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

Total Marks

Chemistry
PAPER 2
Foundation Tier

Tuesday 13 June 2023 – 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					

Y72632A

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 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 is a periodic table 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. It shows the structure of a molecule of each of four compounds, **A**, **B**, **C** and **D**.

(a) The formula of a molecule of compound **A** is H_2O.

Give the formula of a molecule of compound **D**.
(1 mark)

(b) Look at the diagram for Question 1(b) in the Diagram Booklet. The names of two of the compounds in Figure 1 are shown.

Draw one straight line from each name to the structure of a molecule of that compound.
(2 marks)

(continued on the next page)

1 continued.

(c) Figure 2 shows information about the number of electrons in the outer shell of each of the different atoms in a molecule of compound **C**.

FIGURE 2

symbol of element	number of electrons in outer shell of the atom
H	1
S	6

Look at the diagram for Question 1(c) in the Diagram Booklet. Use the information in Figure 2 to complete the dot and cross diagram for a molecule of compound **C**.
(2 marks)

(continued on the next page)

1 continued.

(d) The atomic number of phosphorus, P, is 15.

One atom of phosphorus has a relative atomic mass of 31.

Give the number of protons, neutrons and electrons in this atom of phosphorus.
(3 marks)

number of protons = _____

number of neutrons = _____

number of electrons = _____

(Total for Question 1 = 8 marks)

2 A student investigated the temperature change that took place when different salts were dissolved in water.

The student used the following method.

STEP 1 pour 50 cm^3 of water into a polystyrene cup and record the temperature of the water

STEP 2 find the mass of an empty boiling tube

STEP 3 add 2 spatula measures of a salt to the boiling tube and find its new mass

STEP 4 add the salt to the water

STEP 5 stir the mixture and record the temperature after 2 minutes.

Look at Figure 3 for Question 2 in the Diagram Booklet. It shows the apparatus used.

(continued on the next page)

2 continued.

(a) For steps 2 and 3, the student obtained the mass measurements shown in Figure 4 for the first salt.

FIGURE 4

mass of empty boiling tube in g	22·52
mass of boiling tube + 2 spatula measures of a salt in g	24·16

Use the mass measurements in Figure 4 to calculate the mass of salt, in grams, added to the water. (1 mark)

_____

_____

_____

mass of salt = _____ g

(continued on the next page)

2 continued.

(b) The student repeated the method for three different salts, **A**, **B** and **C**.

The same mass of each salt was used.

Look at Figure 5 for Question 2(b) in the Diagram Booklet. It shows the temperature readings obtained for the three different salts.

(i) Calculate the temperature change for salt **C**.

Include a sign to show if the temperature change is an increase or a decrease.
(2 marks)

_____

_____

temperature change = _____ °C

(continued on the next page)

2(b) continued.

(ii) Explain which salt produces the biggest exothermic change.
(2 marks)

(continued on the next page)

2 continued.

(c) Explain why a polystyrene cup is a better container to use for this investigation than a glass beaker. (2 marks)

(Total for Question 2 = 7 marks)

3 Chemical tests are used to identify unknown substances.

(a) A flame test can be used to identify metal ions in a substance.

(continued on the next page)

3(a) continued.

(i) Complete step 2 of how to carry out a flame test.
(2 marks)

STEP 1 dip a flame test wire in dilute hydrochloric acid and then hold the wire in a roaring Bunsen flame until the flame is colourless

STEP 2 _____

_____

_____

_____

_____

STEP 3 hold the wire with the substance in a roaring Bunsen burner flame.

(continued on the next page)

3(a) continued.

(ii) Look at the diagram for Question 3(a)(ii) in the Diagram Booklet. Many metal ions produce a coloured flame in a flame test.

Draw one straight line from each metal ion to its flame colour in a flame test.
(3 marks)

(continued on the next page)

3 continued.

(b) Some metal ions can be identified using sodium hydroxide solution.

Drops of sodium hydroxide solution were added to a solution containing iron(III) ions, Fe^{3+}.

What would be seen?
(1 mark)

☐ A blue solution

☐ B green liquid

☐ C red-brown precipitate

☐ D yellow gas

(continued on the next page)

3 continued.

(c) In the test for carbonate ions, dilute hydrochloric acid is added to the solid carbonate in a test tube.

