Write your name here

Surname	Other names

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

Centre Number	Candidate Number

Chemistry

Paper 1

Foundation Tier

Sample Assessment Materials for first teaching September 2016
Time: 1 hour 45 minutes

Paper Reference
1CH0/1F

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.*
- 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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S 5 0 0 4 5 A 0 1 3 2

PEARSON

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

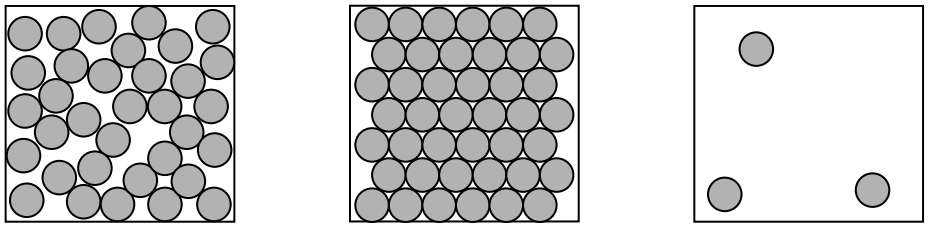
Some questions must be answered with a cross in a box ☒.
If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 There are three states of matter, solid, liquid and gas.

(a) The three boxes in Figure 1 show the arrangement of particles in different states.

(i) Under each box write the name of the state of matter shown.

(2)



....

Figure 1

(ii) A student is given some solid wax.

Use words from the box to name **two** pieces of equipment that the student should use to convert the solid wax into a liquid.

Bunsen burner	test tube	filter funnel
burette	pipette	

(2)

1 .....

2 .....

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(b) Some liquid is left in a warm room.

After a few days no liquid can be seen.

Give the name of the process that has occurred.

(1)

.....

(c) The freezing point of water is 0 °C.

(i) Describe how the movement and arrangement of water particles changes when water is cooled from 10 °C to –10 °C.

(2)

.....

.....

.....

.....

(ii) What is the structure of water?

(1)

☒ **A** ionic

☒ **B** simple molecular (covalent)

☒ **C** giant covalent

☒ **D** metallic

(Total for Question 1 = 8 marks)

2 Ammonium phosphate and ammonium sulfate are made from ammonia.

These compounds can be used as fertilisers.

(a) Ammonia solution is alkaline.

Which of the following could be used to show that ammonia solution is alkaline?

(1)

☒ **A** conical flask

☒ **B** pH meter

☒ **C** pipette

☒ **D** thermometer

(b) Give **one** advantage of using fertilisers made from ammonia rather than using manure.

(1)

.....

.....

(c) The fertiliser ammonium phosphate was made by reacting ammonia solution with dilute phosphoric acid.

(i) In the first step, 25 cm^3 of dilute phosphoric acid was placed in a beaker.

Give the name of a piece of apparatus that could be used to measure out the 25 cm^3 dilute phosphoric acid.

(1)

.....

(ii) Complete the word equation for this reaction.

(1)

ammonia + ... → .....

(iii) Some ammonium phosphate solution was made.

Describe how pure, dry crystals of ammonium phosphate are obtained from the ammonium phosphate solution.

(2)

.....

.....

.....

.....

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(d) The formula of ammonium sulfate is $(NH_4)_2SO_4$.

What is the empirical formula of ammonium sulfate?

(1)

☒ **A** NHSO

☒ **B** NH_2SO_2

☒ **C** NH_4SO_4

☒ **D** $N_2H_8SO_4$

(Total for Question 2 = 7 marks)

3 Unreactive metals are found as uncombined metals in the Earth's crust.

(a) Which of the following metals is found uncombined in the Earth's crust?

(1)

☒ **A** aluminium

☒ **B** gold

☒ **C** sodium

☒ **D** zinc

(b) When iron oxide is heated with carbon, iron is produced.

(i) Complete the word equation for the reaction.

(2)

iron oxide + carbon → ..... + ...

(ii) What happens to the iron oxide during this reaction?

(1)

☒ **A** the iron oxide burns

☒ **B** the iron oxide is neutralised

☒ **C** the iron oxide is oxidised

☒ **D** the iron oxide is reduced

(c) Copper ore contains copper carbonate, $CuCO_3$.

In the first stage of the extraction process, the copper carbonate is decomposed by heating to form copper oxide, CuO, and carbon dioxide.

$$CuCO_3 \rightarrow CuO + CO_2$$

When 100 g of copper carbonate is decomposed completely in this way, it is found that the total mass of products is 100 g.

Give a reason why the starting mass of copper carbonate is **always** the same as the mass of the products formed.

(1)

.....

.....

(d) Zinc can be extracted from its ore by electrolysis or by heating the ore with carbon.

Give a reason for the method that is used.

(1)

.....

.....

