

Paper Reference(s) 4CH1/2C
Pearson Edexcel International GCSE (9–1)

Chemistry
Paper 2C

Total Marks

Time: 1 hour 15 minutes plus your additional time allowance

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

Surname					
Other names					
Centre Number					
Candidate Number					

YOU MUST HAVE

Calculator, ruler

YOU WILL BE GIVEN

Diagram Booklet, Periodic Table

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the spaces provided – there may be more space than you need.

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 ☐.

Turn over

INFORMATION

The total mark for this paper is 70.

The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.

A Periodic Table is provided.

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.

Good luck with your examination.

Answer ALL questions. Write your answers in the spaces provided.

1 Use the Periodic Table to help you answer this question.

**(a) (i) Name the element with atomic number 14
(1 mark)**

**(ii) Name the element with a relative atomic mass of 11
(1 mark)**

**(iii) Name the element in Group 2 and Period 3
(1 mark)**

1 continued.

(b) (i) Determine the number of neutrons in a phosphorus atom with mass number 31 (1 mark)

(ii) State the electronic configuration of an aluminium atom. (1 mark)

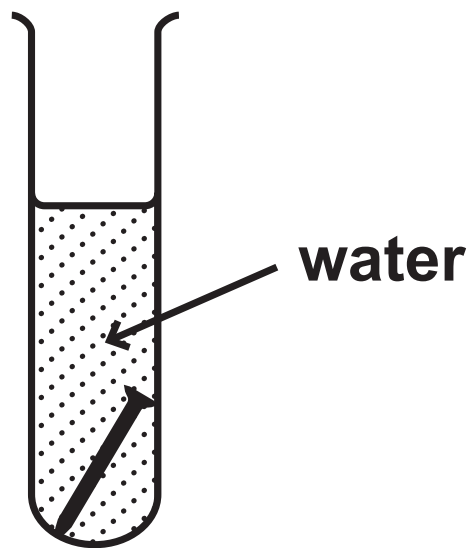
(iii) State why neon is unreactive. (1 mark)

(Total for Question 1 = 6 marks)

Turn over

2 A student investigates the rusting of iron.

(a) She places an iron nail in a test tube of water and leaves it for several days.



**(i) Predict the appearance of the iron nail after several days.
(1 mark)**

(continued on the next page)

2 continued.

**(ii) Name the main compound in rust.
(1 mark)**

(continued on the next page)

2 continued.

(b) The student then sets up two more test tubes containing iron nails. Look at the diagram for Question 2(b) in the Diagram Booklet.

Explain why the iron nail in tube 1 and the iron nail in tube 2 do not rust. (4 marks)

tube 1 _____

(continued on the next page)

Turn over

2 continued.

tube 2 _____

(Total for Question 2 = 6 marks)

3 Look at the diagram for Question 3(a) in the Diagram Booklet. It shows the industrial equipment used to separate crude oil into fractions.

**(a) (i) Give the name of the industrial equipment.
(1 mark)**

**(ii) Give one use of the fuel oil fraction.
(1 mark)**

(continued on the next page)

3 continued.

**(iii) Give the names of fraction A and
fraction F.
(2 marks)**

fraction A _____

fraction F _____

(continued on the next page)

3 continued.

(b) One compound in the gasoline fraction is the alkane octane (C_8H_{18}) and one compound in the kerosene fraction is the alkane dodecane ($\text{C}_{12}\text{H}_{26}$)

These two alkanes are covalently bonded and have simple molecular structures.

**(i) Give the general formula for the alkanes.
(1 mark)**

(continued on the next page)

3 continued.

(ii) Explain, in terms of their structures, why $\text{C}_{12}\text{H}_{26}$ has a higher boiling point than C_8H_{18} (3 marks)

(continued on the next page)

Turn over

3 continued.

(continued on the next page)

3 continued.

(c) Catalytic cracking can be used to convert the alkane $C_{12}H_{26}$ into more useful products.

**(i) Give the name of the catalyst used for catalytic cracking.
(1 mark)**

**(ii) Complete the equation for this cracking reaction.
(1 mark)**



(Total for Question 3 = 10 marks)

- 4 A student investigates the solubility of potassium nitrate in water. She measures the masses of potassium nitrate that dissolve in 25 cm³ of water at different temperatures.**

Look at the table for Question 4(a) in the Diagram Booklet. It shows the student's results. One of the results is anomalous.

Look at the grid for Question 4(a) in the Diagram Booklet.

**(a) (i) Plot the results on the grid.
(1 mark)**

**(ii) Draw a circle around the
anomalous result.
(1 mark)**

**(iii) Ignoring the anomalous result,
draw a curve of best fit.
(1 mark)**

(continued on the next page)

4 continued.

**(b) Suggest TWO possible mistakes that could have caused the anomalous result.
(2 marks)**

1 _____

2 _____

(continued on the next page)

Turn over

4 continued.

- (c) Use your graph for Question 4(a) in the Diagram Booklet to find the maximum mass of potassium nitrate that dissolves in 25 cm^3 of water at 75°C .**

**Show on your graph how you obtained your answer.
(2 marks)**

mass = _____ g

(continued on the next page)

Turn over

4 continued.

