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

Total Marks

Chemistry
PAPER 2
Higher Tier

Time: 1 hour 45 minutes

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

Surname					
Other names					
Centre Number					
Candidate Number					

Y69487A

Pearson

YOU MUST HAVE

Calculator, ruler

YOU WILL BE GIVEN

Diagram Booklet, Periodic Table

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the space 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.

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 (a) Titanium dioxide nanoparticles are used in some sunscreens.

(i) State one property of titanium dioxide nanoparticles that make them suitable for use in sunscreens.
(1 mark)

(continued on the next page)

1 continued.

(ii) Suggest one possible risk associated with using nanoparticles. (1 mark)

(continued on the next page)

1 continued.

(b) Look at FIGURE 1 for Question 1(b) in the Diagram Booklet. It shows the surface area to volume ratio for different diameters of spherical nanoparticles.

(i) State the trend shown by the data in Figure 1.
(1 mark)

(continued on the next page)

1 continued.

(ii) What is the surface area : volume ratio for a spherical nanoparticle with a diameter of 80 nm?
(1 mark)

☐ A 3 : 35

☐ B 3 : 40

☐ C 3 : 45

☐ D 3 : 50

(continued on the next page)

1 continued.

(c) Look at FIGURE 2 for Question 1(c) in the Diagram Booklet. A different nanoparticle is cube shaped, as shown.

The length of one side of this cube is 60 nm.

Show that the surface area : volume ratio for this cube is 1 : 10.
(3 marks)

(continued on the next page)

1 continued.

(Total for Question 1 = 7 marks)

2 Look at FIGURE 3 for Question 2 in the Diagram Booklet. A student used the apparatus in Figure 3 to investigate the rate of the reaction between a metal and dilute hydrochloric acid.

Pieces of the metal were placed in dilute hydrochloric acid in the flask, and the total volume of gas produced was measured every minute.

(a) Look at FIGURE 4 for Question 2(a) in the Diagram Booklet. It shows a graph of the student's results.

(continued on the next page)

2 continued.

(i) Name a piece of apparatus that would be better to measure the volume of gas produced, instead of the 250 cm^3 measuring cylinder.

Give a reason for your answer. (2 marks)

name of apparatus

_____

_____

reason

_____

_____

_____

(continued on the next page)

2 continued.

(ii) Calculate the mean rate of production of hydrogen over the first 90 seconds, in cm^3 per second.
(3 marks)

rate = _____ cm^3 per second

(continued on the next page)

2 continued.

(iii) The student measured the volume of gas for 10 minutes.

State why the measurements could have been stopped at 9 minutes.
(1 mark)

(continued on the next page)

2 continued.

(b) The experiment was repeated, but with acid of a higher concentration.

The rate of reaction was faster.

(i) Explain why the rate of reaction increases when the concentration of acid is increased.
(2 marks)

(continued on the next page)

2 continued.

(ii) Another student suggests four other ways of increasing the rate of this reaction.

Which one is correct?
(1 mark)

☐ A use the same acid but at a lower temperature

☐ B use a larger trough

☐ C use a smaller flask

☐ D use the same metal but in a powdered form

(Total for Question 2 = 9 marks)

3 This question is about gases.

(a) When sodium is added to water, hydrogen gas is produced.

Which observation shows that a gas has been produced?
(1 mark)

☐ A a white precipitate forms

☐ B effervescence is seen

☐ C the sodium sinks in the water

☐ D the water changes to a pink colour

(continued on the next page)

3 continued.

(b) Some damp litmus paper is placed in a gas.
The litmus paper is bleached.

Which gas bleaches damp litmus paper?
(1 mark)

☐ A carbon dioxide

☐ B chlorine

☐ C hydrogen

☐ D oxygen

(continued on the next page)

3 continued.

(c) When calcium carbonate is heated it decomposes.

$$CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$$

When 5·000 g of calcium carbonate is heated, the mass of solid remaining is 2·800 g.

