Paper Reference(s) 4CH1/1CR 4SD0/1CR
Pearson Edexcel International GCSE (9–1)

Total Marks

Chemistry
UNIT: 4CH1
Science (Double Award) 4SD0
PAPER: 1CR

Time: 2 hours

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

Surname					
Other names					
Centre Number					
Candidate Number					

Y70946A

Pearson

YOU MUST HAVE

Calculator, ruler

YOU WILL BE GIVEN

Periodic Table, Diagram Booklet

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.

Show all the steps in any calculations and state the units.

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.

There may be spare copies of some diagrams.

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.

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 (a) Look at the diagram and table for Question 1(a) in the Diagram Booklet. The diagram represents an atom of an element.

Use numbers from the list to complete the table.

You may use each number once, more than once or not at all.
(4 marks)

2

4

5

9

10

(continued on the next page)

1 continued.

(b) In terms of sub-atomic particles, state a similarity and a difference for isotopes of the same element.
(2 marks)

similarity

difference

(Total for Question 1 = 6 marks)

2 This question is about apparatus used in the laboratory.

(a) Look at the table for Question 2(a) in the Diagram Booklet. Complete the table by giving the name of each piece of apparatus and a unit used for the quantity it measures.
(2 marks)

(b) Look at the diagram for Question 2(b) in the Diagram Booklet. It shows apparatus used to obtain pure water from sodium chloride solution by simple distillation.

(continued on the next page)

2 continued.

(i) Explain why it is necessary for water to flow continuously in and out of the apparatus.
(2 marks)

(continued on the next page)

2 continued.

(ii) Describe a chemical test to show that the sodium chloride solution contains chloride ions.
(2 marks)

(continued on the next page)

2 continued.

(iii) Describe a physical test to show that the liquid in the conical flask is pure water.
(2 marks)

(Total for Question 2 = 8 marks)

3 Look at the diagram for Question 3 in the Diagram Booklet. It shows a chromatogram of the food dyes in four different food colourings, A, B, C and D.

(a) (i) Give the letter of the food colouring that contains three different food dyes.
(1 mark)

_____

_____

(ii) Give the letters of the two food colourings that contain the same dye.
(1 mark)

_____

_____

(continued on the next page)

3 continued.

(iii) Using the scale on the diagram, determine the R_f value of the dye in food colouring C.
(2 marks)

R_f = _____

(continued on the next page)

3 continued.

(iv) Give a reason why the dye in food colouring D moves the furthest from the start line.
(1 mark)

(b) Describe how a student could obtain a chromatogram similar to the one shown in the diagram.
(4 marks)

(continued on the next page)

3 continued.

(Total for Question 3 = 9 marks)

4 Look at the diagram for Question 4 in the Diagram Booklet. It shows the positions of some elements in part of the Periodic Table.

(a) (i) Give the symbol of a metal from the diagram.
(1 mark)

(ii) Give the symbol of an element from the diagram that forms an acidic oxide.
(1 mark)

(continued on the next page)

4 continued.

(b) Give a similarity in the electron configurations of Al and In.
(1 mark)

(continued on the next page)

4 continued.

(c) Explain which element in the diagram is unreactive.
(2 marks)

(continued on the next page)

4 continued.

(d) A teacher adds a small piece of sodium to a glass trough containing water and universal indicator.

The universal indicator changes colour.

The equation for the reaction is

$$2Na(s) + 2H_2O(l) \longrightarrow 2NaOH(aq) + H_2(g)$$

(i) Explain the final colour of the universal indicator.
(2 marks)

4 continued.

(ii) The teacher repeats the experiment with potassium instead of sodium.

Give one similarity and one difference observed with potassium.
(2 marks)

similarity

difference

(continued on the next page)

4 continued.

(iii) The reaction with sodium produces 0·036 g of hydrogen gas.

One mole of hydrogen gas contains $6{\cdot}0 \times 10^{23}$ molecules.

On page 21 Calculate the number of molecules of hydrogen gas produced in the reaction with sodium.

(continued on the next page)

4 continued.

Give your answer to two significant figures.
(3 marks)

number of molecules
of hydrogen gas = _____

(Total for Question 4 = 12 marks)

5 This question is about metal carbonates.

When heated, some metal carbonates decompose to form a metal oxide and carbon dioxide gas.