A gas is given off.

(i) Give the name of this gas.
(1 mark)

(continued on the next page)

3(c) continued.

(ii) Look at Figure 6 for Question 3(c)(ii) in the Diagram Booklet. It shows the apparatus that a student set up to test for this gas.

This apparatus will not work.

State what change is needed so that bubbles of the gas can pass through the limewater.
(1 mark)

(continued on the next page)

3 continued.

(d) A compound that contained ammonium ions was dissolved in water.

A solution was formed.

Sodium hydroxide solution was added, and the mixture was heated.

A gas was given off.

This gas was tested with a piece of damp red litmus paper.

The litmus paper turned blue.

Name the gas that was given off.
(1 mark)

(Total for Question 3 = 9 marks)

4 Look at Figure 7 for Question 4 in the Diagram Booklet. A scientist produced the information in Figure 7 about the Earth's atmosphere and the Earth's average surface temperature.

(a) Look at the bar chart for Question 4(a) in the Diagram Booklet. Complete the bar chart showing the composition of the Earth's atmosphere 3 billion years ago by adding a bar to show the percentage of carbon dioxide.
(1 mark)

(continued on the next page)

4 continued.

(b) (i) Use words from the list below to complete the following sentence. (1 mark)

has decreased

has increased

has stayed the same

Over the past 3 billion years the average surface temperature of the Earth

_____

(continued on the next page)

4(b) continued.

(ii) The Earth's atmosphere 3 billion years ago contained much more water vapour than today's atmosphere.

Explain what happened to the water vapour.
(2 marks)

(continued on the next page)

4 continued.

(c) Scientists think that the decrease in percentage of carbon dioxide was partly due to this gas being used in the growth of primitive plants.

(i) Carbon dioxide was used in the growth of primitive plants and produced oxygen.

Give the name of the process in plants that takes in carbon dioxide and produces oxygen.
(1 mark)

(continued on the next page)

4(c) continued.

(ii) Which of the following tests would show that a gas is oxygen? (1 mark)

☐ A put a lighted splint into the gas and it burns with a pop

☐ B put a glowing splint into the gas and it relights

☐ C put a lighted splint into the gas and it relights

☐ D put a glowing splint into the gas and it burns with a pop

(continued on the next page)

4 continued.

(d) Many people are concerned by the increasing amount of carbon dioxide in the atmosphere.

(i) The amount of carbon dioxide in the atmosphere is measured in parts per million (ppm).

Look at Figure 8 for Question 4(d) in the Diagram Booklet. It shows the amount of carbon dioxide in the atmosphere in June 2001 and in June 2021.

Calculate the increase in the amount of carbon dioxide, in ppm, from June 2001 to June 2021.

Give your answer to the nearest whole number.
(2 marks)

Answer space continues on the next page.

4(d)(i) continued.

_____

_____

_____

increase in
amount of
carbon dioxide = _____ ppm

(continued on the next page)

4(d) continued.

(ii) State ONE possible effect that could be caused by the increasing amount of carbon dioxide in the atmosphere. (1 mark)

_____

_____

_____

(Total for Question 4 = 9 marks)

5 Ethanol can be made by fermentation of a solution of glucose, a carbohydrate.

Look at Figure 9 for Question 5 in the Diagram Booklet. A student used the apparatus shown in Figure 9 for the fermentation reaction.

(a) Complete the missing label X below. (1 mark)

(continued on the next page)

5 continued.

(b) The student dissolved 45 g of glucose in water to make 150 cm^3 of glucose solution.

Calculate the concentration of this solution in g dm^{-3}.
(2 marks)

concentration of glucose solution = _____ g dm^{-3}

(continued on the next page)

5 continued.

(c) State what should be added to the glucose solution to cause the fermentation reaction.
(1 mark)

(continued on the next page)

5 continued.

(d) After a few days, a dilute solution of ethanol is formed.

Look at the diagrams for Question 5(d) in the Diagram Booklet. Which piece of apparatus should be used to produce a concentrated solution of ethanol from the dilute solution of ethanol by fractional distillation? (1 mark)

☐ A Diagram A

☐ B Diagram B

☐ C Diagram C

☐ D Diagram D

(continued on the next page)

5 continued.

(e) The complete fermentation of 180 g of glucose produces 92 g of ethanol.