(e) Figure 2 gives information about aluminium and tin.

metal	cost of 1 kg / £	amount in Earth's crust / %
aluminium	1.31	8
tin	12.60	0.0002

Figure 2

Give **two** reasons why it could be more important to recycle tin than to recycle aluminium. Use the information in Figure 2.

(2)

Reason 1

.....

.....

Reason 2

.....

.....

(Total for Question 3 = 8 marks)

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4 An electrolysis experiment is carried out on different solutions, **J**, **K** and **L**.

Electricity is passed through each solution as shown in Figure 3.

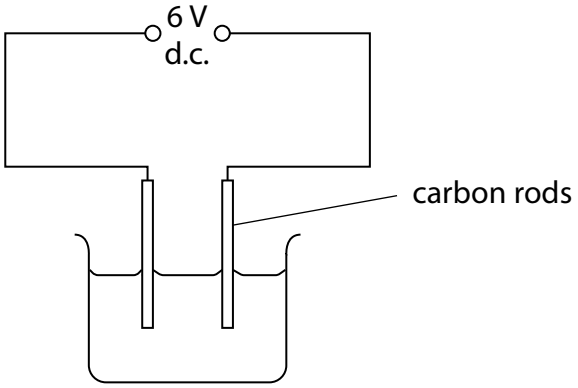

Figure 3

Any products formed at the electrodes are identified.

The results are given in Figure 4.

solution	solution conducts electricity	product at cathode	product at anode
J	yes	copper	chlorine
K	no	none	none
L	yes	hydrogen	chlorine

Figure 4

(a) (i) State an improvement that can be made to the circuit to show that a current is flowing during the electrolysis.

(1)

.....

Some of these solutions are electrolytes.

(ii) State what is meant by the term **electrolyte**.

(2)

.....

.....

.....

.....

(iii) Which of **J**, **K** and **L** are electrolytes?

(1)

☒ **A** **K** only

☒ **B** **J** and **L** only

☒ **C** **K** and **L** only

☒ **D** **J**, **K** and **L**

(b) Copper sulfate solution was electrolysed for five minutes using copper electrodes.

Figure 5 shows the mass of the anode and of the cathode before electrolysis and after electrolysis.

	anode	**cathode**
mass of electrode before electrolysis / g	1.16	1.28
mass of electrode after electrolysis / g	0.85	1.57

Figure 5

Calculate the mass of copper deposited.

(2)

mass of copper deposited = ... g

(c) Identify the products formed at the anode and cathode when molten potassium iodide is electrolysed.

(2)

Anode .....

Cathode .....

(d) In a different electrolysis, molten sodium fluoride is decomposed.

$$2NaF \rightarrow 2Na + F_2$$

(relative atomic masses: F = 19, Na = 23)
(relative formula mass NaF = 42)

Calculate the maximum mass of sodium that could be formed from 168 g of sodium fluoride.

(2)

mass = ... g

(Total for Question 4 = 10 marks)

5 (a) Give **two** advantages for electroplating some metal objects.

(2)

.....

.....

(b) Solder is an alloy of tin and lead.

A sample of a solder was made by mixing 22.5 g of lead with 15.0 g of tin.

Calculate the percentage of tin in this solder.

(2)

percentage of tin = ... %

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(c) The rusting of an iron nail was investigated by setting up three test tubes, as shown in Figure 6.

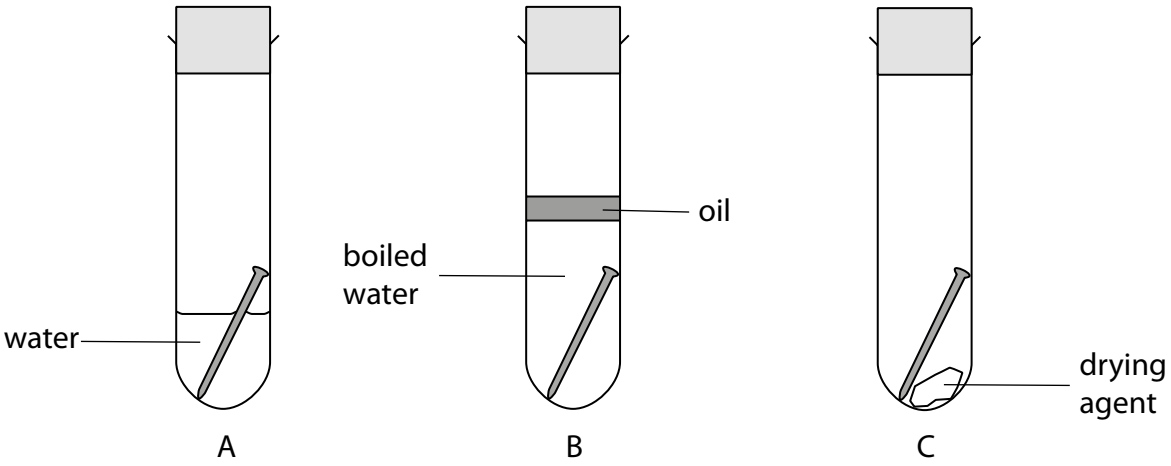

Figure 6

State and justify the result you would see in each tube after one week.