(a) Look at the diagram for Question 5(a) in the Diagram Booklet. A student is given three solid metal carbonates, a timer, some limewater and this apparatus.

Describe a method the student can use to find out which metal carbonate decomposes fastest when heated.
(4 marks)

(continued on the next page)

5 continued.

(continued on the next page)

5 continued.

(b) A student is given a solid metal carbonate with the formula XCO_3

X represents the symbol of a Group 2 metal.

Look at the diagram for Question 5(b) in the Diagram Booklet. A student uses this apparatus to heat a sample of XCO_3 until it all decomposes.

The equation for the decomposition of XCO_3 is

$$XCO_3 \longrightarrow XO + CO_2$$

The student records the mass of XCO_3 and the mass of carbon dioxide that escapes through the cotton wool plug.

These are the student's results.

mass of XCO_3 = 7·40 g

mass of CO_2 = 2·20 g

(continued on the next page)

5 continued.

(i) Give a reason why the student uses a cotton wool plug.
(1 mark)

(continued on the next page)

5 continued.

(ii) Calculate the amount, in mol, of carbon dioxide produced.
(1 mark)

[for carbon dioxide $M_r = 44$]

amount of
carbon dioxide = _____ mol

(continued on the next page)

5 continued.

(iii) Use the equation to determine the amount, in mol, of XCO_3 that decomposed.
(1 mark)

amount of XCO_3 = _____ mol

(continued on the next page)

5 continued.

(iv) Use the mass of XCO_3 and your answer to (b)(iii) to calculate the relative formula mass (M_r) of XCO_3 (2 marks)

M_r of XCO_3 = _____

(continued on the next page)

5 continued.

(v) Use your answer to (b)(iv) and the Periodic Table on the separate sheet provided to determine the identity of the Group 2 metal X.

Show your working.
(2 marks)

identity of X = _____

(Total for Question 5 = 11 marks)

6 Silicon hydride (SiH_4) and silicon dioxide (SiO_2) both contain covalent bonds but they have different structures.

(a) Describe the forces of attraction in a covalent bond.
(2 marks)

(continued on the next page)

6 continued.

(b) Look at the diagram for Question 6(b) in the Diagram Booklet. Complete the diagram to show the outer shell electrons in a molecule of silicon hydride (SiH_4). (1 mark)

(c) Look at the diagram for Question 6(c) in the Diagram Booklet. It represents part of the structure of silicon dioxide (SiO_2).

(i) State how the diagram shows that the atom labelled A is oxygen, not silicon. (1 mark)

(continued on the next page)

6 continued.

(ii) Silicon hydride has a simple molecular structure.

Silicon dioxide has the same type of structure as diamond.

Explain why silicon dioxide has a much higher melting point than silicon hydride.

Refer to structure and bonding in your answer.
(4 marks)

(continued on the next page)

6 continued.

(continued on the next page)

6 continued.

(d) Silicon hydride reacts with oxygen to form silicon dioxide and water.

Write a chemical equation for the reaction between silicon hydride and oxygen.
(1 mark)

(Total for Question 6 = 9 marks)

7 Look at the diagram for Question 7 in the Diagram Booklet. It shows some important conversion processes used in the oil industry.

(a) Describe how kerosene is produced from crude oil in process 1.
(5 marks)

(continued on the next page)

7 continued.

(continued on the next page)

7 continued.

(continued on the next page)

7 continued.

(b) $C_{12}H_{26}$ is present in kerosene.

In process 2, $C_{12}H_{26}$ is cracked to produce two molecules of ethene and one molecule of another hydrocarbon.

(i) Complete the equation for the cracking of $C_{12}H_{26}$
(1 mark)

$C_{12}H_{26} \longrightarrow 2C_2H_4 +$ _____

(ii) Explain why cracking is a useful process in the oil industry.
(4 marks)

