Please check the examination details below before entering your candidate information

Candidate surname	Other names

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

Centre Number	Candidate Number

Thursday 16 May 2019

Morning (Time: 1 hour 45 minutes) | Paper Reference **1CH0/1F**

Chemistry

Paper 1

Foundation Tier

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.
- There is a periodic table on the back cover of the paper.

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 ▶

1/1/1/1/1/1/

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 The three states of matter are solid, liquid and gas.

(a) What is the name of the change of state when a liquid changes into a solid?

(1)

☐ **A** condensation

☐ **B** evaporation

☒ **C** freezing

☐ **D** melting

(b) A gas was left to cool to form a liquid.

Figure 1 shows how the temperature of the substance changed with time.

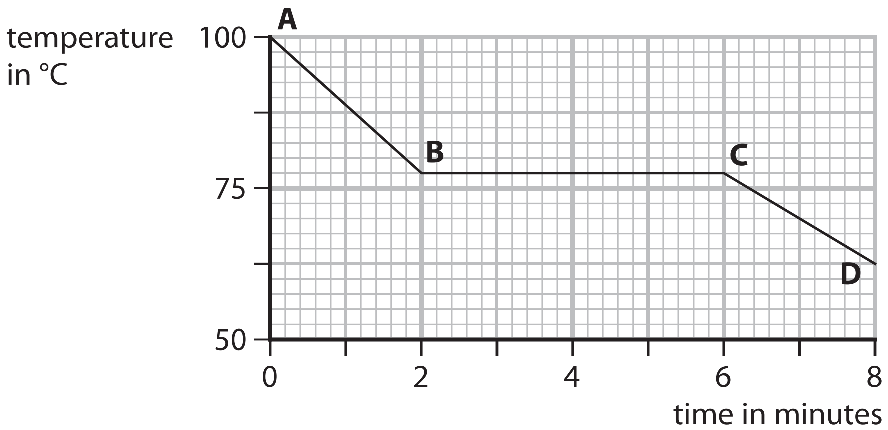


Figure 1

From **A** to **B** the substance is a gas.

From **C** to **D** the substance is a liquid.

(i) State the time when the gas first started to form a liquid.

(1)

2 .... minutes

(ii) Calculate the number of minutes it took from the gas first starting to form a liquid until the substance was completely liquid.

(1)

....

4 .... minutes

(c) Figure 2 shows the melting points and boiling points of four substances, **W**, **X**, **Y** and **Z**.

substance	melting point in °C	boiling point in °C
W	−220	−188
X	−101	−34
Y	−7	59
Z	114	184

Figure 2

Using the information in Figure 2

(i) give the letter of the substance that is a solid at 20 °C

(1)

Z ....

(ii) give the letter of a substance that is a liquid at 50 °C

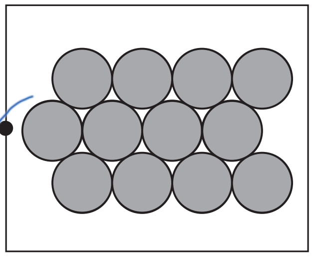
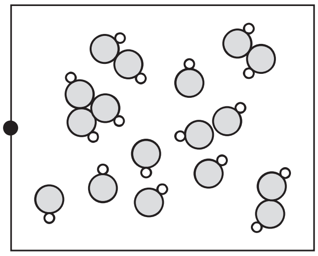
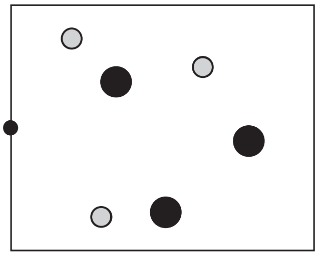
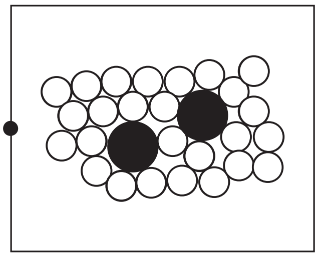
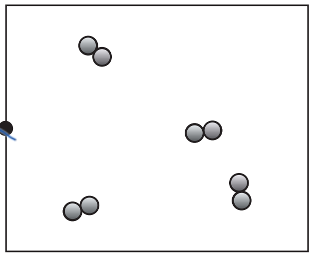
(1)

Y ....