(3)

A .....

.....

B .....

.....

C .....

.....

(d) An iron bucket is coated in zinc.
Over many years of use, the iron bucket has been scratched and left outside in the rain. Although some of the zinc coating has been removed to expose iron, the iron bucket has not rusted.

Explain why the iron has not rusted.

(2)

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.....

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.....

(Total for Question 5 = 9 marks)

6 The apparatus in Figure 7 shows a piece of magnesium ribbon being heated.

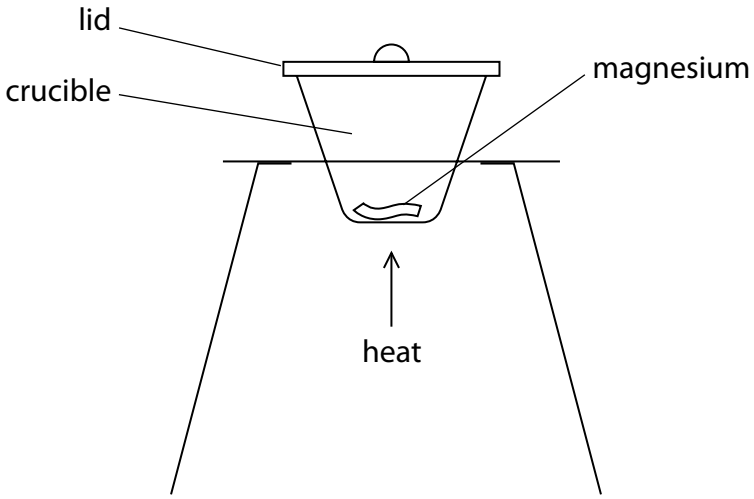


Figure 7

During the heating, the magnesium reacts with oxygen from the air. The lid of the crucible was raised slightly from time to time. Magnesium oxide was formed as a white powder. The experiment was repeated with different masses of magnesium.

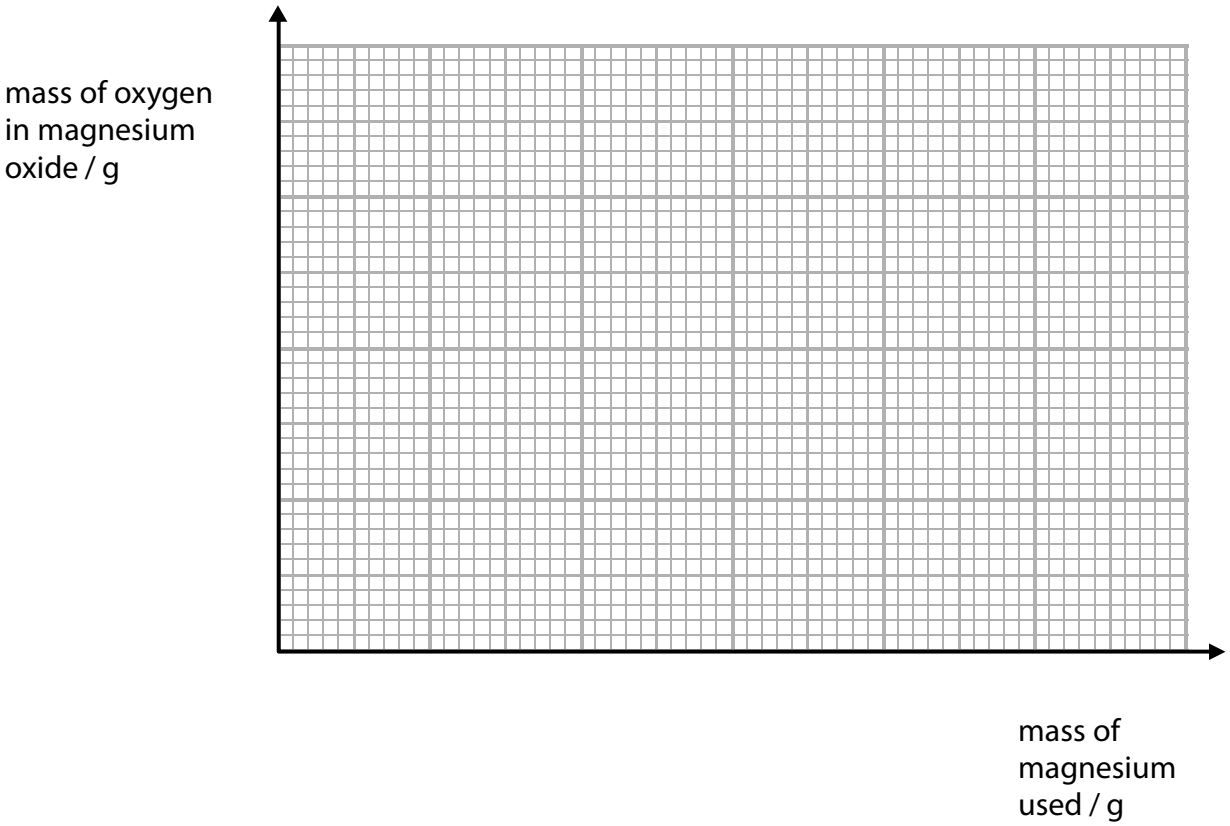
The results are shown in Figure 8.

