Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International GCSE (9–1)

Centre Number | Candidate Number

Time 1 hour 15 minutes

Paper reference **4CH1/2C**

Chemistry
PAPER 2C

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- 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 ☒.

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.*

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.

Turn over ▶

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The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112–116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58–71) and the actinoids (atomic numbers 90–103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.

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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)

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

(1)

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

(1)

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

(1)

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

(1)

(iii) State why neon is unreactive.

(1)

(Total for Question 1 = 6 marks)

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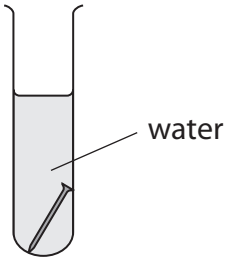
2 A student investigates the rusting of iron.

(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)

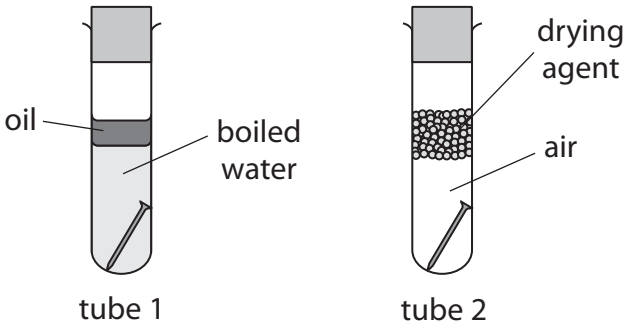
.....

(ii) Name the main compound in rust.

(1)

.....

(b) The student then sets up two more test tubes containing iron nails.



Explain why the iron nail in tube 1 and the iron nail in tube 2 do not rust.

(4)

tube 1.....

.....

.....

.....

tube 2.....

.....

.....

.....

(Total for Question 2 = 6 marks)

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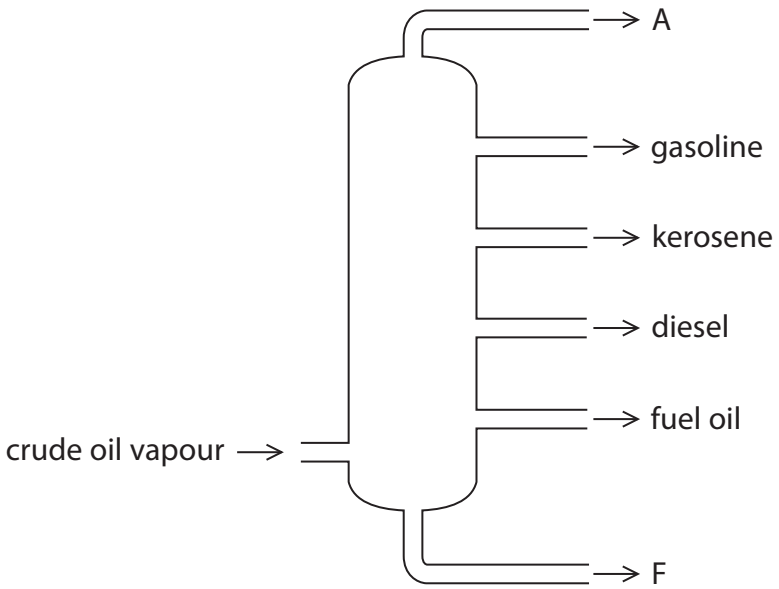
3 The diagram shows the industrial equipment used to separate crude oil into fractions.



(a) (i) Give the name of the industrial equipment.

(1)

.....

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

(1)

.....

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

(2)

fraction A.....

fraction F.....

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(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 ($C_{12}H_{26}$)

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

(i) Give the general formula for the alkanes.

(1)

.....

(ii) Explain, in terms of their structures, why $C_{12}H_{26}$ has a higher boiling point than C_8H_{18}

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(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)

.....

(ii) Complete the equation for this cracking reaction.