Calculate the maximum mass of ethanol, in g, produced from the complete fermentation of 45 g of glucose.
(2 marks)

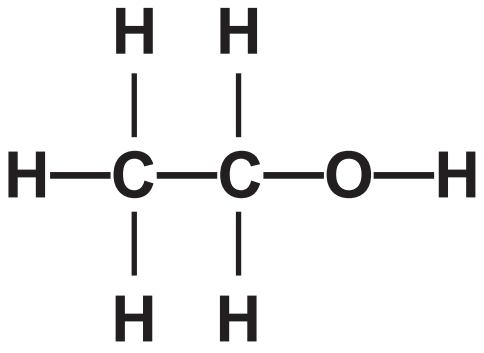
maximum
mass of ethanol = _____ g

(continued on the next page)

5 continued.

(f) The structure of a molecule of ethanol is shown in Figure 10.

FIGURE 10



Ethanol is an example of an alcohol.

Look at the structures for Question 5(f) in the Diagram Booklet. What is the functional group of an alcohol?
(1 mark)

☐ A Structure A

☐ B Structure B

☐ C Structure C

☐ D Structure D

(continued on the next page)

5 continued.

(g) Ethanol can be oxidised to form ethanoic acid.

State what is seen when a piece of universal indicator paper is placed in some dilute ethanoic acid.
(1 mark)

(Total for Question 5 = 9 marks)

6 Chlorine is an element in group 7 of the periodic table.

(a) What name is given to group 7 of the periodic table?
(1 mark)

☐ A alkali metals

☐ B halogens

☐ C noble gases

☐ D transition metals

(b) Chlorine reacts with sodium to form sodium chloride.

(i) Write the word equation for this reaction.
(2 marks)

→

6(b) continued.

(ii) Chlorine, Cl_2, is made of simple molecules.

Describe what is meant by the term MOLECULE.
(2 marks)

(continued on the next page)

6(b) continued.

(iii) Sodium, like all metals, conducts electricity.

Explain how sodium conducts electricity.
(2 marks)

(continued on the next page)

6(b) continued.

(iv) Sodium chloride contains sodium ions, Na^+, and chloride ions, Cl^-.

Use this information to state the formula of sodium chloride.
(1 mark)

(continued on the next page)

6(b) continued.

(v) Sodium chloride is made of a giant structure of ions.

Look at the diagrams for Question 6(b)(v) in the Diagram Booklet. Which diagram shows the arrangement of particles in sodium chloride?
(1 mark)

☐ A Diagram A

☐ B Diagram B

☐ C Diagram C

☐ D Diagram D

(continued on the next page)

6(b) continued.

(vi) Look at Figure 11 for Question 6(b)(vi) in the Diagram Booklet. Sodium chloride solution conducts electricity.

State what can be put into the circuit in Figure 11 to show that a current is flowing.
(1 mark)

(continued on the next page)

6 continued.

(c) Look at Figure 12 for Question 6(c) in the Diagram Booklet. It shows a flow diagram of how hydrochloric acid can be made.

(i) Balance the equation for the reaction between hydrogen and chlorine to form hydrogen chloride.
(1 mark)

$H_2 + Cl_2 \longrightarrow$ _____ HCl

(ii) State how hydrogen chloride can be converted into hydrochloric acid.
(1 mark)

_____

_____

_____

(Total for Question 6 = 12 marks)

7 In the complete combustion of alkanes, the alkane reacts with oxygen to produce carbon dioxide and water only.

(a) Pentane, C_5H_{12}, is an alkane.

The equation for the complete combustion of pentane, C_5H_{12}, can be shown as

$$C_5H_{12} + 8O_2 \longrightarrow wCO_2 + 6H_2O$$

(i) What is the value of **w** needed to balance the equation for the reaction?
(1 mark)

☐ A 2

☐ B 5

☐ C 8

☐ D 12

(continued on the next page)

7(a) continued.

$$C_5H_{12} + 8O_2 \longrightarrow wCO_2 + 6H_2O$$

(ii) What happens to pentane in this reaction?
(1 mark)

☐ A pentane is cracked

☐ B pentane is distilled

☐ C pentane is oxidised

☐ D pentane is reduced

(continued on the next page)

7 continued.