_____

_____

_____

_____

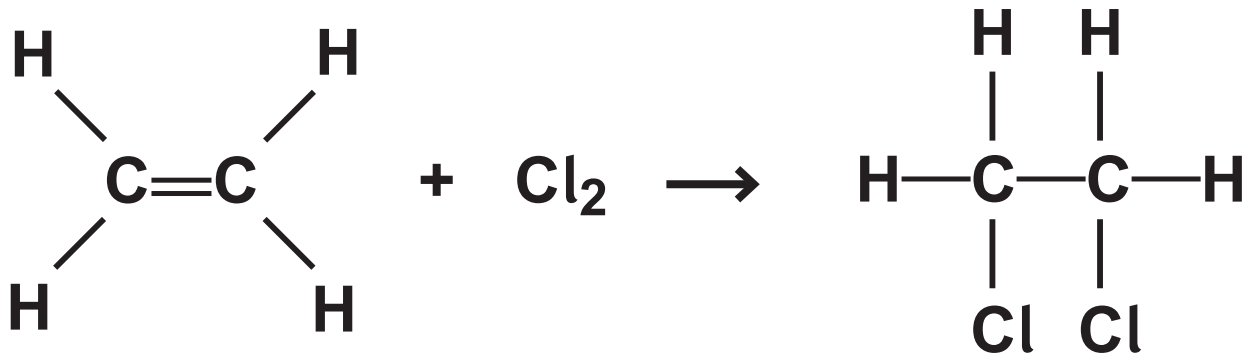
(continued on the next page)

7 continued.

(continued on the next page)

7 continued.

(c) This is the equation for one of the reactions that may occur during process 3.



What is the name of this type of reaction?
(1 mark)

☐ A addition

☐ B combustion

☐ C decomposition

☐ D substitution

(continued on the next page)

7 continued.

(d) (i) Look at the equation for Question 7(d)(i) in the Diagram Booklet. Complete the equation for the polymerisation of chloroethene in process 4. (2 marks)

(continued on the next page)

7 continued.

(ii) Explain why the disposal of polymers such as poly(chloroethene) is difficult. (2 marks)

(Total for Question 7 = 15 marks)

8 This question is about exothermic reactions.

(a) Look at the diagram for Question 8(a) in the Diagram Booklet. A student uses this apparatus to measure the temperature increase when an excess of zinc powder is added to copper(II) sulfate solution.

(i) Complete the word equation for the reaction.
(1 mark)

zinc + copper(II) sulfate ⟶

_____ +

_____

(continued on the next page)

8 continued.

(ii) Give a reason why the student uses a polystyrene cup inside a glass beaker.
(1 mark)

(iii) State why zinc reacts with copper(II) sulfate solution.
(1 mark)

(continued on the next page)

8 continued.

(iv) The temperature at the start of the reaction is 19·7 °C.

The temperature at the end of the reaction is 48·3 °C.

Calculate the heat energy change, in joules, for the reaction.
(2 marks)

[for the mixture, c = 4·2 J/g/°C]

heat energy change = _____ J

(continued on the next page)

8 continued.

(b) (i) The reaction between zinc and silver nitrate solution is exothermic.

A mass of 0·65 g of zinc is added to excess silver nitrate solution.

The heat energy change is 800 J.

On page 47 calculate the molar enthalpy change, ΔH, in kJ/mol.

(continued on the next page)

8 continued.

Include a sign in your answer.
(3 marks)

ΔH = _____ kJ/mol

(continued on the next page)

8 continued.

(ii) This is the ionic equation for the reaction between zinc and silver nitrate solution.

$$Zn(s) + 2Ag^{+}(aq) \longrightarrow Zn^{2+}(aq) + 2Ag(s)$$

Explain, in terms of electrons, why this is a redox reaction.
(2 marks)

(continued on the next page)

8 continued.

(Total for Question 8 = 10 marks)

9 This question is about rates of reaction.

(a) A student uses this method to investigate the rate of reaction between iron(III) nitrate solution and sodium thiosulfate solution.

- pour 50 cm^3 of iron(III) nitrate solution into a conical flask
- add one drop of catalyst solution
- add 50 cm^3 of sodium thiosulfate solution to the conical flask
- record the time for the mixture to become colourless

The student repeats the method using different catalysts and also with no catalyst.

Look at the table for Question 9 in the Diagram Booklet. It shows the student's results.

(continued on the next page)

9 continued.

(i) Explain which is the best catalyst for the reaction.
(2 marks)

(continued on the next page)

9 continued.

(ii) Explain how a catalyst increases the rate of a reaction.
(2 marks)

(continued on the next page)

9 continued.

(b) The rate of a reaction can also be altered by changing the temperature or by changing the concentration of solutions.

(i) Explain, using the particle collision theory, how increasing the temperature affects the rate of a reaction.
(4 marks)

(continued on the next page)

9 continued.

