Paper Reference(s) 1CH0/2H
Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Chemistry

PAPER 2
Higher Tier

Total Marks

Tuesday 11 June 2024 – Morning

Time: 1 hour 45 minutes

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, Periodic table (enclosed)

YOU WILL BE GIVEN

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.

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 100.

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 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 (a) Concrete is a composite material made of cement, sand and stone.

Different types of concrete are produced by changing the ratio of cement, sand and stone.

Look at Figure 1 for Question 1(a) in the Diagram Booklet. It shows some information about three different types of concrete, A, B and C.

(i) State how the amount of stone added to the mixture affects the compressive strength of concrete.
(1 mark)

(continued on the next page)

1(a) continued.

(ii) Look again at Figure 1 for Question 1(a) in the Diagram Booklet. What mass of stone is in a sample of concrete **B** containing **5000 kg** of sand?
(1 mark)

☐ A **2500 kg**

☐ B **5000 kg**

☐ C **7500 kg**

☐ D **10 000 kg**

(continued on the next page)

1(a) continued.

(iii) Sand contains silicon dioxide.

Look at Figure 2 for Question 1(a)(iii) in the Diagram Booklet. It shows part of the structure of silicon dioxide.

State the type of structure and bonding in silicon dioxide.
(1 mark)

_____

_____

_____

(continued on the next page)

1 continued.

(b) (i) Which statement about nanoparticles is correct?
(1 mark)

☐ A nanoparticles are smaller than atoms and molecules

☐ B nanoparticles are smaller than atoms but larger than molecules

☐ C nanoparticles are larger than atoms but smaller than molecules

☐ D nanoparticles are larger than atoms and molecules

(continued on the next page)

1(b) continued.

(ii) Some sunscreens contain nanoparticles of titanium dioxide.

Explain why nanoparticles of titanium dioxide are used in some sunscreens.
(2 marks)

(Total for Question 1 = 6 marks)

2 A student investigates the reaction between marble chips and dilute hydrochloric acid.

The student measures the total volume of carbon dioxide gas produced each minute, for 10 minutes.

(a) Look at Figure 3 for Question 2(a) in the Diagram Booklet. It shows part of the apparatus used in the experiment.

Complete Figure 3 by drawing and labelling apparatus that could be used to collect and measure the volume of the carbon dioxide gas. (2 marks)

(continued on the next page)

2 continued.

(b) Look at Figure 4 for Question 2(b) in the Diagram Booklet. It shows a graph of the results of the experiment.

A tangent has been drawn on the curve at a time of 3·5 minutes.

(i) State the total volume of carbon dioxide produced in the first 3·5 minutes.
(1 mark)

volume = _____ cm^3

(continued on the next page)

2(b) continued.

(ii) Using the tangent, calculate the rate of reaction at 3·5 minutes in cm^3 per minute. (3 marks)

$$\text{rate of reaction} = \frac{\text{change in gas volume}}{\text{change in time}}$$

rate = _____ cm^3 per minute

(continued on the next page)

2 continued.

(c) The student repeats the experiment using the same mass of smaller marble chips.

All other conditions remain the same.

Explain the effect on the rate of reaction of using smaller marble chips.
(2 marks)

(continued on the next page)

2 continued.

(d) Which change would make the rate of reaction slower?
(1 mark)

- ☐ **A** using the same acid at a higher temperature
- ☐ **B** using acid of a lower concentration
- ☐ **C** using a larger flask
- ☐ **D** adding a catalyst

(Total for Question 2 = 9 marks)

3 This question is about the atmosphere.

(a) Describe the test to show that a gas is oxygen.
(2 marks)

(continued on the next page)

3 continued.

(b) Copper reacts with oxygen to form copper oxide.

2·100 g of copper will react completely with **0·529 g** of oxygen.

In an experiment, **4·200 g** of copper is heated with **50·000 g** of oxygen until the reaction is complete.

Calculate the mass of oxygen remaining at the end of the experiment.
(2 marks)

_____

_____

_____

mass of oxygen = _____ g

(continued on the next page)

3 continued.