experiment	mass of magnesium used / g	mass of magnesium oxide formed / g	mass of oxygen in magnesium oxide / g
1	0.10	0.16	0.06
2	0.15	0.24	0.09
3	0.25	0.40	0.15
4	0.30	0.48	0.18
5	0.35	0.49	0.14
6	0.50	0.80	0.30

Figure 8

(a) (i) Draw a graph of the mass of oxygen in magnesium oxide against the mass of magnesium used.

(3)



(ii) The result for experiment 5 is anomalous.
The masses were all measured accurately.

Suggest a reason for this anomalous result.

(1)

.....

.....

(b) Balance the equation for the reaction of magnesium with oxygen to form magnesium oxide.

(1)

..... Mg + ... O_2 → ..... MgO

(c) Calcium nitrate contains calcium ions and nitrate ions.

Calculate the relative formula mass of calcium nitrate, $Ca(NO_3)_2$.
(relative atomic masses: Ca = 40, N = 14, O = 16)

(2)

relative formula mass = ...

(d) Two oxides of lead, **R** and **S**, were analysed.

The empirical formula of oxide **R** was found to be PbO.

The results of the analysis of oxide **S** showed it contained 0.207 g of lead combined with 0.032 g of oxygen.

Show, by calculation, that the two oxides had different empirical formulae.
(relative atomic masses: O = 16, Pb = 207)

(3)

(Total for Question 6 = 10 marks)

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7 Substances can be pure or they can be mixtures.

(a) Which of these is a mixture?

(1)

☒ **A** chlorine

☒ **B** sodium

☒ **C** sodium chloride

☒ **D** sodium chloride solution

(b) Figure 9 shows some mixtures to be separated and possible methods of separation.

Place a tick (✓) in one box in each row of the table to show the best method to separate the first named substance from each of the mixtures.

(3)

substance to separate	method of separation			
	crystallisation	filtration	simple distillation	fractional distillation
sand from a mixture of sand and sodium chloride solution				
copper sulfate crystals from copper sulfate solution				
useful liquids from crude oil				

Figure 9

(c) Paper chromatography was used to separate a mixture of blue and red inks. A spot of the mixture was placed on chromatography paper as shown in Figure 10.

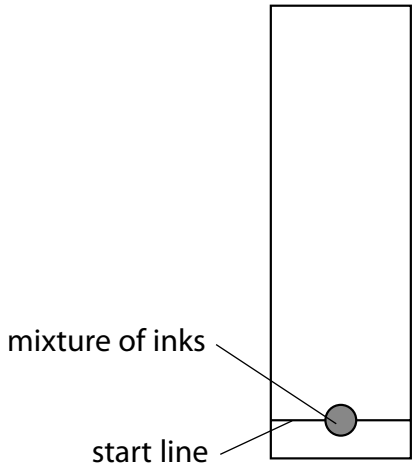

Figure 10

(i) Give a reason why the start line is drawn in pencil rather than in ink.

(1)

.....

.....

(ii) The chromatography paper, with the spot of mixture on it, was placed in a beaker with the bottom of the paper in solvent.

On Figure 11, complete the diagram showing the position of the chromatography paper with the spot of mixture at the start of the experiment.

(1)

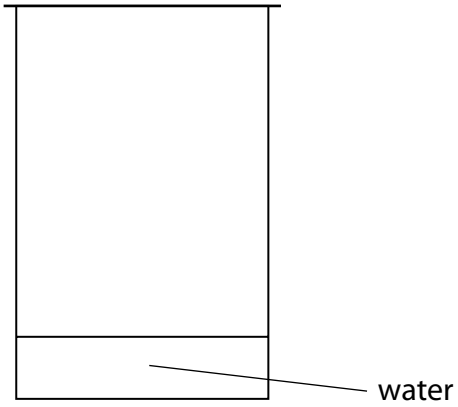

Figure 11

(iii) The chromatography was carried out and the result is shown in Figure 12.