(1)

$$C_{12}H_{26} \rightarrow C_9H_{20} + \text{.....}$$

(Total for Question 3 = 10 marks)

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4 A student investigates the solubility of potassium nitrate in water.
She measures the masses of potassium nitrate that dissolve in 25 cm^3 of water at different temperatures.

The table shows the student's results. One of the results is anomalous.

Temperature in °C	10	20	30	40	50	60	70
Mass of potassium nitrate in g	8.0	10.0	12.5	16.0	17.5	26.5	34.0

(a) (i) Plot the results on the grid.

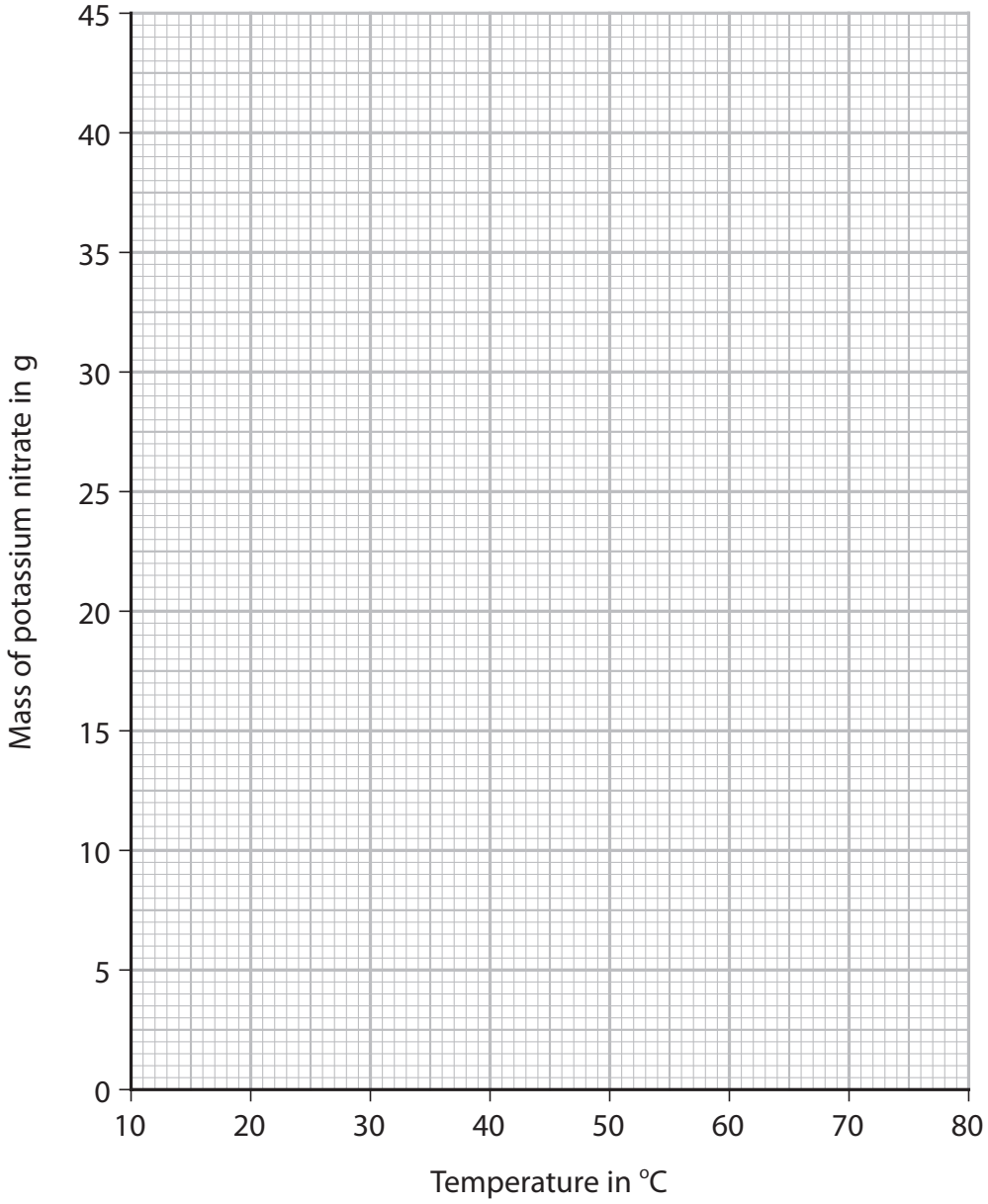
(1)

(ii) Draw a circle around the anomalous result.

