Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Friday 17 May 2024

Morning (Time: 1 hour 45 minutes)

Paper reference **1CH0/1F**

Chemistry

PAPER 1

Foundation Tier

You must have:
Calculator, ruler, Periodic Table (enclosed)

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.*
- 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.

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.

Turn over ▶

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P 7 4 4 2 1 A 0 1 3 2

Pearson

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 Figure 1 shows a test tube being heated in a beaker of water.

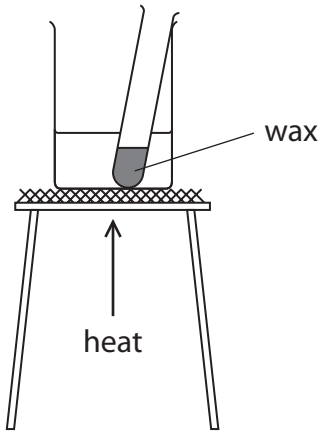


Figure 1

The test tube contains solid wax.

As the test tube was heated, the solid wax changed to liquid wax.

After heating, the wax was allowed to cool to room temperature.

(a) Figure 2 shows the arrangement of particles in liquid wax.

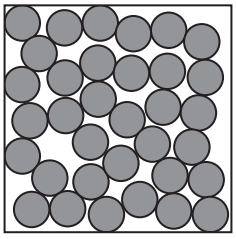


Figure 2

Draw the arrangement of particles in solid wax in the box in Figure 3.

(1)

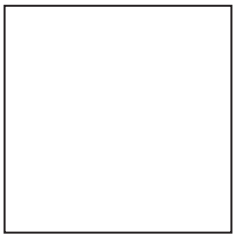


Figure 3

(b) When the wax cools, it changes from a liquid back to a solid.
This change is a **physical change**.

(i) What name is given to the change of a liquid to a solid?

(1)

- ☒ **A** condensing
- ☒ **B** evaporating
- ☒ **C** freezing
- ☒ **D** melting

(ii) Explain why the change from a liquid to a solid is a physical change rather than a chemical change.

(2)

(c) Another physical change is when a liquid changes into a gas.

(i) Which row shows the movement and arrangement of the particles in a gas?

(1)

	movement of particles	arrangement of particles
☒ **A**	slow	regular
☒ **B**	slow	random
☒ **C**	fast	regular
☒ **D**	fast	random

(ii) Suggest why the wax did **not** change into a gas when the test tube was heated in the beaker of water.

(1)

(Total for Question 1 = 6 marks)

2 (a) Nitrogen reacts with hydrogen to form ammonia.

The reaction is reversible.

(i) Complete the word equation for the reaction by adding the **symbol** to show that the reaction is reversible.

(1)

nitrogen + hydrogen ..... ammonia

(ii) Figure 4 shows the electronic configuration of an atom of hydrogen.

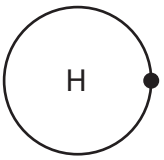
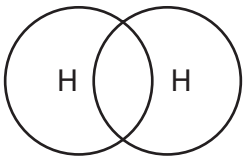


Figure 4

Complete the dot and cross diagram for a molecule of hydrogen, H_2.

(1)



(b) Ammonia reacts with sulfuric acid to form ammonium sulfate.

(i) Write the word equation for this reaction.

(2)

..... + ... → .....

(ii) Ammonium sulfate contains ammonium ions, NH_4^+, and sulfate ions, SO_4^{2-}.

What is the formula of ammonium sulfate?

(1)

☒ **A** NHSO

☒ **B** NH_4SO_4

☒ **C** $(NH_4)_2SO_4$

☒ **D** $NH_4(SO_4)_2$

(iii) Explain why some farmers spread ammonium sulfate on their fields.

(2)

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.....

.....

.....

(Total for Question 2 = 7 marks)

3 Water treatment is needed to make most sources of water suitable for drinking.

(a) Water treatment includes the processes of **chlorination**, **filtration** and **sedimentation**.