(d) The diagrams below show particles in five different structures.
The different circles show different particles.

Draw one straight line from each substance to its structure.

(2)

substance	**particles in structures**
solid zinc metal, Zn(s)	
	
	
hydrogen gas, H_2(g)	
	

(Total for Question 1 = 7 marks)

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P 5 6 4 0 6 A 0 5 3 6

2 Alloys are mixtures of two or more metals.

(a) Alloy steels are formed when other metals are mixed with iron.

Cutlery is made of stainless steel.

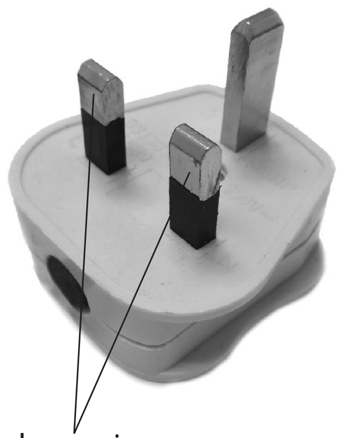
Give **two** reasons why cutlery is made of stainless steel rather than iron.

(2)

1 stainless steel does not {rust / corrode} ORA

2 stainless steel is stronger ORA

(b) Brass is an alloy of copper.
Figure 3 shows the brass pins of an electric plug.



(Source: © Adamlee01/Shutterstock)

Figure 3

Brass is harder than copper.

Give a reason why using a harder substance for the pins is an advantage.

(1)

pins do not bend

(c) Magnalium is an alloy of magnesium and aluminium.
It is often used for aircraft parts.

(i) Figure 4 shows information about pure aluminium and magnalium.

substance	density in g cm^{-3}	relative strength	resistance to corrosion
aluminium	2.7	low	high
magnalium	2.0	high	very high

Figure 4

Explain, using the information in Figure 4, why magnalium, rather than pure aluminium, is used for aircraft parts.

(3)

magnalium has a lower density than aluminium

magnalium is stronger than aluminium ORA

magnalium has a higher resistance to corrosion than aluminium ORA

(ii) 63.0 g of magnalium contains 3.15 g of magnesium.

Calculate the percentage by mass of magnesium in the magnalium.

(2)

$\frac{3.15 \times 100}{63.0}$

=5.0

percentage of magnesium in the magnalium = ...

(Total for Question 2 = 8 marks)

3 (a) Transition metals and group 1 metals have many properties in common because they are all metals.

However some properties of transition metals are different from properties of group 1 metals.

Which is a property of transition metals but not of group 1 metals?

(1)

☐ **A** good conductor of electricity

☒ **B** high melting point

☐ **C** malleable

☐ **D** shiny when cut or polished

(b) Copper is a transition metal.

Magnesium reacts with copper sulfate solution to form copper and a solution of magnesium sulfate.
Magnesium sulfate solution is colourless.

Describe **two** changes you would **see** during this reaction.

(2)

1 colourless solution forms

2 red-brown solid forms

(c) Rusting is the corrosion of iron.

(i) Water is one of two substances needed for iron to rust.

Give the name of the **other** substance needed for iron to rust.

(1)

Oxygen

(ii) The rate of rusting can be increased by using sea water.

Describe a simple experiment to compare how much an iron nail rusts in sea water when compared to water.

(3)

Clean iron nails
place a nails into test tubes of water and sea water
leave test tubes for a period of time
observe the tubes and record any
changes to compare {appearance/mass}

(iii) Rusting can be prevented by galvanising iron which involves coating the iron with a layer of zinc.

A small iron bucket was galvanised. The surface area of the bucket was $0.68\,m^2$.