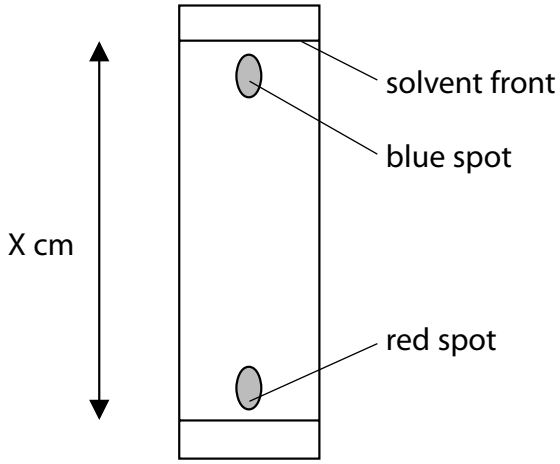

Figure 12

The blue spot had moved 14.5 cm and the solvent front had moved 15.3 cm.

Calculate the R_f value of the substance in the blue spot, giving your answer to 2 significant figures.

$$R_f \text{ value} = \frac{\text{distance travelled by a dye}}{\text{distance travelled by solvent front}}$$

(2)

R_f value = ...

(d) P, Q, R and S are mixtures of food colourings.

They are investigated using paper chromatography.

Figure 13 shows the chromatogram at the end of the experiment.

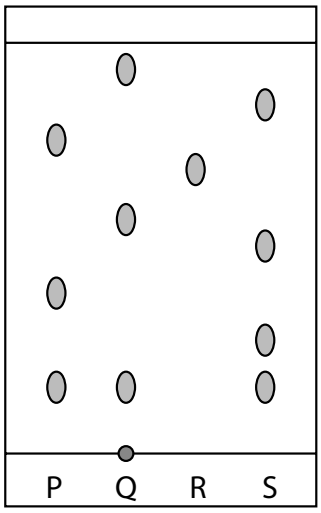

Figure 13

(i) Which mixture contains an insoluble food colouring?

(1)

☒ **A** mixture **P**

☒ **B** mixture **Q**

☒ **C** mixture **R**

☒ **D** mixture **S**

(ii) Give a change that could be made to the experiment to obtain an R_f value for the insoluble colouring.

(1)

.....

.....

(iii) Explain, by referring to Figure 13, which mixture is separated into the greatest number of soluble food colourings by this chromatography experiment.

(2)

.....

.....

.....

.....

(Total for Question 7 = 12 marks)

8 A titration is to be carried out to find the concentration of a solution of sodium hydroxide.

The sodium hydroxide solution is titrated with dilute sulfuric acid.

The available apparatus includes a burette, a pipette, a funnel, a conical flask and an indicator.

(a) State one safety precaution that must be taken when using sodium hydroxide solution and dilute sulfuric acid.

(1)

.....

.....

.....

(b) The sodium hydroxide solution is made by dissolving 4.3 g of sodium hydroxide in water and making the solution up to 250 cm^3 with water.

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

(2)

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

(c) Write the balanced equation for the reaction of dilute sulfuric acid, H_2SO_4, with sodium hydroxide.

(2)

.....

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(d) The results of titrations to determine how much of an acid is required to neutralise a given volume of an alkaline solution are shown in Figure 14.

	titration 1	titration 2	titration 3	titration 4
final burette reading (cm^3)	27	27.40	29.20	29.30
initial burette reading (cm^3)	0	2.10	4.00	3.50
volume of acid used (cm^3)	27	25.30	25.20	25.80

Figure 14

Two of the titrations in Figure 14 should **not** be used to calculate the mean volume of acid required.

Identify each titration and give a reason why it should not be used in the calculation of the mean.

(2)

.....

.....

.....

.....

*(e) Describe the experimental procedure to carry out a titration to find the exact volume of sulfuric acid needed to neutralise 25.0 cm^3 of sodium hydroxide solution and obtain pure, dry crystals of sodium sulfate.

(6)

(Total for Question 8 = 13 marks)

9 Ionic compounds contain ions.

(a) The numbers of electrons, neutrons and protons in four particles, **W**, **X**, **Y** and **Z**, are shown in Figure 15.

particle	electrons	neutrons	protons
W	9	10	9
X	10	14	12
Y	16	16	16
Z	18	18	16

Figure 15

Explain which particle, **W**, **X**, **Y** or **Z**, is a negative ion.

(2)

(b) Lithium fluoride, LiF, is an ionic compound.

It contains lithium cations and fluoride anions.

The electronic configurations of a lithium atom and of a fluorine atom are shown in Figure 16.