- (d) Use your graph for Question 4(a) in the Diagram Booklet to calculate the solubility of potassium nitrate in g per 100 g of water at 25°C.
(2 marks)**

[1·0 cm³ of water has a mass of 1·0 g]

**solubility = _____ g per 100 g
of water**

(Total for Question 4 = 9 marks)

Turn over

5 Ethanol, $\text{C}_2\text{H}_5\text{OH}$, is a member of the homologous series of alcohols.

**(a) Give two characteristics of a homologous series.
(2 marks)**

1 _____

2 _____

(continued on the next page)

5 continued.

(b) When ethanol is heated with potassium dichromate(VI) and one other reagent, the ethanol is oxidised to ethanoic acid, CH_3COOH

**(i) Give the formula of the other reagent.
(1 mark)**

**(ii) State the colour change that occurs during this oxidation reaction.
(2 marks)**

from _____

to _____

(continued on the next page)

Turn over

5 continued.

- (iii) Look at the diagram for Question 5(b)(iii) in the Diagram Booklet. Draw the displayed formulae for ethanol and ethanoic acid in the boxes.
(2 marks)**

(continued on the next page)

5 continued.

(c) Ethanol can be manufactured by two different methods.

Look at the table for Question 5(c)(i) in the Diagram Booklet. It gives some information about the two methods.

**(i) Discuss the advantages and disadvantages of these two methods, using information from the table.
(6 marks)**

(continued on the next page)

Turn over

5 continued.

(continued on the next page)

Turn over

5 continued.

(continued on the next page)

5 continued.

(ii) The word equation for the fermentation process is

glucose \rightarrow ethanol + carbon dioxide

**Look at the diagram for Question 5(c)(ii) in the Diagram Booklet. Complete the chemical equation for this reaction.
(1 mark)**

(Total for Question 5 = 14 marks)

6 Look at the diagram for Question 6(a) in the Diagram Booklet. It shows how hydrogen gas and chlorine gas can be prepared in the laboratory by electrolysis of a concentrated solution of sodium chloride.

**(a) (i) Give a test for hydrogen gas.
(1 mark)**

(continued on the next page)

6 continued.

**(ii) Give a test for chlorine gas.
(2 marks)**

(continued on the next page)

6 continued.

(b) The ionic half-equation for the formation of chlorine at the positive electrode is



**(i) State why this reaction is an oxidation reaction.
(1 mark)**

(continued on the next page)

6 continued.

- (ii) Give the ionic half-equation for the formation of hydrogen at the negative electrode.
(1 mark)**

- (iii) State why it is safer to do this electrolysis in a fume cupboard.
(1 mark)**

(continued on the next page)

Turn over

6 continued.

- (iv) Suggest why the volume of chlorine collected during this electrolysis is less than the volume of hydrogen collected.
(1 mark)**

(continued on the next page)

6 continued.

(c) In the chemical industry, chlorine can be produced by the electrolysis of molten sodium chloride.

The overall equation for this reaction is



**(i) Explain why sodium chloride needs to be molten rather than solid for electrolysis to occur.
(2 marks)**

(continued on the next page)

Turn over

6 continued.

(continued on the next page)

6 continued.

- (ii) Calculate the maximum volume, in dm^3 , of chlorine gas at rtp that can be obtained from 23.4 tonnes of molten sodium chloride. (4 marks)**

[1 tonne = 10^6 g]

[M_r of NaCl = 58.5]

[molar volume of chlorine at rtp = 24 dm^3]

Give your answer in standard form.

(continue your answer on the next page)

Turn over

6 continued.

volume = _____ dm³

(Total for Question 6 = 13 marks)

Turn over

- 7 A student does a titration to find the concentration of a solution of phosphoric acid.**

He uses these pieces of apparatus X, Y and Z in his titration.

Look at the diagrams for Question 7(a) in the Diagram Booklet. Diagrams are not to scale.

- (a) Give the names of X, Y and Z.
(3 marks)**

X _____

Y _____

Z _____

(continued on the next page)

Turn over

7 continued.

**(b) What is the colour of phenolphthalein in phosphoric acid?
(1 mark)**

☐ **A blue**

☐ **B colourless**

☐ **C pink**

☐ **D red**

(continued on the next page)

7 continued.

- (c) The student titrates 25.0 cm^3 of phosphoric acid with a solution of sodium hydroxide (NaOH).**

Look at Table 1 for Question 7(c) in the Diagram Booklet. It shows the student's results.

Concordant results are those within 0.20 cm^3 of each other.

- (i) Add ticks (✓) to Table 1 to show the concordant results.
(1 mark)**

(continued on the next page)

7 continued.

- (ii) Use your ticked results to calculate the mean (average) volume of NaOH added.
(2 marks)**

mean volume =

_____ cm³

(continued on the next page)

Turn over

7 continued.

(d) Look at Table 2 for Question 7(d) in the Diagram Booklet. It shows the titration results of another student.

The equation for the reaction is



**(i) Calculate the amount, in moles, of NaOH in 30.40 cm³ of sodium hydroxide solution.
(2 marks)**

amount = _____ mol

(continued on the next page)

Turn over

7 continued.

- (ii) Calculate the amount, in moles,
of H_3PO_4 in 25.0 cm^3 of
phosphoric acid.
(1 mark)**

amount = _____ mol

(continued on the next page)

7 continued.

- (iii) Calculate the concentration, in mol/dm^3 , of the phosphoric acid. (2 marks)**

concentration =

_____ mol/dm^3

(Total for Question 7 = 12 marks)

TOTAL FOR PAPER = 70 MARKS
END