Calculate the mass of zinc required to coat the surface of the bucket with a layer of zinc of $200\,g\,m^{-2}$.

(1)

0.68 x 100 (1)
=136 (g)

mass of zinc = ... g

(Total for Question 3 = 8 marks)

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4 Mixtures of substances can be separated using different techniques.

(a) Which of the following is a mixture of substances?

(1)

☒ **A** air

☐ **B** carbon dioxide

☐ **C** gold

☐ **D** titanium

(b) Figure 5 shows the apparatus that a student set up to obtain pure water from ink.

There are three mistakes in the way the apparatus has been set up.

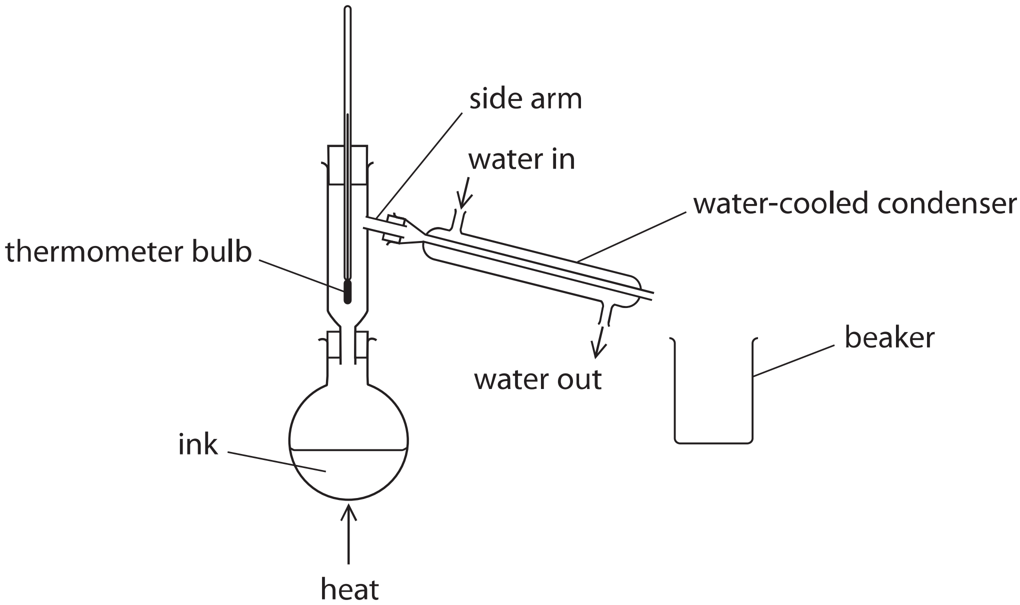

Figure 5

(i) One mistake is that the bulb of the thermometer is too low.

The bulb of the thermometer should be level with the side arm.

Give a reason why the bulb of the thermometer should be level with the side arm.

(1)

to measure the temperature of water vapour / steam passing into the condenser

....

(ii) State **one** other mistake in Figure 5.

(1)

beaker not under condenser exit

....

(c) Paper chromatography is used to separate the substances in five different food colourings, **P**, **Q**, **R**, **S** and **T**.

Figure 6 shows the chromatogram at the end of the experiment.