(c) Helium, neon and argon are all inert.

(i) Explain, in terms of electrons, why these gases are inert.
(2 marks)

(continued on the next page)

3(c) continued.

(ii) Two pieces of steel can be joined by heating the metal pieces with a very hot flame.

This process is often carried out in an argon atmosphere rather than in air.

Which property makes argon gas suitable for this use?
(1 mark)

☐ A argon has a low density

☐ B argon has a low melting point

☐ C argon is colourless

☐ D argon is unreactive

(continued on the next page)

3 continued.

(d) Carbon dioxide is removed from the atmosphere by plants and stored in plants and soil as carbon compounds.

Look at Figure 5 for Question 3(d) in the Diagram Booklet. It shows the relative amounts of carbon stored in plants and soils in different environments.

It has been suggested that preserving coastal ecosystems is more effective than reforestation in the mitigation of climate change.

Describe how the data in Figure 5 supports this suggestion.
(2 marks)

_____

_____

_____

_____

_____

_____

(Total for Question 3 = 9 marks)

4 (a) Look at Figure 6 for Question 4(a) in the Diagram Booklet. It shows a poly(ethene) bottle containing substance K with one of its hazard symbols showing.

(i) Explain a safety precaution that should be taken when using a substance with the hazard symbol shown in Figure 6.
(2 marks)

(ii) Substance K has the formula $AgNO_3$
Give the name of substance K.
(1 mark)

(continued on the next page)

4(a) continued.

(iii) State ONE property of poly(ethene) that makes it a suitable material to make a container for storing substances.
(1 mark)

_____

_____

_____

(continued on the next page)

4(a) continued.

(iv) A student tests a solid for chloride ions.

The student uses the following method.

step 1 dissolve a small amount of the solid in water

step 2 add some dilute hydrochloric acid

step 3 add a few drops of a solution of **K**

step 4 observe whether or not a white precipitate forms.

This method to show whether the solid contains chloride ions will not work.

Explain a change that needs to be made to step 2 to allow this method to work.
(2 marks)

Answer space continues on the next page.

4(a)(iv) continued.

_____

_____

_____

(b) In the test for carbonate ions, the carbonate ions react with an acid.

Sodium carbonate, Na_2CO_3, is reacted with dilute hydrochloric acid.

Look at the diagram for Question 4(b) in the Diagram Booklet. Complete and balance the equation for this reaction.
(3 marks)

(continued on the next page)

4 continued.

(c) The carbonate of element X has the formula X_2CO_3

The relative formula mass of this carbonate is 230

Using this information, calculate the relative atomic mass of X.
(2 marks)

(relative atomic masses: C = 12, O = 16)

relative atomic mass of X = _____

(Total for Question 4 = 11 marks)

5 (a) (i) **Most hydrocarbons found in fossil fuels are members of the alkane homologous series.**

State TWO features of an homologous series.
(2 marks)

1 _____

_____

_____

2 _____

_____

_____

(ii) **Which molecule is in the same homologous series as CH_4?**
(1 mark)

☐ A C_5H_{20}

☐ B C_6H_{12}

☐ C C_8H_{18}

☐ D C_9H_{16}

(continued on the next page)

5 continued.

(b) A fossil fuel contains carbon and sulfur.

Explain how the products of the complete combustion of this fossil fuel would affect the environment.
(4 marks)

Answer space continues on the next page.

5(b) continued.

(c) Incomplete combustion of fuels may produce carbon monoxide.

Write the balanced equation for the incomplete combustion of heptane, C_7H_{16}, where all of the carbon atoms form carbon monoxide.
(2 marks)

(Total for Question 5 = 9 marks)

6 (a) Damp iron wool reacts with oxygen in the air.

Look at Figure 7 for Question 6(a) in the Diagram Booklet. A student uses the apparatus in Figure 7 to investigate the percentage of oxygen in the atmosphere.