(continued on the next page)

9 continued.

(ii) Explain why using a solution of a lower concentration decreases the rate of reaction.
(2 marks)

(Total for Question 9 = 10 marks)

10 A student investigates how the electrical conductivity changes as dilute sulfuric acid is added to barium hydroxide solution.

This is the student's method.

STEP 1 add 50·0 cm^3 of barium hydroxide solution to beaker

STEP 2 measure the electrical conductivity of the solution

STEP 3 add 10·0 cm^3 of dilute sulfuric acid to the beaker

STEP 4 stir the mixture

STEP 5 measure the electrical conductivity of the mixture

STEP 6 repeat steps 3 to 5 until a total of 100 cm^3 of dilute sulfuric acid has been added

(continued on the next page)

10 continued.

Look at the table for Question 10 in the Diagram Booklet. It shows the student's results.

(a) (i) Name a piece of apparatus the student could use to add 10·0 cm^3 of dilute sulfuric acid to the beaker.
(1 mark)

(ii) Look at the graph for Question 10(a) in the Diagram Booklet. The first four points have been plotted for you. Plot the rest of the student's results.
(2 marks)

(continued on the next page)

10 continued.

(iii) Ignoring the anomalous result, draw two lines of best fit, making sure that the two lines cross.
(1 mark)

(iv) Give the trend shown on the graph for the first 50 cm^3 of acid added.
(1 mark)

(continued on the next page)

10 continued.

(v) Suggest a mistake the student could have made to cause the anomalous result.
(1 mark)

(continued on the next page)

10 continued.

(b) This is the equation for the reaction.

$$Ba(OH)_2(aq) + H_2SO_4(aq) \longrightarrow BaSO_4(s) + 2H_2O(l)$$

(i) When 50 cm^3 of dilute sulfuric acid have been added, only barium sulfate and water are present in the mixture.

Explain why this mixture does not conduct electricity.
Refer to the type of bonding in barium sulfate and in water in your answer.
(3 marks)

(continued on the next page)

10 continued.

(continued on the next page)

10 continued.

(ii) Name a technique the student could use to separate barium sulfate from the mixture after 100 cm^3 of dilute sulfuric acid has been added. (1 mark)

(Total for Question 10 = 10 marks)

11 This question is about the reduction of tungsten oxide, WO_3

(a) Look at the diagram for Question 11(a) in the Diagram Booklet. A teacher uses this apparatus to reduce tungsten oxide.

This is the teacher's method.

- **record the mass of a weighing boat**
- **add tungsten oxide and record the mass again**
- **heat the weighing boat and tungsten oxide strongly for two minutes and then allow to cool**
- **record the mass of the weighing boat and its contents**

(continued on the next page)

11 continued.

(i) Complete the equation by adding the state symbols.
(2 marks)

WO_3(_____) + $3H_2$(_____) $\rightarrow$

W(_____) + $3H_2O$(_____)

(ii) Give an addition to the method to check that the tungsten oxide has been completely reduced.
(1 mark)

(continued on the next page)

11 continued.

(iii) Look at the table for Question 11(a)(iii) in the Diagram Booklet. It shows the teacher's results.

On page 66 use the teacher's results to show that the empirical formula of tungsten oxide is WO_3 (3 marks)

(continued on the next page)

11 continued.

[for tungsten, $A_r = 184$
for oxygen, $A_r = 16$]

(continued on the next page)

11 continued.

(iv) The teacher wears eye protection and a lab coat during the experiment.

Give one other safety precaution the teacher should take.
(1 mark)

(continued on the next page)

11 continued.

(b) In industry, tungsten oxide is reduced on a large scale using hydrogen.

The percentage yield of tungsten is 73·5%

This is the equation for the reaction.

$$WO_3 + 3H_2 \longrightarrow W + 3H_2O$$

On page 69 calculate the mass, in tonnes, of tungsten that is produced when 2784 tonnes of tungsten oxide are reacted with an excess of hydrogen.
(3 marks)

(continued on the next page)

11 continued.

[1 tonne = 1×10^6 g]

[for tungsten, A_r = 184
for oxygen, A_r = 16]

mass of tungsten = _____ tonnes

(Total for Question 11 = 10 marks)

TOTAL FOR PAPER = 110 MARKS
END OF PAPER