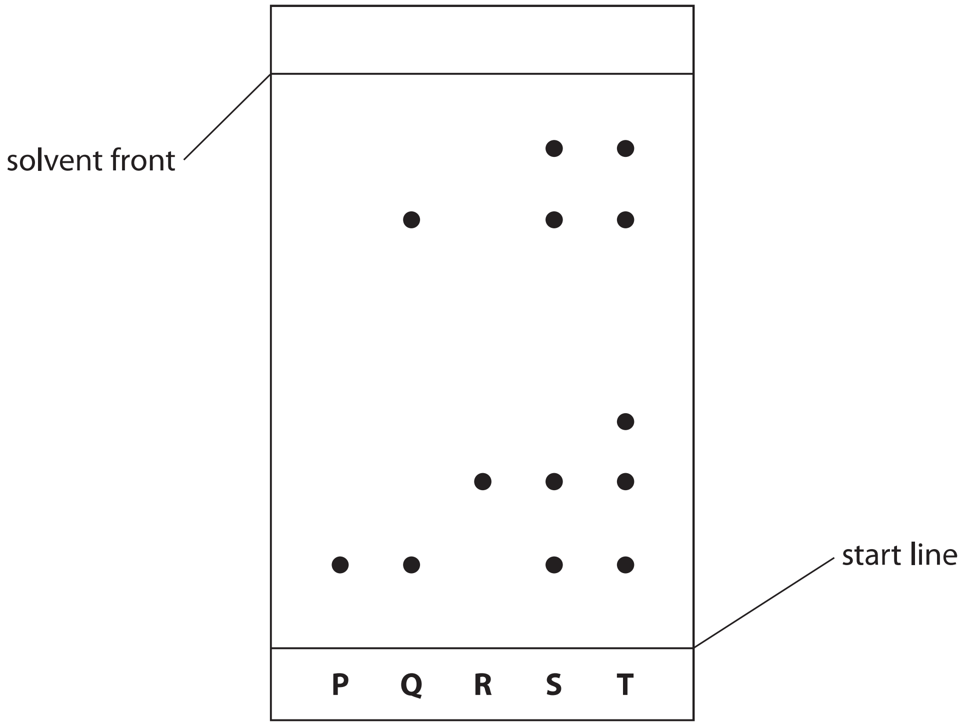

Figure 6

(i) The steps needed to carry out the chromatography experiment are listed below. They are not in the correct order.

1 leave the solvent to rise up the paper
2 put solvent in the beaker
3 draw a start line on the piece of paper
4 place the paper in the beaker
5 remove the paper when the solvent is near the top
6 put small spots of the food colourings on the start line

List the steps in the correct order.

The first two steps have been done for you.

(2)

2	**3**	6	4	1	5

(ii) Explain, using Figure 6, which food colouring contains the greatest number of coloured substances.

(2)

• mixture T

• because it gives {the greatest number / 5} spots

(iii) During chromatography of the food colourings, the solvent front moved 8.00 cm and the food colouring **R** moved 2.30 cm.

Calculate the R_f value for food colouring **R**.
Give your answer to two significant figures.

(2)

$R_f = \frac{2.30}{8.00}$

$= 0.2875$

$= 0.29$

R_f value = ...

(Total for Question 4 = 9 marks)

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5 (a) The reactivity of copper, magnesium and zinc was investigated.
Each metal was placed separately in dilute hydrochloric acid.
The amount of effervescence was observed.

(i) The same mass of metal was used in each experiment.
Which piece of apparatus should be used to find the mass of metal used?

(1)

- [x] **A** a balance
- [ ] **B** a pipette
- [ ] **C** a stopwatch
- [ ] **D** a thermometer

(ii) State **two** variables, apart from the mass of the metals, that should be controlled in this investigation.

(2)

1 Same volume of acid

2 Same concentration of acid

(iii) Magnesium produces the most vigorous effervescence.
Copper does not produce any effervescence.

Give the reason why copper does not produce any effervescence.

(1)

Copper is unreactive

(iv) The magnesium reacts with dilute hydrochloric acid to form magnesium chloride solution and hydrogen gas.

The equation for the reaction is

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

Fill in the missing state symbols in the spaces provided.

(2)

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(b) Potassium carbonate reacts with dilute sulfuric acid to form potassium sulfate.

(i) Potassium sulfate contains potassium ions, K^+, and sulfate ions, SO_4^{2-}.

Write the formula of potassium sulfate.

(1)

K2SO4

(ii) Equal volumes of a solution of potassium carbonate were reacted separately with an excess of dilute sulfuric acid solution.
Pure dry samples of potassium sulfate were obtained from the resulting solutions.

The experiment was repeated three times using the same conditions.