Place these processes in the order that they take place during water treatment.

(2)

first		last

(b) Some tap water contains chloride ions.

(i) Explain, in terms of electrons, how a chlorine atom, Cl, forms a chloride ion, Cl^-.

(2)

.....

.....

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.....

(ii) Why is chlorine added to water during water treatment?

(1)

☒ **A** to clean the water

☒ **B** to dissolve insoluble substances in the water

☒ **C** to increase the pH of the water to 11

☒ **D** to kill any bacteria in the water

(iii) State why tap water is not suitable for use in chemical analysis.

(1)

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.....

(c) A student was asked to distil a sample of tap water.
Figure 5 shows the apparatus the student used.

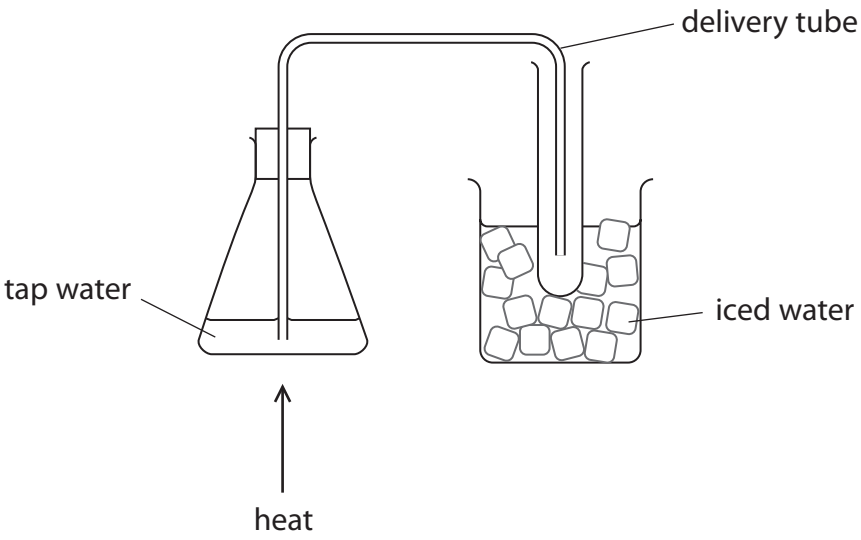

Figure 5

(i) The student made an error when setting up the apparatus in Figure 5.

This error meant that pure water could **not** be collected in the test tube.

Explain what the student needs to change so that pure water can be collected in the test tube.

(2)

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.....

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.....

(ii) State what the student should use to heat the water.

(1)

.....

(Total for Question 3 = 9 marks)

4 A student was asked to find the volume of lithium hydroxide solution that would react exactly with 25.0 cm^3 of dilute hydrochloric acid.

The student used the equipment in Figure 6 to carry out a rough titration and then a further three accurate titrations.

