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

Combined Science

PAPER 5

Higher Tier

Total Marks

Tuesday 13 June 2023 – Morning

Time: 1 hour 10 minutes

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

Surname					
Other names					
Centre Number					
Candidate Number					

X72563A

Pearson

YOU MUST HAVE

Calculator, ruler

YOU WILL BE GIVEN

Diagram Booklet, Periodic Table

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the spaces provided in this Question Paper or in the separate Diagram Booklet – 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.

(continued on the next page)

INFORMATION continued.

Questions labelled 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 as a separate insert.

There may be spare copies of some diagrams.

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 Look at Figure 1 for Question 1 in the Diagram Booklet. A student used the apparatus shown in Figure 1 to investigate the reaction between marble chips and dilute hydrochloric acid.

Look at Figure 2 for Question 1 in the Diagram Booklet. The student recorded the volume of gas every minute as shown in Figure 2.

(a) Look at the grid for Question 1(a) in the Diagram Booklet. On the grid, plot the results shown in Figure 2.

Draw a curve of best fit.
(3 marks)

(continued on the next page)

1 continued.

(b) Rate of reaction can be calculated using

$$\text{rate of reaction} = \frac{\text{volume of gas produced in 1 minute}}{\text{1 minute}}$$

Look at Figure 3 for Question 1(b) in the Diagram Booklet. It shows the rates of reaction calculated from the results of this experiment.

The rate of reaction for the time interval 2 to 3 minutes is missing.

(i) Calculate the rate of reaction for the time interval 2 to 3 minutes.
(1 mark)

_____

_____

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

(continued on the next page)

1(b) continued.

(ii) State and explain what happens to the rate of reaction as the acid reacts with the marble chips in this experiment.
(3 marks)

(continued on the next page)

1 continued.

(c) The student repeated the experiment using the same volume of acid and the same mass of marble chips but used smaller marble chips.

All other conditions remained the same.

The student found that the reaction with the smaller marble chips was faster to start with but produced the same volume of gas.

Look again at the grid for Question 1(a) in the Diagram Booklet. Using this information, draw a line on the grid to show the results for the reaction with the smaller marble chips.

Label this line 'C'.
(2 marks)

(Total for Question 1 = 9 marks)

2 Look at Figure 4 for Question 2 in the Diagram Booklet. It shows some information about the group 1 metals.

(a) Explain, in terms of their electronic configurations, why these metals are placed in group 1 of the periodic table.
(2 marks)

(continued on the next page)

2 continued.

(b) Which row shows two correct properties of group 1 metals?
(1 mark)

	properties of group 1 metals	
☐ A	compounds are white in colour	high density
☐ B	low melting points	compounds are blue in colour
☐ C	soft enough to be cut by a knife	low melting points
☐ D	high density	conduct electricity

(continued on the next page)

2 continued.

(c) The word equation for the reaction of potassium with bromine is

potassium + bromine ⟶ potassium bromide

Add the missing state symbol and balance the equation for this reaction.
(2 marks)

_____K(_____) + Br_2(g) ⟶

_____KBr(s)

(continued on the next page)

2 continued.

(d) A sample of potassium contains three isotopes, potassium-39, potassium-40 and potassium-41.

(i) Explain the meaning of the term ISOTOPES. (2 marks)

(continued on the next page)

2(d) continued.

(ii) This sample of potassium contains

93·25% potassium-39

0·02% potassium-40

6·73% potassium-41

Calculate the relative atomic mass of this sample of potassium.
(2 marks)

relative atomic mass = _____

(Total for Question 2 = 9 marks)

3 (a) Look at Figure 5 for Question 3(a) in the Diagram Booklet. It shows the percentage of three gases, X, Y and Z, in the Earth's early atmosphere.

What is the name of gas Z?
(1 mark)

☐ A argon

☐ B carbon dioxide

☐ C nitrogen

☐ D oxygen

(continued on the next page)

3 continued.

(b) It is thought that small quantities of hydrogen sulfide, H_2S, were also in the Earth's early atmosphere.

Draw the dot and cross diagram for a molecule of hydrogen sulfide.

Show outer electrons only.
(2 marks)

Answer space continues on the next page.

3(b) continued.

(continued on the next page)

3 continued.

(c) Acid rain is caused by some pollutant gases present in the atmosphere.

Explain how impurities in fossil fuels can result in acid rain.
(3 marks)

(continued on the next page)

3 continued.

(d) A student investigates the effect of acid rain on cress plants.

The student uses this method.

STEP 1 grow 20 cress plants in each of two dishes, **A** and **B**

STEP 2 water the cress plants in dish **A** with 10 cm^3 of dilute hydrochloric acid with a pH of 2

STEP 3 water the cress plants in dish **B** with 10 cm^3 of pure water with a pH of 7

STEP 4 repeat steps 2 and 3 every day for one week

STEP 5 count how many plants are still alive after one week.

(i) State what piece of equipment the student could use to measure the pH of each liquid. (1 mark)

_____

_____

(continued on the next page)

3(d) continued.

(ii) Explain ONE improvement that the student could make to the method to make the results more valid.
(2 marks)

(Total for Question 3 = 9 marks)

4 Chlorine gas can be prepared by reacting concentrated hydrochloric acid with solid potassium manganate(VII).

Look at Figure 6 for Question 4 in the Diagram Booklet. It shows the apparatus used.

(a) Look at Figure 7 for Question 4(a) in the Diagram Booklet. It shows the hazard symbols for concentrated hydrochloric acid, potassium manganate(VII) and chlorine gas.