The masses of potassium sulfate obtained were

experiment 1 = 5.22 g
experiment 2 = 5.24 g
experiment 3 = 5.21 g

Calculate the mean mass of potassium sulfate obtained, giving your answer to two decimal places.

(2)

5.22+5.24+5.21
3

=5.2233

mean mass of potassium sulfate = ... g

(Total for Question 5 = 9 marks)

6 Metals are extracted from substances naturally occurring in the Earth's crust.

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

(1)

- ☐ **A** calcium
- ☒ **B** gold
- ☐ **C** iron
- ☐ **D** magnesium

(b) Zinc can be extracted by heating zinc oxide with carbon.

The products are zinc and carbon dioxide.

(i) Write the word equation for this reaction.

(2)

zinc oxide + carbon → zinc + carbondioxide

(ii) In this reaction zinc oxide loses oxygen.

State the type of reaction taking place when an oxide loses oxygen.

(1)

Reduction

(c) Aluminium is extracted from aluminium oxide by electrolysis.
Aluminium oxide is made up of ions.

(i) The formula of aluminium oxide is Al_2O_3.

Give the number of ions in the formula Al_2O_3.

(1)

5

(ii) Complete the balanced equation for the overall reaction by putting numbers in the spaces.

(2)

$2Al_2O_3 \rightarrow$ 4 Al + 3 O_2

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(d) (i) The environmental impact of a product is assessed in a life-cycle assessment.

The stages in this assessment are given below.
They are not in the correct order.

A disposal of the product
B manufacturing the product
C obtaining and processing the raw materials
D using the product

List the stages of the life-cycle assessment, using letters **A**, **B**, **C**, **D**, in the correct order from start to finish.

(2)

C	B	D	A

(ii) Aluminium can be obtained by recycling aluminium waste.

Give **two** advantages of obtaining aluminium by recycling aluminium waste rather than mining the raw material and extracting aluminium from that raw material.

(2)

1 conserves natural reserves of raw materials.

less damage to {landscape / habitats}

2

(Total for Question 6 = 11 marks)

P 5 6 4 0 6 A 0 1 7 3 6

Turn over

7 (a) Fertilisers contain compounds that promote plant growth.

(i) State the name of an element in these compounds that promotes plant growth. **(1)**

Phosphorus

(ii) Potassium nitrate is present in some fertilisers.

Potassium nitrate is formed by the reaction of potassium hydroxide solution with nitric acid.

Complete the balanced equation for this reaction. **(2)**

$KOH + HNO_3 \rightarrow$ KNO3 + H2O

(b) In the Haber process, hydrogen and nitrogen react to form ammonia.

hydrogen + nitrogen $\rightleftharpoons$ ammonia

(i) The $\rightleftharpoons$ symbol in the word equation shows that the reaction goes forwards and backwards at the same time.

Give the name of this type of reaction. **(1)**

Reversible

(ii) State the formula of a molecule of ammonia. **(1)**

NH3

(iii) Figure 7 shows a graph of world ammonia production, in millions of tonnes, from 1945 to 2015.

