes plus your additional time allowance

In the boxes below, write your name, centre number and candidate number.

Surname					
Other names					
Centre Number					
Candidate Number					

Pearson

YOU MUST HAVE

Calculator, ruler

YOU WILL BE GIVEN

Diagram Book, Periodic Table

INSTRUCTIONS

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.

A periodic table is provided.

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.

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) An atom of potassium has atomic number 19 and mass number 39.

(i) Give the electronic configuration of this potassium atom. (1 mark)

(continued on the next page)

1 continued.

(ii) This potassium atom forms the ion K^+.

Which row shows the number of protons and the number of neutrons in this potassium ion, K^+? (1 mark)

	number of protons	number of neutrons
☐ A	19	19
☐ B	19	20
☐ C	20	19
☐ D	20	20

(continued on the next page)

1 continued.

(b) Potassium and caesium are in the same group of the periodic table.

Explain, in terms of electrons, why potassium and caesium are in the same group. (2 marks)

(continued on the next page)

1 continued.

(c) Fluorine boils at –188 °C.
There are forces between fluorine molecules.

Explain, in terms of these forces, why the boiling point of fluorine is low. (2 marks)

(continued on the next page)

1 continued.

(d) Look at the equation for Question 1(d) in the Diagram Book.
Potassium reacts with fluorine to form potassium fluoride.
Potassium fluoride is a solid.

Complete the balanced equation for this reaction and add the state symbols. (3 marks)

(TOTAL FOR QUESTION 1 = 9 MARKS)

2 Calcium carbonate reacts with dilute hydrochloric acid to produce carbon dioxide gas.

The rate of reaction between calcium carbonate and dilute hydrochloric acid at room temperature was investigated.

(continued on the next page)

2 continued.

(a) Look at Figure 1 for Question 2 in the Diagram Book.
The investigation was carried out with different sized calcium carbonate pieces.

The mass of calcium carbonate and all other conditions were kept the same.

The results are shown in Figure 1.

State, using the information in Figure 1, the effect of the surface area of the calcium carbonate on the rate of this reaction. (1 mark)

(continued on the next page)

2 continued.

(b) The calcium carbonate powder produced 90 cm^3 of carbon dioxide in five minutes.

Calculate the average rate of reaction in $cm^3 s^{-1}$. (3 marks)

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

(continued on the next page)

2 continued.

(c) The experiments were repeated at a higher temperature.
The rate of reaction for each experiment increased.

Explain, in terms of particles, why the rate of reaction increased when the temperature was increased. (3 marks)

(TOTAL FOR QUESTION 2 = 7 MARKS)

3 (a) Sodium thiosulfate solution, $Na_2S_2O_3$, reacts with dilute hydrochloric acid.

$$Na_2S_2O_3(aq) + 2HCl(aq) \longrightarrow 2NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$$

(i) When dilute hydrochloric acid is mixed with sodium thiosulfate solution, the mixture turns cloudy.

Explain why the mixture turns cloudy.
(2 marks)

(continued on the next page)

3 continued.

(ii) In an investigation, different concentrations of hydrochloric acid are reacted with sodium thiosulfate solution.
The mixture goes cloudy at different rates.

Describe how the rate at which the mixture goes cloudy can be measured. (3 marks)

(continued on the next page)

3 continued.

(iii) You are provided with some dilute hydrochloric acid which has a concentration of 50 g dm^{-3}.

For this experiment, dilute hydrochloric acid with a concentration of 20 g dm^{-3} is required.

How much water must be added to 100 cm^3 of 50 g dm^{-3} hydrochloric acid to make dilute hydrochloric acid with a concentration of 20 g dm^{-3}? (1 mark)

☐ A 200 cm^3

☐ B 150 cm^3

☐ C 100 cm^3

☐ D 50 cm^3

(continued on the next page)

3 continued.

(b) Sodium iodide solution is colourless.

When a solution of bromine is added to sodium iodide solution, a reaction occurs.

$$2NaI + Br_2 \longrightarrow 2NaBr + I_2$$

(i) The mixture turns brown.

Give the name of the substance causing the brown colour. (1 mark)

(ii) Explain which substance has been reduced in this reaction. (2 marks)

(TOTAL FOR QUESTION 3 = 9 MARKS)

4 (a) Air contains several gaseous elements.

Which of these shows the three most common gaseous elements in air, listed in order from the most common to the least common? (1 mark)

☐ A oxygen, chlorine, nitrogen

☐ B nitrogen, oxygen, hydrogen

☐ C oxygen, nitrogen, helium

☐ D nitrogen, oxygen, argon

(continued on the next page)

4 continued.

(b) Look at Figure 2 for Question 4(b)(i) in the Diagram Book.
The density of a gas can be found using the equation

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

A student carried out an experiment to find the density of argon.

The mass of a stopper and flask, containing no gas, was known.
The flask was completely filled with argon and its mass measured.

Figure 2 shows the results the student wrote down.