(i) The initial volume of air in the measuring cylinder was $18{\cdot}0\,cm^3$

The student left the apparatus overnight.

The volume of gas in the measuring cylinder the next day was $14{\cdot}5\,cm^3$

To the nearest whole number, what percentage of the air has reacted with the iron wool? (1 mark)

☐ A 19 %

☐ B 21 %

☐ C 24 %

☐ D 81 %

(continued on the next page)

6(a) continued.

(ii) Describe ONE improvement the student could make to this method to ensure that all of the oxygen in the measuring cylinder has reacted. (2 marks)

(continued on the next page)

6 continued.

(b) (i) When hydrocarbon fuels are burned, the products are water and carbon dioxide.

Look at Figure 8 for Question 6(b)(i) in the Diagram Booklet. Describe what needs to be done to the apparatus in Figure 8 to collect the water and show that carbon dioxide has been produced.
(2 marks)

(continued on the next page)

6(b) continued.

(ii) A hydrocarbon, C_xH_y, is burned in excess oxygen, forming $26{\cdot}4\,g$ of carbon dioxide and $5{\cdot}4\,g$ of water.

The relative formula mass of C_xH_y is 78

Calculate the molecular formula of the hydrocarbon C_xH_y
(4 marks)

(relative atomic masses: $H = 1{\cdot}0$, $C = 12$;
relative formula masses: $H_2O = 18$, $CO_2 = 44$)

Answer space continues on the next page.

6(b) continued.

_____

_____

molecular formula = _____

(Total for Question 6 = 9 marks)

7 (a) The relative atomic mass of argon is 40 and the relative atomic mass of potassium is 39 but potassium appears after argon in the periodic table.

State why potassium appears after argon in the periodic table.
(1 mark)

_____

_____

_____

(b) Potassium reacts with water to form two products.

(i) Look at the diagram for Question 7(b)(i) in the Diagram Booklet. Give the formulae of both products.
(1 mark)

(ii) The reaction of potassium with water is exothermic.

Look at Figure 9 for Question 7(b)(ii) in the Diagram Booklet. On Figure 9, draw and label the reaction profile diagram for this reaction, labelling the activation energy.
(2 marks)

(continued on the next page)

7 continued.

(c) Some reactions are endothermic.

Explain, in terms of bond breaking and bond forming, why some reactions are endothermic. (3 marks)

(continued on the next page)

7 continued.

(d) Look at the diagram and Figure 10 for Question 7(d) in the Diagram Booklet.
Ethene reacts with hydrogen chloride.
Figure 10 shows the bond energies for the different bonds in the three molecules in the reaction.

Calculate the energy change for this reaction.
(4 marks)

Answer space continues on the next page.

7(d) continued.

energy change = _____ $kJ\,mol^{-1}$

(Total for Question 7 = 11 marks)

8 (a) A solid is known to be either aluminium chloride or aluminium sulfate or calcium chloride.

A few drops of sodium hydroxide solution are added to a solution of the solid and the mixture is shaken.

A white precipitate is seen.

A student concludes that the solid is aluminium sulfate.

(i) Explain why this conclusion may not be correct.
(2 marks)

(continued on the next page)

8(a) continued.

(ii) Describe a test the student could use to confirm that the solid contains sulfate ions. (2 marks)

(continued on the next page)

8 continued.

(b) A solution containing iron ions is mixed with sodium hydroxide solution.

A green precipitate forms.

After a period of time exposed to air, the precipitate changes colour to brown.

Which statement would explain this change in colour?
(1 mark)

☐ A iron(II) ions, Fe^{2+}, are oxidised to iron(III) ions, Fe^{3+}

☐ B iron(II) ions, Fe^{2+}, are reduced to iron(III) ions, Fe^{3+}

☐ C iron(III) ions, Fe^{3+}, are oxidised to iron(II) ions, Fe^{2+}

☐ D iron(III) ions, Fe^{3+}, are reduced to iron(II) ions, Fe^{2+}

(continued on the next page)

8 continued.

*(c) A technician has samples of two substances, **R** and **S**.