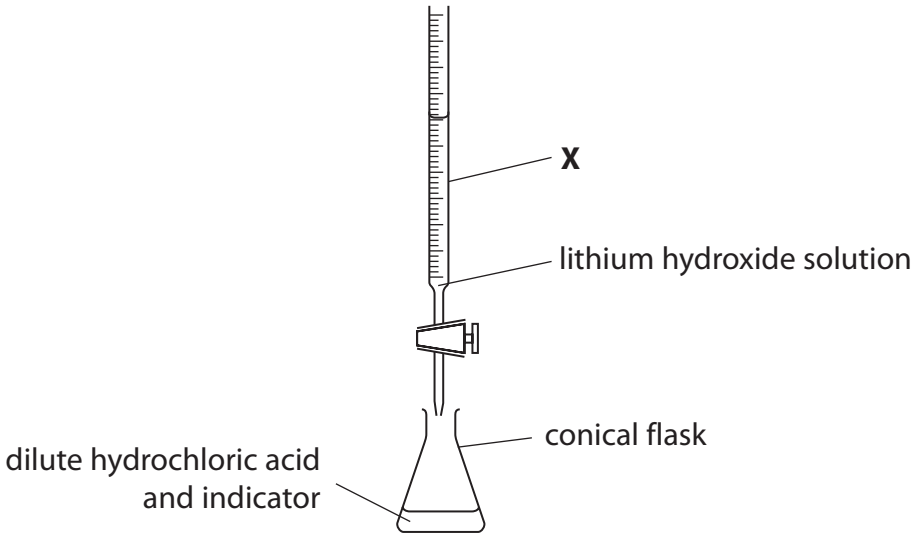

Figure 6

(a) (i) Which is the name of the piece of equipment labelled **X** in Figure 6?

(1)

- ☒ **A** boiling tube
- ☒ **B** burette
- ☒ **C** funnel
- ☒ **D** measuring cylinder

(ii) Describe how the student should measure the 25.0 cm^3 of dilute hydrochloric acid accurately into the conical flask.

(2)

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.....

(b) Figure 7 shows the results of the student's titrations.

	rough titration	accurate titration 1	accurate titration 2	accurate titration 3
final reading on **X** in cm^3	29.15	28.20	27.30	27.60
initial reading on **X** in cm^3	1.50	3.50	2.50	3.00
volume of lithium hydroxide solution added in cm^3		24.70	24.80	24.60

Figure 7

(i) Calculate the volume of lithium hydroxide solution added in the **rough** titration.

(1)

.....

.....

volume of lithium hydroxide solution = ... cm^3

(ii) Calculate the mean volume of lithium hydroxide solution used in the **accurate** titrations.

(2)

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.....

.....

mean volume of lithium hydroxide solution = ... cm^3

(c) Methyl orange indicator was added to dilute hydrochloric acid in the conical flask in the titration.

What colour change would be seen in the conical flask at the end point of the titration?

(1)

☒ **A** blue to green

☒ **B** colourless to black

☒ **C** red to orange

☒ **D** white to pink

(d) During the titration, lithium hydroxide solution, LiOH, reacts with dilute hydrochloric acid, HCl, to form lithium chloride, LiCl, and water.

(i) Write the balanced equation for the reaction.

(2)

..... + ... → ..... + ...

(ii) State the name of this type of reaction.

(1)

.....

(Total for Question 4 = 10 marks)

5 (a) Figure 8 shows some information about an atom of chlorine.

$$^{35}_{17}Cl$$

Figure 8

State the number of protons, neutrons and electrons in this atom.

(3)

number of protons = ...

number of neutrons = ...

number of electrons = ...

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

A sample of silicon chloride contains 1.4 g of silicon atoms and 7.1 g of chlorine atoms.

Calculate the empirical formula of this sample of silicon chloride.

(relative atomic masses: Si = 28, Cl = 35.5)

(3)

.....

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.....

empirical formula = ...

(c) The modern periodic table is organised into groups and periods.

State in which group and in which period of the periodic table silicon is found.

You should use the periodic table to help you answer this question.

(2)

group = ...

period = ...

(d) Describe **two** differences between Mendeleev's periodic table and the modern periodic table.

(2)

1 .....

.....

2 .....

.....

(Total for Question 5 = 10 marks)

6 (a) A 250 cm^3 solution of copper sulfate contains 6.52 g of dissolved solid.

Calculate the concentration of this copper sulfate solution in g dm^{-3}.

$$\text{concentration (g dm}^{-3}\text{)} = \frac{\text{mass of solid (g)}}{\text{volume of solution (dm}^3\text{)}}$$

(2)

.....

.....

.....

concentration = ... g dm^{-3}

(b) Sodium hydroxide solution and copper sulfate solution were reacted together completely.

The result was a mixture of a precipitate of copper hydroxide in a solution of sodium sulfate.

Describe how to obtain

- a pure sample of solid copper hydroxide from the mixture
- a pure sample of solid sodium sulfate from the mixture.

(4)

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(c) Figure 9 shows the equipment used to electrolyse a sample of sodium sulfate solution.