Use the information in Figure 7 to help you answer (a)(i) and (a)(ii).

(i) What are the hazards associated with potassium manganate(VII)?
(1 mark)

☐ **A** flammable, harmful and corrosive

☐ **B** flammable, toxic and hazardous to the environment

☐ **C** oxidising, harmful and hazardous to the environment

☐ **D** oxidising, toxic and corrosive

(continued on the next page)

4(a) continued.

(ii) Explain ONE precaution that should be taken when preparing the sample of chlorine gas. (2 marks)

precaution

_____

_____

_____

reason

_____

_____

_____

(continued on the next page)

4 continued.

(b) State the purpose of the delivery tube.
(1 mark)

_____

_____

_____

(c) Suggest why damp blue litmus is placed at the top of the gas jar.
(2 marks)

_____

_____

_____

_____

_____

_____

(continued on the next page)

4 continued.

(d) In the reaction, potassium manganate(VII), $KMnO_4$, reacts with hydrochloric acid to form manganese chloride, $MnCl_2$, potassium chloride, chlorine and water.

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

_____

_____

(Total for Question 4 = 9 marks)

5 Ammonia can be produced from the reaction of hydrogen with nitrogen.

(a) What is the percentage by mass of nitrogen in ammonia, NH_3?

(relative atomic masses: H = 1·0, N = 14)
(1 mark)

☐ **A 18%**

☐ **B 42%**

☐ **C 51%**

☐ **D 82%**

(continued on the next page)

5 continued.

(b) The reaction between hydrogen and nitrogen is exothermic.

Look at Figure 8 for Question 5(b) in the Diagram Booklet. It shows the reaction profile of this exothermic reaction.

(i) Which arrow represents the activation energy for the reaction?
(1 mark)

☐ A arrow **P**

☐ B arrow **Q**

☐ C arrow **R**

☐ D arrow **S**

(continued on the next page)

5(b) continued.

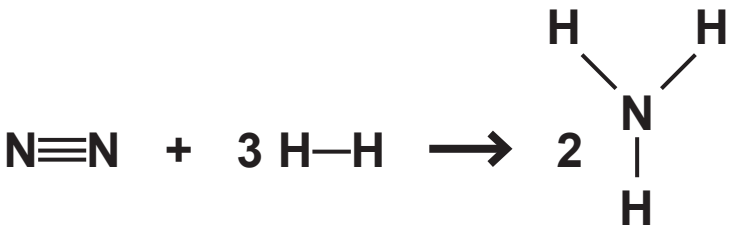
(ii) Describe what the reaction profile shows about the energy involved in bond breaking and bond making in this reaction.
(2 marks)

(continued on the next page)

5(b) continued.

(iii) Look at Figure 9 for Question 5(b)(iii) in the Diagram Booklet. It shows the energies of some bonds.

The equation for the reaction between nitrogen and hydrogen to form ammonia is



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

Answer space continues on the next page.

5(b)(iii) continued.

_____

_____

_____

_____

_____

energy change = _____ kJ mol^{-1}

(continued on the next page)

5 continued.

(c) Ammonia, NH_3, and silicon dioxide, SiO_2, are both compounds that are made of two non-metallic elements.

Ammonia has a boiling point of –33 °C.
Silicon dioxide has a boiling point of 2230 °C.

Explain why the boiling points of ammonia and silicon dioxide are so different.
(3 marks)

(Total for Question 5 = 11 marks)

6 Crude oil is a mixture of hydrocarbons.

Crude oil can be separated into useful fractions by the process of fractional distillation in a fractionating column.

(a) Look at Figure 10 for Question 6(a) in the Diagram Booklet. It shows a fractionating column, the fractions obtained and the trend in viscosity of the fractions.

(i) Which row shows the correct uses for bitumen, diesel oil and fuel oil?
(1 mark)

	bitumen	diesel oil	fuel oil
☐ A	fuel for large ships	surfacing roads	fuel for trains
☐ B	fuel for large ships	fuel for trains	surfacing roads
☐ C	surfacing roads	fuel for trains	fuel for large ships
☐ D	surfacing roads	fuel for large ships	fuel for trains

(continued on the next page)

6(a) continued.

(ii) Explain the trend in the viscosity of the fractions.
(2 marks)

(continued on the next page)

6 continued.

(b) Hydrocarbon **X** was cracked to form one molecule of hexane, C_6H_{14}, and one molecule of alkene **Y**.

$$X \longrightarrow C_6H_{14} + Y$$

The relative formula mass of **Y** is 56.

The empirical formula of **Y** is CH_2.

Deduce the molecular formula of hydrocarbon **X**.

Show your working.

(relative atomic masses: H = 1·0, C = 12)
(4 marks)

Answer page continues on the next page.

6(b) continued.

_____

_____

_____

_____

_____

molecular formula of X = _____

(continued on the next page)

6 continued.

***(c) Large quantities of methane are used as a fuel.**

Look at Figure 11 for Question 6(c) in the Diagram Booklet. It shows a Bunsen burner.

Methane can be used as fuel for the Bunsen burner.

The air-hole on the chimney of the Bunsen burner can be opened and closed.

Explain the effect of opening and closing the air-hole of the Bunsen burner on the products of combustion of methane and the harm that using large quantities of methane as a fuel can cause. (6 marks)

Answer space continues on the next 4 pages.

6(c) continued.

6(c) continued.

6(c) continued.

6(c) continued.

(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 60 MARKS
END OF PAPER