Calculate the mass of carbon dioxide that has been released.

Give your answer to three significant figures.
(2 marks)

mass of carbon dioxide =

_____ g

(continued on the next page)

3 continued.

(d) Look at FIGURE 5 for Question 3(d) in the Diagram Booklet. It shows a diagram of an atom of helium.

(i) Explain, using Figure 5, why helium is inert.
(2 marks)

(continued on the next page)

3 continued.

(ii) Helium is used to fill balloons.

State one property of helium, apart from it being inert, that makes it suitable for filling balloons.
(1 mark)

(continued on the next page)

3 continued.

(e) Oxygen gas has the formula O_2.

Calculate the number of oxygen ATOMS in 3·50 mol of oxygen gas. (2 marks)

(Avogadro constant = $6{\cdot}02 \times 10^{23}$)

number of oxygen atoms =

(Total for Question 3 = 9 marks)

4 (a) Some acids are used in tests for ions.

Look at FIGURE 6 for Question 4(a) in the Diagram Booklet. A bottle of one acid is shown.

(continued on the next page)

4 continued.

(i) The acid in Figure 6 can be used in the test for carbonate ions.

Explain, giving the name of the hazard symbol shown, what safety precautions should be taken when using this acid.
(2 marks)

(continued on the next page)

4 continued.

(ii) Give the name of the acid shown in Figure 6.
(1 mark)

(iii) State a property of glass that makes it a suitable material to make the container for an acid.
(1 mark)

(continued on the next page)

4 continued.

(b) A teacher conducts a flame test to identify the metal ions in some unknown solids.

STEP 1 dip a flame test wire into hydrochloric acid

STEP 2 dip the flame test wire into the unknown solid

STEP 3 hold the flame test wire above a Bunsen burner flame

(continued on the next page)

4 continued.

(i) This method did not work well.

Explain an improvement that needs to be made to STEP 3 to enable a bright flame colour to be produced.
(2 marks)

(continued on the next page)

4 continued.

(ii) Look at FIGURE 7 for Question 4(b)(ii) in the Diagram Booklet. It shows the results of the flame tests on three compounds, **P**, **Q** and **R**.

Use Figure 7 to identify the metal ions in compounds **P**, **Q** and **R**. (3 marks)

P _____

Q _____

R _____

(continued on the next page)

4 continued.

(c) A flame photometer was used to analyse samples of a solution of metal ions.

Each sample was treated with $5{\cdot}00\,cm^3$ of dilute hydrochloric acid.

$1{\cdot}00\,dm^3$ of the acid contained 219 g of hydrogen chloride.

Calculate the mass of hydrogen chloride in the acid used to test 20 samples.
(2 marks)

(continued on the next page)

4 continued.

mass = _____ g

(Total for Question 4 = 11 marks)

5 (a) Look at FIGURE 8 for Question 5(a) in the Diagram Booklet. It shows some information about the composition of pollutant exhaust gases from the engines of two different vehicles.

(i) Give TWO ways in which the data in Figure 8 shows that the diesel engine is MORE damaging to the environment than the petrol engine.
(2 marks)

(continued on the next page)

5 continued.

(ii) Explain, using information from Figure 8, ONE way in which the diesel engine is LESS damaging to the environment than the petrol engine.
(2 marks)

(continued on the next page)

5 continued.

(b) (i) Which statement about the members of the alkane homologous series is correct? (1 mark)

☐ A they show a trend in chemical properties

☐ B their boiling point decreases as the molecules get larger

☐ C the molecular formula of neighbouring compounds differs by CH_3

☐ D their viscosity increases as the molecules get larger

(continued on the next page)

5 continued.

(ii) Which one of the following hydrocarbons belongs to the same homologous series as octane, C_8H_{18}?
(1 mark)

☐ A C_4H_6

☐ B C_4H_8

☐ C C_4H_{10}

☐ D C_4H_{12}

(continued on the next page)

5 continued.