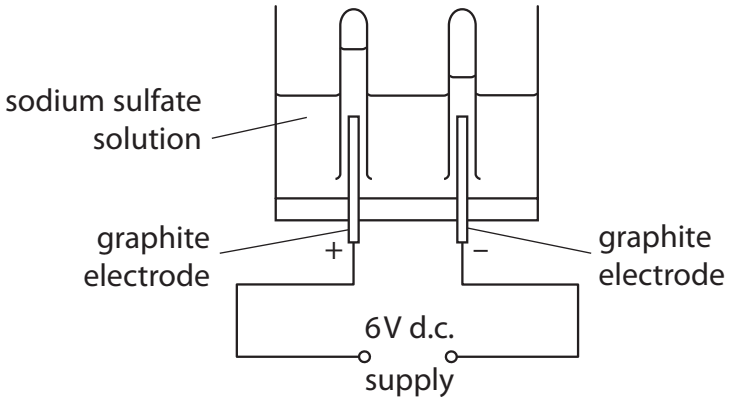


Figure 9

Graphite electrodes are used in the electrolysis.

(i) Give **two** reasons why graphite is a suitable material for the electrodes.

(2)

1 .....

2 .....

(ii) Sodium sulfate solution contains ions.

Which ions are attracted to the positive electrode during the electrolysis?

(1)

☒ **A** H^+ ions only

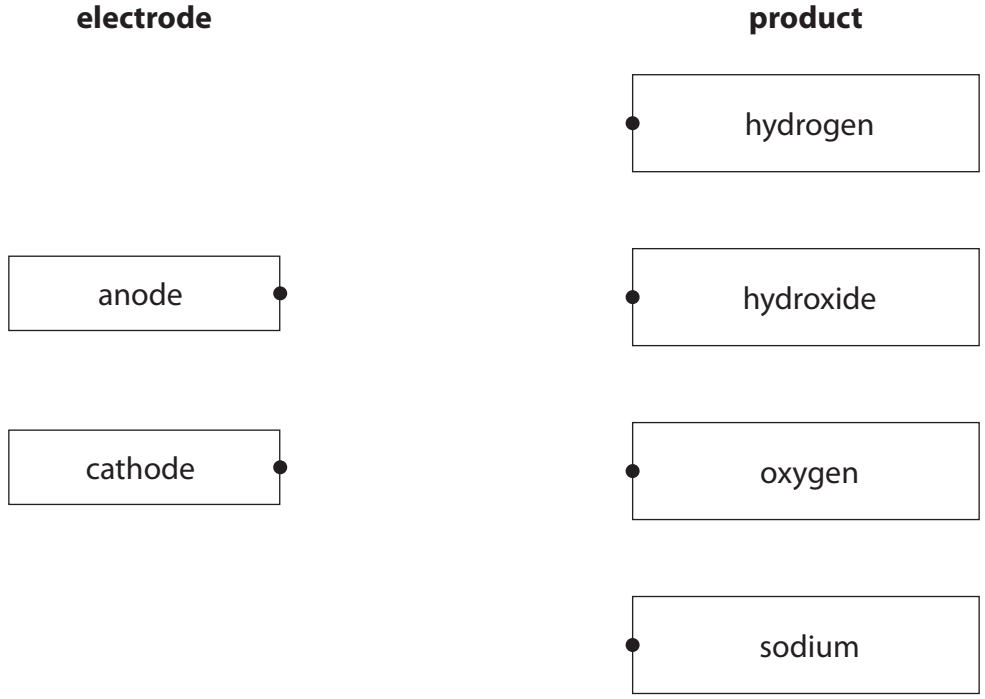
☒ **B** OH^- ions only

☒ **C** H^+ and Na^+ ions

☒ **D** SO_4^{2-} and OH^- ions

(iii) Draw **one** straight line from each electrode to the product formed at that electrode during the electrolysis of sodium sulfate solution.