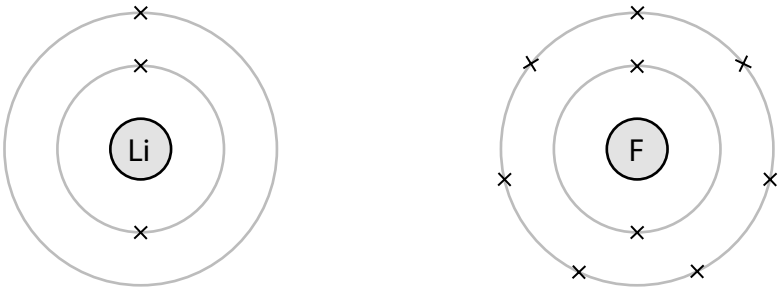

Figure 16

Complete Figure 17 to show the electronic configurations and charges of the ions in lithium fluoride.

(4)

charge on ion ..... charge on ion .....

Figure 17

*(c) Figure 18 shows the ability of different substances to conduct electricity.

substance	conducts electricity
solid calcium chloride	no
molten calcium chloride	yes
diamond	no
zinc	yes

Figure 18

Explain these results by referring to the structures of the substances.

(6)

(Total for Question 9 = 12 marks)

10 The method used to prepare a salt depends on its solubility in water.

(a) Complete Figure 19 by placing one tick in each row to show whether the salt is soluble or insoluble.

(2)

salt	soluble	insoluble
ammonium chloride		
lithium sulfate		
magnesium carbonate		

Figure 19

(b) Lead nitrate solution mixed with sodium sulfate solution forms lead sulfate as a precipitate.

$$Pb(NO_3)_2 + Na_2SO_4 \rightarrow PbSO_4 + 2NaNO_3$$

In an experiment, the theoretical yield of lead sulfate for this reaction was 2.85 g. In the experiment only 2.53 g of lead sulfate is obtained.

Calculate the percentage yield of lead sulfate in this experiment.

Give your answer to two significant figures.

(3)

percentage yield = ...%

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(c) The method used to make the lead sulfate is:

- pour 100 cm^3 lead nitrate solution into a beaker
- add drops of sodium sulfate solution until a precipitate is seen
- allow the precipitate to settle to the bottom of the beaker
- pour off the liquid
- use a spatula to transfer the solid lead sulfate onto a filter paper.

Explain **two** ways of improving this experimental method in order to increase the amount and quality of lead sulfate that could be obtained from 100 cm^3 of lead nitrate solution.

(4)

(d) Ammonium nitrate is produced from ammonia and nitric acid on a large scale in industry.

Ammonium nitrate can also be made in the laboratory by titrating ammonia solution with dilute nitric acid.

$$NH_3 + HNO_3 \rightarrow NH_4NO_3$$

Ammonium nitrate crystals can then be obtained by evaporating off some of the water from the solution.

Give **two** reasons why this laboratory method is not suitable for use on a large scale in industry.

(2)

.....

.....

.....

.....

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS

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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.

Paper 1 Foundation

Question number	Answer	Mark
1(a)(i)	liquid solid gas • all three correct (2) • one/two correct (1)	(2)

Question number	Answer	Mark
1(a)(ii)	• Bunsen burner (1) • test tube (1)	(2)

Question number	Answer	Additional guidance	Mark
1(b)	evaporation	do not accept 'boiling'	(1)

Question number	Answer	Mark
1(c)(i)	An answer that provides a description by making reference to **two** of the following points: • molecules become closer (1) • molecules lose energy (1) • molecules slow down (1)	(2)

Question number	Answer	Mark
1(c)(ii)	B	(1)

Question number	Answer	Mark
2(a)	B	(1)

Question number	Answer	Mark
2(b)	Any **one** advantage from: • reliable composition of fertiliser • produced in large quantities as required • all soluble therefore fertiliser will reach roots as required	(1)

Question number	Answer	Additional guidance	Mark
2(c)(i)	measuring cylinder	allow burette or pipette	(1)

Question number	Answer	Mark
2(c)(ii)	(ammonia) + phosphoric acid → ammonium phosphate	(1)

Question number	Answer	Mark
2(c)(iii)	An answer that combines the following points of application of knowledge and understanding to provide a logical description: • first heat the solution/leave water to evaporate (1) • and then filter off/dry crystals formed (1)	(2)

Question number	Answer	Mark
2(d)	D	(1)

Question number	Answer	Mark
3(a)	B	(1)

Question number	Answer	Mark
3(b)(i)	• iron (1) • carbon dioxide/carbon monoxide (1)	(2)

Question number	Answer	Mark
3(b)(ii)	D	(1)

Question number	Answer	Mark
3(c)	all the original atoms have simply been rearranged in the products.	(1)

Question number	Answer	Mark
3(d)	heating with carbon is used as it is cheaper than using electrolysis.	(1)