(1)

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

(1)



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(b) Suggest **two** possible mistakes that could have caused the anomalous result.

(2)

1 .....

.....

2 .....

.....

(c) Use your graph 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)

mass = ... g

(d) Use your graph to calculate the solubility of potassium nitrate in g per 100 g of water at 25 °C.

[1.0 cm^3 of water has a mass of 1.0 g]

(2)

solubility = ... g per 100 g of water

(Total for Question 4 = 9 marks)

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5 Ethanol, C_2H_5OH, is a member of the homologous series of alcohols.

(a) Give two characteristics of a homologous series.

(2)

1 .....

.....

2 .....

.....

(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)

.....

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

(2)

from ..... to .....

(iii) Draw the displayed formulae for ethanol and ethanoic acid in the boxes.

(2)

ethanol	ethanoic acid

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(c) Ethanol can be manufactured by two different methods.
The table gives some information about the two methods.

	Hydration of ethene	Fermentation of glucose
raw material	crude oil	sugar cane
rate of reaction	fast	slow
purity of ethanol	pure	impure
operating temperature	300 °C	30 °C
operating pressure	60 – 70 atmospheres	1 atmosphere
catalyst	phosphoric acid	enzymes in yeast

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

(6)

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(ii) The word equation for the fermentation process is

glucose → ethanol + carbon dioxide

Complete the chemical equation for this reaction.

(1)

$C_6H_{12}O_6 \rightarrow$ ..... + ...

(Total for Question 5 = 14 marks)

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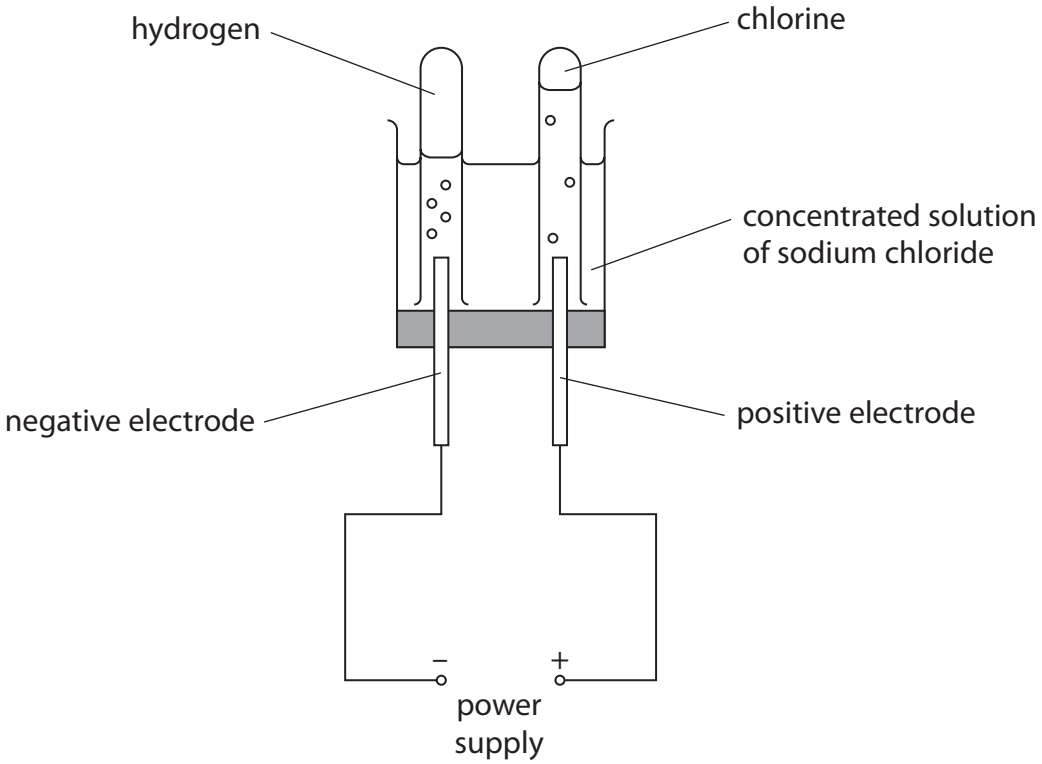
6 The diagram shows how hydrogen gas and chlorine gas can be prepared in the laboratory by electrolysis of a concentrated solution of sodium chloride.