(2)



(Total for Question 6 = 11 marks)

7 (a) A student investigated the rusting of iron rods using the following method.

step 1 find the mass of two identical iron rods

step 2 wrap magnesium ribbon around one of the iron rods

step 3 place each rod in separate boiling tubes containing 10 cm^3 of water

step 4 leave the iron rods for one week

step 5 find the new mass of the iron rods.

Figure 10 shows the apparatus used.

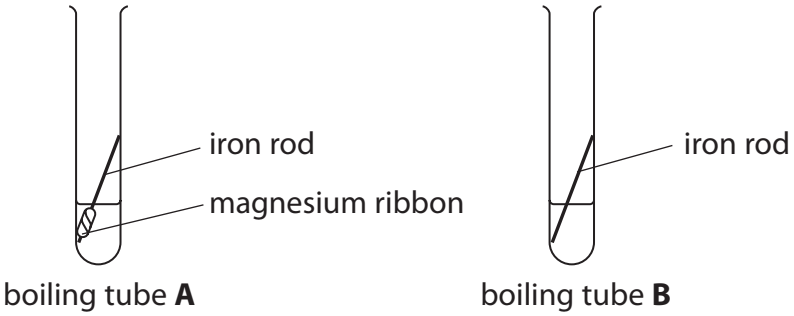


Figure 10

Figure 11 shows the results of the investigation.

	initial mass of iron rod in g	final mass of iron rod in g	change in mass in g
boiling tube **A**	7.00	7.00	0.00
boiling tube **B**	7.00	7.56	

Figure 11

(i) Use the results in Figure 11 to calculate the percentage increase in the mass of the iron rod in boiling tube **B**.

$$\% \text{ increase} = \frac{\text{change in mass}}{\text{initial mass}} \times 100$$

(3)

.....

.....

.....

percentage increase in mass of iron rod = ...

(ii) Which gas from the air has reacted with the iron rod in boiling tube **B**?

(1)

- ☒ **A** argon
- ☒ **B** carbon dioxide
- ☒ **C** nitrogen
- ☒ **D** oxygen

(iii) The iron rod did not rust in boiling tube **A**.

Explain why.

(2)

*(b) Figure 12 shows some uses of copper metal.

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Figure 12

Describe how the properties of copper metal make it a suitable material for the uses shown.

Your answer should include

- uses of copper metal shown in the photographs
- properties of copper metal including:
  - chemical reactivity
  - electrical conductivity
  - malleability
  - thermal conductivity

(6)

(Total for Question 7 = 12 marks)

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8 Barium hydroxide reacts with dilute hydrochloric acid to form barium chloride solution and water.

(a) (i) Complete the balanced equation for the reaction by adding a **number** in front of HCl(aq).

(1)

$$Ba(OH)_2(s) + \ldots\ldots HCl(aq) \rightarrow BaCl_2(aq) + 2H_2O(l)$$

(ii) State what you would **see** during the reaction.

(1)

.....

.....

(b) A student investigated how the pH of the mixture changed as barium hydroxide was added to dilute hydrochloric acid.

The student used this method.

step 1 measure out 50 cm^3 of dilute hydrochloric acid into a beaker using a measuring cylinder

step 2 use a glass rod to place a drop of the acid onto a piece of universal indicator paper and record the pH

step 3 add one spatula measure of barium hydroxide to the acid in the beaker and stir

step 4 use the glass rod to place a drop of the mixture onto a new piece of universal indicator paper and record the pH again

step 5 repeat steps 3 and 4 until there is no further change in the pH.

(i) Name a piece of equipment that could be used to measure the pH of a substance more accurately than universal indicator paper.

(1)

.....

(ii) Explain why, in step 3, the mixture was stirred after adding the barium hydroxide.

(2)

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.....

.....