R is an ionic solid.

Molecules of **S** contain 2 carbon atoms.

The technician carries out some tests on **R** and on a solution of **S**.

Look at Figure 11 for Question 8(c) in the Diagram Booklet. The tests and the results obtained are shown in Figure 11.

Identify **R** and **S**, using all of the data in Figure 11, explaining your reasoning from each test.
(6 marks)

Answer space continues on the next 4 pages.

8(c) continued.

8(c) continued.

8(c) continued.

8(c) continued.

(Total for Question 8 = 11 marks)

9 The elements in group 7 of the periodic table are the halogens.

(a) Which row shows the colour and physical state of iodine at room temperature?
(1 mark)

	colour	physical state
☐ A	dark grey	solid
☐ B	red brown	liquid
☐ C	green	solid
☐ D	purple	gas

(continued on the next page)

9 continued.

(b) Look at Figure 12 for Question 9(b) in the Diagram Booklet. Iron wool is heated with bromine vapour as shown in Figure 12.

At the end of the reaction, a solid forms at the top of the test tube.

Identify the solid.
(1 mark)

_____

_____

(c) Aluminium reacts with bromine.

Write the balanced equation for the reaction between aluminium and bromine.
(3 marks)

_____

_____

(continued on the next page)

9 continued.

***(d) (i) The order of reactivity of the halogens can be found by displacement reactions.**

A student was provided with

- **solutions of bromine, chlorine and iodine**
- **solutions of sodium bromide, sodium chloride and sodium iodide.**

Describe experiments the student could carry out using these solutions to find the order of reactivity of bromine, chlorine and iodine, explaining how the results would show the order of reactivity.

You should use equations to support your answer.
(6 marks)

Answer space continues on the next 5 pages.

9(d)(i) continued.

9(d)(i) continued.

9(d)(i) continued.

9(d)(i) continued.

9(d)(i) continued.

_____

_____

_____

(continued on the next page)

9(d) continued.

(ii) Explain why the displacement reactions of halogens are redox reactions.
(2 marks)

(Total for Question 9 = 13 marks)

10 (a) Look at Figure 13 for Question 10(a) in the Diagram Booklet. It shows the apparatus used to burn different alcohols.

The mass of each alcohol required to raise the temperature of the water by 40 °C is found.

(i) State ONE variable, apart from the volume of water, that should be kept the same when each alcohol is burned.
(1 mark)

_____

_____

(continued on the next page)

10(a) continued.

(ii) It is found that 1·6 g of ethanol is used to raise the temperature of water by 40 °C.

Calculate the number of moles of ethanol used. Give your answer to two significant figures. (relative formula mass: ethanol = 46) (2 marks)

_____

_____

_____

_____

_____

number of moles = _____

(continued on the next page)

10(a) continued.

(iii) The mass of ethanol used to raise the temperature of the water by $40\,^{\circ}C$ is higher than the theoretical value.

The experiment is repeated and the same result obtained.

Give a reason why the mass of ethanol used is higher than expected.
(1 mark)

_____

_____

_____

(continued on the next page)

10 continued.

(b) Poly(phenylethene) is an addition polymer.

Look at Figure 14 for Question 10(b) in the Diagram Booklet. It shows part of the poly(phenylethene) molecule formed in the addition reaction between three phenylethene monomer molecules.

(i) Draw the structure of ONE phenylethene monomer molecule below Figure 14 in the Diagram Booklet.
(2 marks)

(ii) Explain what is SEEN when a few drops of bromine water are shaken with phenylethene.
(3 marks)

Answer space continues on the next page.

10(b)(ii) continued.

(continued on the next page)

10 continued.

(c) Poly(phenylethene) is an addition polymer.

Polyesters are condensation polymers.

Describe the differences between the type of monomer molecules used to form addition polymers and the type of monomer molecules used to form condensation polymers.
(3 marks)

(Total for Question 10 = 12 marks)

TOTAL FOR PAPER = 100 MARKS
END OF PAPER