Question number	Answer	Mark
3(e)	• tin costs {much/about 10 times} more than aluminium (1) • amount of tin in Earth much smaller than the amount of aluminium (1)	(2)

Question number	Answer	Mark
4(a)(i)	• connect {lamp/ammeter} in series (1)	(1)

Question number	Answer	Mark
4(a)(ii)	• a substance that conducts electricity (1) • when molten or in aqueous solution (1)	(2)

Question number	Answer	Mark
4(a)(iii)	B	**(1)**

Question number	Answer	Additional guidance	Mark
4(b)	• copper is deposited on the cathode, therefore mass deposited = 1.57 – 1.28 (1) • = 0.29 (g) (1)	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Mark
4(c)	• iodine at the anode (1) • potassium at the cathode (1)	**(2)**

Question number	Answer	Mark
4(d)	• 84 g sodium fluoride → 46 g of sodium (1) • so 168 g sodium fluoride → 92 g of sodium (1) **or** • 168 ÷ 42 = 4 (mol NaF) (1) • 4 × 23 = 92 (g) (1)	**(2)**

Question number	Answer	Mark
5(a)	• improve appearance (1) • help prevent corrosion (1)	**(2)**

Question number	Answer	Additional guidance	Mark
5(b)	% of tin in alloy = $\frac{15.0}{(15.0+22.5)} \times 100$ (1) = 40.0 (%) (1)	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Mark
5(c)	• A will rust, as there is air/oxygen and water present (1) • B will not rust, as there is no air/oxygen present (1) • C will not rust, as no water is present (1)	**(3)**

Question number	Answer	Mark
5(d)	An explanation that combines identification – application of knowledge (1 mark) and reasoning/justification – application of understanding (1 mark): • (iron has not rusted because) zinc is more reactive than iron (1) • so zinc corrodes instead of iron (1)	**(2)**

Question number	Answer	Additional guidance	Mark
6(a)(i)	• axes with linear scale that use more than half of each edge of the grid (1) • all points correctly plotted to ± half a square (1) • single straight line passing through all points except result 5 (1)	5 points plotted correctly (i.e. one error) allow ecf from plotting error	**(3)**

Question number	Answer	Mark
6(a)(ii)	Any **one** reason from: • not all magnesium reacted • incomplete reaction • some magnesium oxide lost	**(1)**

Question number	Answer	Mark
6(b)	**2**Mg + O_2 → **2**MgO/Mg + $\frac{\mathbf{1}}{\mathbf{2}}O_2$ → MgO	**(1)**

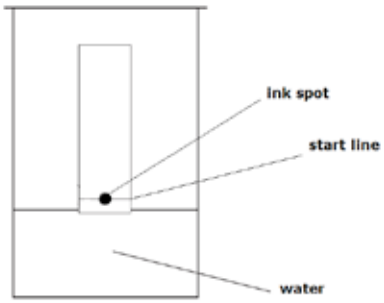
Question number	Answer	Additional guidance	Mark
6(c)	40 + 2 × (14 + 16 × 3) (1) = 164 (1)	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Mark
6(d)	• divide mass by relative atomic mass: lead $\frac{0.207}{207}=0.001$, oxygen $\frac{0.032}{16}=0.002$ (1) • divide by the smaller: $\frac{0.001}{0.001}=1$, $\frac{0.002}{0.001}=2$ (1) empirical formula PbO_2 which is different to that of compound R (1)	**(3)**

Question number	Answer	Mark
7(a)	D	**(1)**

<table>
<tr><th>Question number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>7(b)</td><td>One mark for each correct row.
<table>
<tr><th rowspan="2">substance to separate</th><th colspan="4">method of separation</th></tr>
<tr><th>crystallisation</th><th>filtration</th><th>simple distillation</th><th>fractional distillation</th></tr>
<tr><td>sand from a mixture of sand and sodium chloride solution</td><td></td><td>✓</td><td></td><td></td></tr>
<tr><td>copper sulfate crystals from copper sulfate solution</td><td>✓</td><td></td><td></td><td></td></tr>
<tr><td>useful liquids from crude oil</td><td></td><td></td><td></td><td>✓</td></tr>
</table></td><td>(3)</td></tr>
</table>

Question number	Answer	Mark
7(c)(i)	pencil is insoluble in the solvent (but chromatography would separate the ink in an ink line)	**(1)**

Question number	Answer	Mark
7(c)(ii)	Correct position of chromatography paper with start line and ink spot above surface of water  	**(1)**

Question number	Answer	Additional guidance	Mark
7(c)(iii)	• R_f = 14.5 / 15.3 = 0.9477 (1) • = 0.95 answer to 2 significant figures (1)	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Mark
7(d)(i)	B	**(1)**