(b) Look at Figure 13 for Question 7(b)(i) in the Diagram Booklet. It shows some information about four alkanes.

(i) Complete Figure 13 to show the structure of one molecule of propane and the formula of butane.
(2 marks)

(ii) Using the information in Figure 13, give the empirical formula of hexane.
(1 mark)

(continued on the next page)

7(b) continued.

*(iii) A student is asked to compare the amount of energy released during the combustion of two alkanes, hexane and octane.

Look at Figure 14 for Question 7(b)(iii) in the Diagram Booklet. The student is given the apparatus shown in Figure 14.

Using the apparatus shown, devise a plan for the student to compare the masses of hexane and octane required to raise the temperature of water by 30 °C, describing how any variables in the experiment can be controlled to make a fair comparison.
(6 marks)

Answer space continues on the next 5 pages.

7(b)(iii) continued.

7(b)(iii) continued.

7(b)(iii) continued.

7(b)(iii) continued.

7(b)(iii) continued.

(Total for Question 7 = 11 marks)

8 Look at Figure 15 for Question 8 in the Diagram Booklet. A student used the apparatus shown in Figure 15 to investigate the reaction between marble chips and dilute hydrochloric acid.

The student recorded the volume of gas every minute as shown in Figure 16.

FIGURE 16

time in minutes	0	1	2	3	4	5	6
volume of gas in cm^3	0	52	78	91	97	100	100

(a) Look at the grid for Question 8(a) in the Diagram Booklet. On the grid, plot the results shown in Figure 16.

Draw a curve of best fit.
(3 marks)

(continued on the next page)

8 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 17 for Question 8(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)

8(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)

8 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 8(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)

(continued on the next page)

8 continued.

(d) Which of the following changes would make the reaction faster?
(1 mark)

☐ A use a larger boiling tube

☐ B use a larger volume of the dilute acid

☐ C use a more concentrated acid

☐ D use a smaller boiling tube

(e) State what could be used to measure time in the investigation.
(1 mark)

_____

_____

(Total for Question 8 = 11 marks)

9 Look at Figure 18 for Question 9 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)

9 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)

9 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)

9 continued.

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

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

(continued on the next page)

9 continued.

*(e) The reactivity of the group 1 metals increases from lithium to caesium.

Often, teachers demonstrate the reactions of lithium, sodium and potassium with water.

These reactions can be used to predict the behaviour and reactions of rubidium and caesium with water.

Describe the reactions of each of the group 1 metals with water including the predicted behaviour and reactions of rubidium and caesium.

You may use word equations in your answer.
(6 marks)

Answer space continues on the next 4 pages.

9(e) continued.

9(e) continued.

9(e) continued.

9(e) continued.

(Total for Question 9 = 13 marks)

10 (a) Atoms, molecules, nanoparticles and protons are types of particle.

List these four types of particle in order of size from smallest to largest. (2 marks)

smallest

largest

(continued on the next page)

10 continued.

(b) Nanoparticles have a large surface area to volume ratio.

Look at Figure 19 for Question 10(b) in the Diagram Booklet. It shows a cube-shaped nanoparticle with sides of 90 nm.

(i) What is 90 nm in metres? (1 mark)

☐ A $9{\cdot}0 \times 10^{-5}$

☐ B $9{\cdot}0 \times 10^{-6}$

☐ C $9{\cdot}0 \times 10^{-8}$

☐ D $9{\cdot}0 \times 10^{-11}$

(continued on the next page)

10(b) continued.

(ii) Calculate the simplest surface area to volume ratio for the nanoparticle in Figure 19.

Show your working.
(3 marks)

surface area to
volume ratio = 1 : _____

(continued on the next page)

10 continued.

(c) Look at Figure 20 for Question 10(c) in the Diagram Booklet. It shows the structure of a molecule of tetrafluoroethene.

(i) Tetrafluoroethene can form the polymer poly(tetrafluoroethene).

Draw a diagram to show the structure of the repeating unit of this polymer.
(2 marks)

(continued on the next page)

10(c) continued.

(ii) Poly(tetrafluoroethene) is also known as Teflon™.

State one use of poly(tetrafluoroethene) and explain how one of its properties makes it suitable for that use.
(3 marks)

Answer space continues on the next page.

use

explanation

10(c)(ii) continued.

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS
END OF PAPER