(iii) Write the balanced equation for the complete combustion of octane, C_8H_{18}
(3 marks)

(Total for Question 5 = 9 marks)

6 The elements in group 7 of the periodic table are known as the halogens.

(a) Name the halogen that is in period 4 of the periodic table.
(1 mark)

(continued on the next page)

6 continued.

(b) Explain why chlorine is more reactive than iodine.
(3 marks)

(continued on the next page)

6 continued.

(c) Look at FIGURE 9 for Question 6(c) in the Diagram Booklet. A piece of burning sodium is placed into a gas jar containing chlorine gas, as shown.

At the end of the reaction, the inside of the gas jar is coated with white crystals.

Identify the white crystals.
(1 mark)

_____

_____

(continued on the next page)

6 continued.

(d) Sodium also reacts with bromine.

(i) Write the balanced equation for the reaction between sodium and bromine.
(2 marks)

(ii) In another experiment, a student adds colourless sodium bromide solution to chlorine water.

State what you would SEE in this reaction.
(1 mark)

(continued on the next page)

6 continued.

(iii) The ionic equation for the reaction between sodium bromide and chlorine is:

$$2Br^- + Cl_2 \longrightarrow 2Cl^- + Br_2$$

Explain which species has been oxidised in this reaction.
(2 marks)

(Total for Question 6 = 10 marks)

7 This question is about oxygen.

(a) The percentage of oxygen in today's atmosphere is greater than the percentage of oxygen in the Earth's early atmosphere.

Explain what caused this change to happen.
(2 marks)

(continued on the next page)

7 continued.

(b) Magnesium reacts with oxygen from the air to form magnesium oxide.

A student carries out an investigation to determine the mass of magnesium oxide formed when a known mass of magnesium reacts completely with oxygen.

(continued on the next page)

7 continued.

This is the method the student used.

STEP 1 find the mass of a crucible and lid

STEP 2 put a known mass of magnesium into the crucible and put the lid on

STEP 3 heat for five minutes using a roaring Bunsen burner flame

STEP 4 let the crucible, lid and contents cool down

STEP 5 find the final mass of the crucible, lid and contents

(continued on the next page)

7 continued.

Explain how the student could check that the magnesium had reacted completely with oxygen.
(2 marks)

(continued on the next page)

7 continued.

(c) In another experiment, it was found that 1·24 g of phosphorus reacted completely with 1·60 g of oxygen to form phosphorus oxide.

The relative formula mass of this phosphorus oxide is 284.

Deduce the molecular formula of this phosphorus oxide.

You must show your working.

(relative atomic masses:
O = 16, P = 31)
(4 marks)

(continued on the next page)

7 continued.

molecular formula = _____

(continued on the next page)

7 continued.

(d) Look at FIGURE 10 for Question 7(d) in the Diagram Booklet. A student uses the apparatus shown in Figure 10 to investigate the percentage of oxygen in the atmosphere.

The apparatus was left for a few days.

(i) Explain one change the student would see after a few days. (2 marks)

(continued on the next page)

7 continued.

(ii) Explain one change that can be made to the apparatus in Figure 10 to allow the student to calculate the percentage of oxygen in the atmosphere.
(2 marks)

(Total for Question 7 = 12 marks)

8 (a) A precipitate is produced when an alkaline solution is added to a solution containing some metal ions.

(i) Which of these is evidence of a precipitate being produced? (1 mark)

☐ A fizzing

☐ B solid forms in the solution

☐ C the solution turns purple

☐ D the solution gets hot

(continued on the next page)

8 continued.

(ii) You are given two solutions, one containing Ca^{2+} ions and the other containing Al^{3+} ions.

Devise a plan to identify which solution is which.
(4 marks)

(continued on the next page)

8 continued.

(continued on the next page)

8 continued.

*(b) A scientist carries out some tests on solid **V** and on a solution of **V**.