Question number	Answer	Mark
7(d)(ii)	use a different solvent.	**(1)**

Question number	Answer	Mark
7(d)(iii)	an explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • mixture S (1) • because it gives the greatest number of spots/gives four spots (1)	**(2)**

Question number	Answer	Mark
8(a)	any **one** precaution from: • wear gloves to prevent contact with skin/safety (1) • spectacles to prevent contact with eyes (1)	**(1)**

Question number	Answer	Additional guidance	Mark
8(b)	1000 cm^3 contain $\frac{4.3 \times 1000}{250}$ (1) 1 dm^3 contains 17.1 ($g\,dm^{-3}$) (1)	Award full marks for correct numerical answer without working.	**(2)**

Question number	Answer	Additional guidance	Mark
8(c)	$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ • correct formulae (1) • balancing (1)	Do not award 2 if incorrect balancing added.	**(2)**

Question number	Answer	Mark
8(d)	• {titration 1/27 cm^3} should not be used because burette readings {not precise/not accurate/not read to 2 d.p.} (1) • {titration 4/25.80 cm^3} should not be used because volume of used (25.80 cm^3) not concordant with other two (1)	**(2)**

Question number	Indicative content
*8(e)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO1 (6 marks)** • rinse pipette with alkali and burette with acid • measure alkali using a pipette into suitable container e.g. flask/beaker and place flask on a white tile • add a few drops of indicator/suitable named indicator (eg methyl orange/phenolphthalein) • fill burette with acid and read volume of acid in burette • add acid from burette to the flask slowly swirling the flask until {indicator just changes colour/correct colour change for named indicator (eg methyl orange yellow to peach/orange, phenolphthalein pink to colourless)/solution is neutral} • read volume of acid in burette at end of titration • repeat experiment until concordant results • mix the same volume of alkali with the volume of acid determined from the titration but do not add indicator • pour solution into an evaporating basin then {heat solution/leave the water to evaporate} until pure salt crystals are left • dry crystals using absorbent paper

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) • Presents a description which is not logically ordered and with significant gaps. (AO1)
Level 2	3-4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) • Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) • Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)

Question number	Answer	Additional guidance	Mark
9(a)	An explanation that combines identification via a judgement (1 mark) to reach a conclusion via justification/reasoning (1 mark): • a negative ion must have more electrons than protons in the particle (1) • therefore Z will have a 2– charge (1)	Do not allow any comparison involving neutrons.	**(2)**

Question number	Answer	Mark
9(b)	• Li ion with empty outer shell (1) • 1+ charge on Li (1) • 8 electrons on outer shell of F (1) • 1– charge on F (1)	**(4)**

Question number	Indicative content
*9(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. **AO2 (6 marks)** • solid calcium chloride contains ions/cations/anions which are charged particles • solid calcium chloride does not conduct because charged particles are not free to move because they are held together by strong electrostatic forces/ionic bonds in lattice • molten calcium chloride solution conducts because ions/cations/anions are present which are charged particles and are free to move • the ions have separated and move to electrode of opposite charge • diamond does not conduct because it is giant molecular covalent with no free electrons • outer electrons of carbon atoms used in bonding • zinc metallic structure consists of delocalised free electrons which can move between layers of metals atoms/cations

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	• The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2) • Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3-4	• The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2) • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5-6	• The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO4) • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)

Question number	Answer	Mark
10(a)	<table><tr><th>salt</th><th>soluble</th><th>insoluble</th></tr><tr><td>ammonium chloride</td><td>✓</td><td></td></tr><tr><td>lithium sulfate</td><td>✓</td><td></td></tr><tr><td>magnesium carbonate</td><td></td><td>✓</td></tr></table> • All three correct (2) • Any two correct (1)	**(2)**

Question number	Answer	Additional guidance	Mark
10(b)	• mass values in correct places (1) • multiplication by 100 (1) • correct final answer to two significant figures (1)	$\frac{2.53}{2.85} \times 100 = 88.8\%$ 89% (to 2 s.f.) award full marks for correct numerical answer without working	**(3)**

Question number	Answer	Mark
10(c)	An explanation that combines identification – improvement of the experimental procedure (maximum 2 marks) and justification/reasoning, which must be linked to the improvement (maximum 2 marks): • add excess sodium sulfate solution rather than a few drops (1) • so more reaction occurs to form more lead sulfate (1) • filter the reaction mixture rather than pour off the liquid (1) • so none of the lead sulfate is lost on separation (1) • wash the lead sulfate (1) • so the impurities are removed (1) • place the lead sulfate in an oven/warm place (1) • so the lead sulfate is dry (1)	**(4)**

Question number	Answer	Mark
10(d)	• volumes of solution too large for titration method (1) • large volumes of liquid need to be heated and then allowed to crystallise (1)	**(2)**