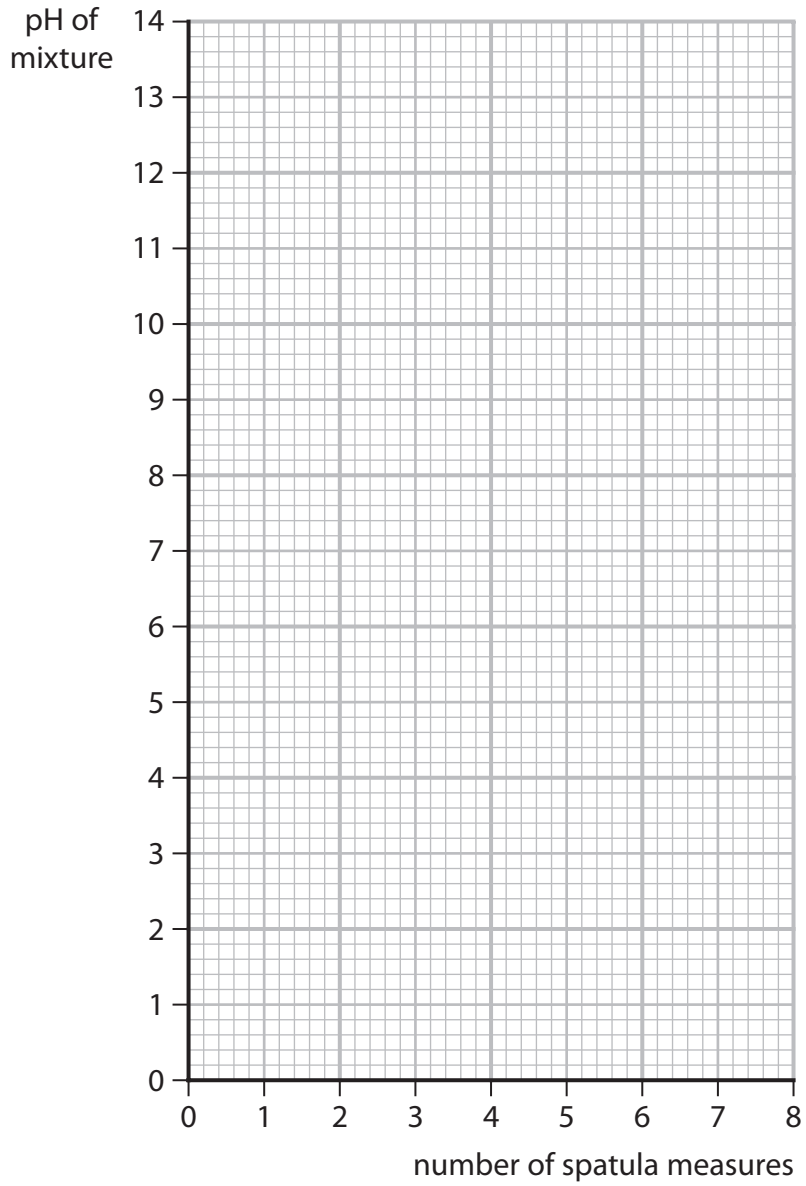
(iii) Figure 13 shows the student's results.

number of spatula measures of barium hydroxide	pH of mixture
0	1
1	1
2	1
3	1
4	3
5	8
6	12
7	13
8	13

Figure 13

Plot a graph of the pH of the mixture against the number of spatula measures of barium hydroxide.

(3)



(iv) Use the graph to find the pH of the mixture when 4.5 spatula measures of barium hydroxide are added.

(1)

pH of the mixture = ...

(c) Figure 14 shows a hazard symbol on the container of barium hydroxide.

Figure 14

What is the meaning of the hazard symbol in Figure 14?

(1)

- ☒ **A** corrosive
- ☒ **B** health hazard
- ☒ **C** oxidising
- ☒ **D** toxic

(d) The barium hydroxide was measured in spatulas.

State **one** way that the measuring of the barium hydroxide could be improved.

(1)

.....

.....

.....

(Total for Question 8 = 11 marks)

9 Sodium carbonate has the formula Na_2CO_3.

(a) Sodium carbonate contains Na^+ ions and CO_3^{2-} ions.

(i) The atomic number of sodium is 11.