(i) Use the results to calculate the density of argon in $g\,cm^{-3}$. (2 marks)

_____

_____

_____

_____

_____

density of argon = _____ $g\,cm^{-3}$

(continued on the next page)

4 continued.

(ii) Look at Figure 3 for Question 4(b)(ii) in the Diagram Book.
The flask used for the experiment is shown in Figure 3.
The flask holds 250·0 cm^3 when filled up to the line.

There is an error in the volume the student has used in the calculation.
This would give an incorrect value for the density of argon.

Identify this error and state what should be done to correct it. (2 marks)

error _____

_____

_____

what should be done to correct it _____

_____

_____

_____

_____

(continued on the next page)

4 continued.

(c) Four of the noble gases are argon, helium, krypton and neon.

Give these gases in order of increasing density.
(2 marks)

_____

_____

_____

(d) Look at the equation for Question 4(d) in the Diagram Book.
Much of the carbon dioxide present in the Earth's early atmosphere dissolved into the oceans.

This led to the formation of compounds including calcium carbonate, $CaCO_3$.

Some of the calcium carbonate reacted with magnesium ions to form dolomite, $CaMg(CO_3)_2$.

Complete the IONIC equation for the reaction of calcium carbonate with magnesium ions.
(2 marks)

(continued on the next page)

4 continued.

(e) Look at Figure 4 for Question 4(e) in the Diagram Book.
P and Q are both mixtures of gases.
One has the same composition as the early atmosphere and the other has the same composition as the current atmosphere.

Tests are carried out on gas mixtures P and Q.

The test for carbon dioxide is to bubble the gas into limewater; if carbon dioxide is present calcium carbonate is formed.

The results of the tests are shown in Figure 4.

Explain, using the data in Figure 4, which gas mixture represents the early atmosphere. (2 marks)

(TOTAL FOR QUESTION 4 = 11 MARKS)

5 **The first four elements in group 1 are lithium, sodium, potassium and rubidium.**

(a) Rubidium reacts with water to form rubidium hydroxide and hydrogen.

$$2Rb(s) + 2H_2O(l) \longrightarrow 2RbOH(aq) + H_2(g)$$

(i) Predict what you would SEE when a small piece of rubidium is placed in a large volume of water. (3 marks)

(continued on the next page)

5 continued.

(ii) Why is rubidium more reactive than potassium? (1 mark)

☐ A the metallic bonds in rubidium are weaker than those in potassium

☐ B rubidium is a softer metal than potassium

☐ C the outer electron of a rubidium atom is further from the nucleus than potassium's

☐ D rubidium has a more exothermic reaction with water than potassium does

(continued on the next page)

5 continued.

(iii) 8·5 g of rubidium are reacted completely with water.

The reaction makes a solution of rubidium hydroxide.
The volume of this solution is 2·5 dm^3.

Calculate the concentration of the rubidium hydroxide solution in g dm^{-3}. (4 marks)

(relative atomic mass: Rb = 85;
relative formula mass: RbOH = 102)

concentration = _____ g dm^{-3}

5 continued.

(b) An example of an endothermic reaction is the reaction between rubidium hydroxide and ammonium carbonate, $(NH_4)_2CO_3$.

This reaction forms rubidium carbonate, Rb_2CO_3, ammonia and one other product.

Write the balanced equation for this reaction.
(3 marks)

(TOTAL FOR QUESTION 5 = 11 MARKS)

6 (a) Look at Figure 5 for Question 6(a) in the Diagram Book.

An impure hydrocarbon fuel is burned in the apparatus in Figure 5.

When the fuel is burned

- **the funnel becomes hot**
- **a colourless liquid forms in tube A**
- **the indicator in tube B changes colour to show an acidic gas.**

Explain these observations. (3 marks)

(continued on the next page)

6 continued.

(b) Look at Figures 6 and 7 for Question 6(b) in the Diagram Book.
The energies of some bonds are shown in Figure 6.

Methane burns in oxygen to form carbon dioxide and water.

Figure 7 shows the structures of the molecules.

Calculate the energy change, in $kJ\,mol^{-1}$, for this reaction. (4 marks)

(continued on the next page)

6 continued.

_____

_____

_____

_____

energy change = _____ kJ mol^{-1}

(continued on the next page)

6 continued.

*(c) Look at Figure 8 for Question 6(c) in the Diagram Book.
Petrol and diesel are used as fuels for cars.
The emissions from three similar sized cars were investigated.
The first car was the oldest, had no catalytic converter and used petrol.
The other two cars were only a few years old.
One of these was fitted with a catalytic converter and used petrol and the other car used diesel.

Figure 8 shows the emissions in grams for each kilometre travelled by these three cars.

Discuss and compare the impact on the environment of the emissions from these three cars using the information from Figure 8.
(6 marks)

(continued on the next page)

6 continued.

(continued on the next page)

6 continued.

(continued on the next page)

6 continued.

(continued on the next page)

6 continued.

(TOTAL FOR QUESTION 6 = 13 MARKS)

TOTAL FOR PAPER = 60 MARKS

END