(a) (i) Give a test for hydrogen gas.

(1)

.....

.....

(ii) Give a test for chlorine gas.

(2)

.....

.....

.....

.....

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

$$2Cl^- \rightarrow Cl_2 + 2e^-$$

(i) State why this reaction is an oxidation reaction.

(1)

.....

.....

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

(1)

.....

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

(1)

.....

.....

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

(1)

.....

.....

.....

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

The overall equation for this reaction is

$$2NaCl(l) \rightarrow 2Na(l) + Cl_2(g)$$

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

(2)

.....

.....

.....

.....

.....

.....

(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.

[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.

(4)

volume = ... dm^3

(Total for Question 6 = 13 marks)

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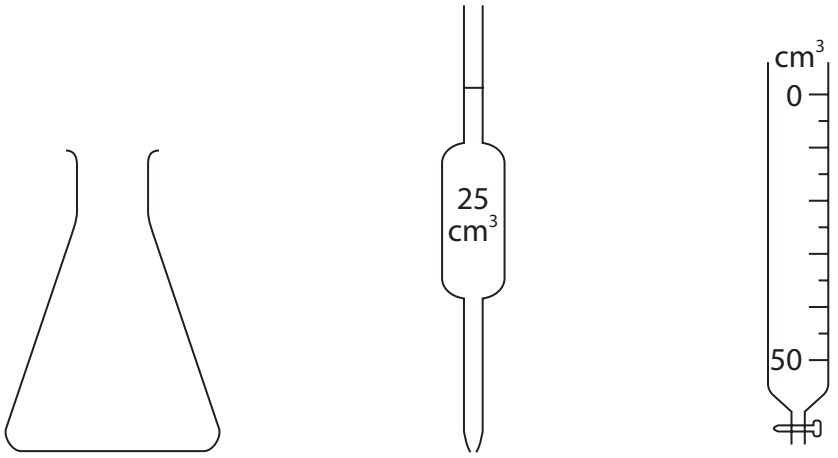
7 A student does a titration to find the concentration of a solution of phosphoric acid.

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



X Y Z

Diagrams are not to scale.

(a) Give the names of X, Y and Z.

(3)

X .....

Y .....

Z .....

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

(1)

- ☒ **A** blue
- ☒ **B** colourless
- ☒ **C** pink
- ☒ **D** red

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

Table 1 shows the student's results.

titration number	1	2	3	4
volume of NaOH added in cm^3	30.35	30.25	30.00	30.30
concordant results				

Table 1

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

(i) Add ticks (✓) to table 1 to show the concordant results.

(1)

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

(2)

mean volume = ... cm^3

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(d) Table 2 shows the titration results of another student.

volume of phosphoric acid used in cm^3	25.0
concentration of sodium hydroxide solution in mol/dm^3	0.525
mean volume of sodium hydroxide added in cm^3	30.40

Table 2

The equation for the reaction is

$$3NaOH + H_3PO_4 \rightarrow Na_3PO_4 + 3H_2O$$

(i) Calculate the amount, in moles, of NaOH in 30.40 cm^3 of sodium hydroxide solution.

(2)

amount = ... mol

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

(1)

amount = ... mol

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

(2)

concentration = ... mol/dm^3

(Total for Question 7 = 12 marks)

TOTAL FOR PAPER = 70 MARKS

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