What is the electronic configuration of the Na^+ ion?

(1)

☒ **A** 1

☒ **B** 2.8

☒ **C** 2.8.1

☒ **D** 2.8.2

(ii) Explain why solid sodium carbonate **cannot** conduct electricity but a solution of sodium carbonate **can** conduct electricity.

(3)

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.....

(b) Calculate the percentage by mass of sodium in sodium carbonate, Na_2CO_3.

$$\text{percentage by mass of element} = \frac{\text{total relative atomic mass of element}}{\text{relative formula mass of compound}} \times 100$$

(relative atomic masses: C = 12, O = 16, Na = 23)

(3)

.....

.....

.....

.....

percentage by mass of sodium = ...

*(c) A student has three solids, **A**, **B** and **C**.

The solids are sodium carbonate, powdered zinc and copper oxide, but the student does not know which solid is which.

The student reacted each solid with dilute sulfuric acid.

Figure 15 shows the student's observations and the results of tests on any gases produced.

	observations and results		
	reaction with dilute sulfuric acid	**gas bubbled through limewater**	**gas tested with a lit splint**
solid **A**	bubbles seen colourless solution formed	no change	squeaky pop
solid **B**	blue solution formed some black solid remains at bottom of test tube	no gas produced	no gas produced
solid **C**	bubbles seen colourless solution formed	limewater turned cloudy	puts out lit splint

Figure 15

Use the observations and results in Figure 15 to identify which solid is which.

Your answer should include

- how each test result helps you to identify the solid
- word equations to support your answer.

(6)

(Total for Question 9 = 13 marks)

10 (a) Titanium can be extracted from titanium oxide, TiO_2, by reaction with magnesium.

(i) 100 tonnes of titanium oxide was heated with magnesium.
The titanium formed in the reaction was separated and purified.
The mass of titanium was then determined.

The results are shown in Figure 16.

	mass in tonnes
mass of titanium oxide	100.00
mass of titanium produced	45.26
theoretical mass of titanium formed	60.00

Figure 16

Use the information in Figure 16 to calculate the percentage yield of titanium in this process.

$$\text{percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

Give your answer to 1 decimal place.

(3)

.....

.....

.....

.....

percentage yield = ...

(ii) Give **two** reasons why the percentage yield for **this process** is less than 100%.

(2)

1 .....

.....

2 .....

.....

(iii) The balanced equation for this process is

$$TiO_2 + 2Mg \rightarrow Ti + 2MgO$$

Calculate the atom economy of this process to produce titanium.

$$\text{atom economy (\%)} = \frac{\text{total formula mass of desired product}}{\text{total formula mass of all reactants or products}} \times 100$$

Give your answer to 2 significant figures.

(relative atomic masses: O = 16, Mg = 24, Ti = 48)

(3)

.....

.....

.....

atom economy = ...%

(b) Ethanol, C_2H_5OH, can be produced by two different methods.

- by the hydration of ethene, C_2H_4

  $C_2H_4 + H_2O \rightarrow C_2H_5OH$ atom economy = 100%

- and by the fermentation of a carbohydrate, e.g. sucrose, $C_{12}H_{22}O_{11}$

  $C_{12}H_{22}O_{11} + H_2O \rightarrow 4C_2H_5OH + 4CO_2$ atom economy = 51.1%

(i) State why the hydration of ethene has an atom economy of 100%.

(1)

.....

.....

(ii) Explain how the atom economy of the fermentation reaction can be improved.

(2)

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(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS

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Pearson Edexcel Level 1/Level 2 GCSE (9–1)

Friday 17 May 2024

Paper reference **1CH0/1F**

Chemistry

PAPER 1

Foundation Tier

Periodic Table Insert

Do not return this Insert with the question paper.

Turn over ▶

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F:1/1/1/1/1/1/1/

P 7 4 4 2 1 A

Pearson

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

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

* The elements with atomic numbers from 58 to 71 are omitted from this part of the periodic table.

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