Look at FIGURE 11 for Question 8(b) in the Diagram Booklet. The tests and results are shown.

Use the data in Figure 11 to deduce information about **V**, **W** and **X**, explaining your deductions.
(6 marks)

(continued on the next page)

8 continued.

(continued on the next page)

8 continued.

(continued on the next page)

8 continued.

(continued on the next page)

8 continued.

(continued on the next page)

8 continued.

(Total for Question 8 = 11 marks)

9 (a) In some chemical reactions, bonds are broken in the reactant molecules and new bonds are formed to make the product molecules.

(i) Which row is correct about the energy changes for these processes?
(1 mark)

	energy change	
	breaking a bond	making a bond
☐ A	energy is released	energy is released
☐ B	energy is released	energy is absorbed
☐ C	energy is absorbed	energy is released
☐ D	energy is absorbed	energy is absorbed

(continued on the next page)

9 continued.

(ii) Hydrogen reacts with fluorine.

$$H_2 + F_2 \longrightarrow 2HF$$

Look at FIGURE 12 for Question 9(a)(ii) in the Diagram Booklet. It shows the bond energies for the bonds in the three molecules in the equation.

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

(continued on the next page)

9 continued.

energy change =

_____ kJ mol^{-1}

(continued on the next page)

9 continued.

*(b) Look at FIGURE 13 for Question 9(b) in the Diagram Booklet. The reaction profile for an uncatalysed exothermic reaction is shown.

Using some examples of catalysts you have met in chemistry, discuss what catalysts do and their effect on the activation energy of a reaction.

You can use Figure 13 to illustrate your answer.
(6 marks)

(continued on the next page)

9 continued.

(continued on the next page)

9 continued.

(continued on the next page)

9 continued.

(continued on the next page)

9 continued.

(continued on the next page)

9 continued.

(Total for Question 9 = 11 marks)

10 (a) Look at FIGURE 14 for Question 10(a) in the Diagram Booklet. It shows the structure of a molecule of hydrocarbon **Z**, C_4H_8.

(i) Give the name of hydrocarbon **Z** shown in Figure 14.
(1 mark)

_____

_____

(ii) Complete the balanced equation for the reaction of hydrocarbon **Z**, C_4H_8, with bromine.
(2 marks)

C_4H_8 + _____ $\longrightarrow$

_____

(continued on the next page)

10 continued.

(iii) Draw the repeating unit of the addition polymer formed when hydrocarbon **Z** undergoes polymerisation. (2 marks)

(continued on the next page)

10 continued.

(b) Look at FIGURE 15 for Question 10(b) in the Diagram Booklet. It shows the arrangement of atoms in a molecule of an alcohol.

(i) Give the name of the carbon-containing product formed when the alcohol in Figure 15 undergoes dehydration. (1 mark)

(continued on the next page)

10 continued.

(ii) Give the formula of the functional group of the product formed when the alcohol in Figure 15 undergoes oxidation.
(1 mark)

(continued on the next page)

10 continued.

(iii) A student wants to investigate the amount of energy released when 1·00 g of the alcohol is burned.

Look at FIGURE 16 for Question 10(b)(iii) in the Diagram Booklet. They set up the apparatus shown in Figure 16 to measure the temperature rise of the water.

State why this apparatus is not suitable for use in this experiment.
(1 mark)

(continued on the next page)

10 continued.

(c) Some alcohols can react with some carboxylic acids to form polyesters, which are condensation polymers.

Look at FIGURE 17 for Question 10(c) in the Diagram Booklet. It shows the repeating unit of the polyester molecule formed in a reaction between a carboxylic acid and an alcohol.

(i) Give the formula of the other product formed in this reaction. (1 mark)

(continued on the next page)

10 continued.

(ii) Draw the structure of one molecule of the alcohol used to produce the polyester shown in Figure 17, showing all covalent bonds.
(2 marks)

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS
END OF PAPER