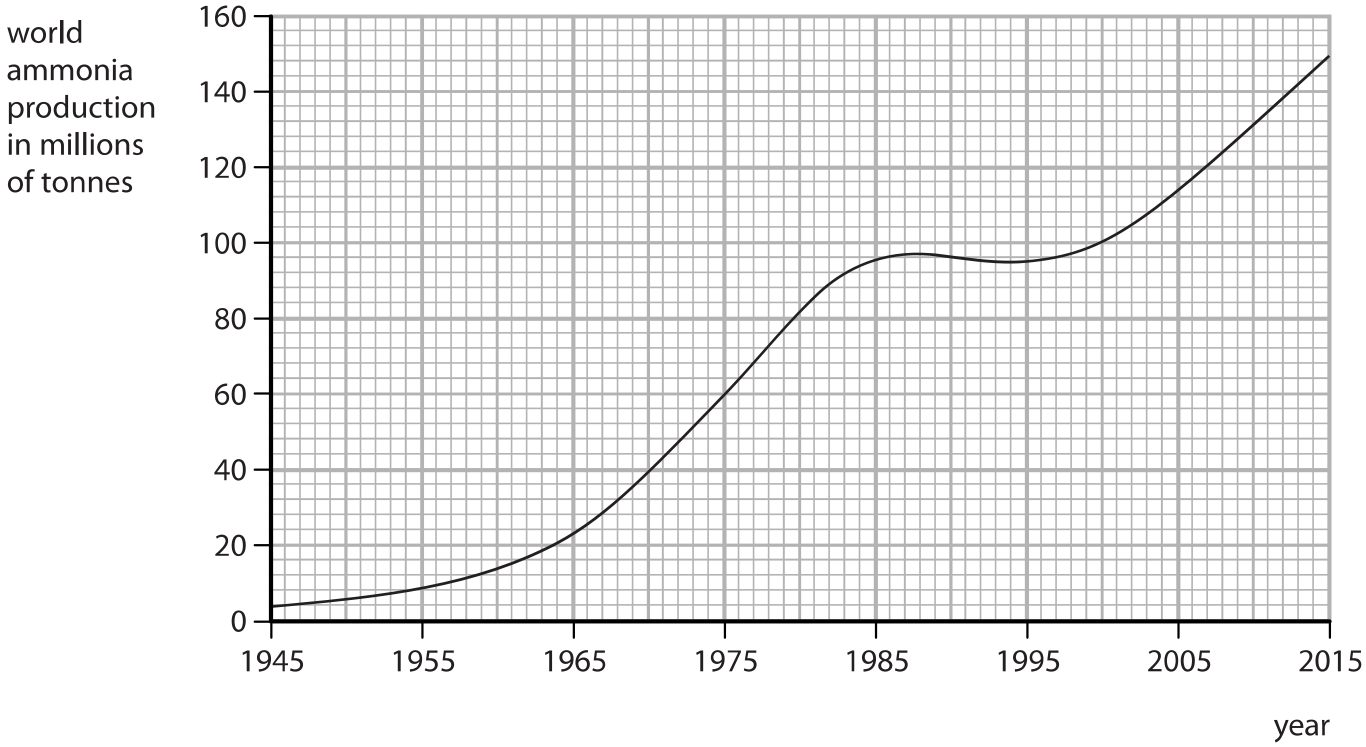

Figure 7

State the overall trend in world ammonia production from 1945 to 2015.

(1)

world ammonia production increases over time

(c) Hydrogen can also be used in a hydrogen-oxygen fuel cell.

Give the name of the product formed in this fuel cell.

(1)

Water

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P 5 6 4 0 6 A 0 1 9 3 6

Turn over

*(d) Ammonia solution and dilute sulfuric acid are used to prepare pure, dry ammonium sulfate crystals.

In an experiment a titration is carried out to determine the volumes of ammonia solution and dilute sulfuric acid that react together.
Then an ammonium sulfate solution is prepared from which the pure, dry crystals are obtained.

Describe in detail, using suitable apparatus, how this experiment should be carried out.

(6)

- pipette to measure out the ammonia solution (25 cm^3)
- into a suitable container, e.g. conical flask
- add few drops of methyl orange indicator
- put flask on a white tile
- fill burette with sulfuric acid solution
- read level of liquid in burette
- add acid from the burette
- swirl flask gently / mix
- add drop-wise near end-point
- until {indicator just changes colour}
- read level on burette
- repeat experiment until concordant results owtte
- mix the same volumes of sulfuric acid and ammonia solution (determined from the titration experiment)
- but leaving out the indicator/methyl orange
- pour solution into an evaporating dish
- heat the solution to point of crystallisation
- leave to cool
- filter off crystals
- leave to dry

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(Total for Question 7 = 13 marks)

8 In Figure 8, the letters **A**, **E**, **G**, **J**, **X** and **Z** show the positions of six elements in the periodic table.

These letters are not the symbols of the atoms of these elements.

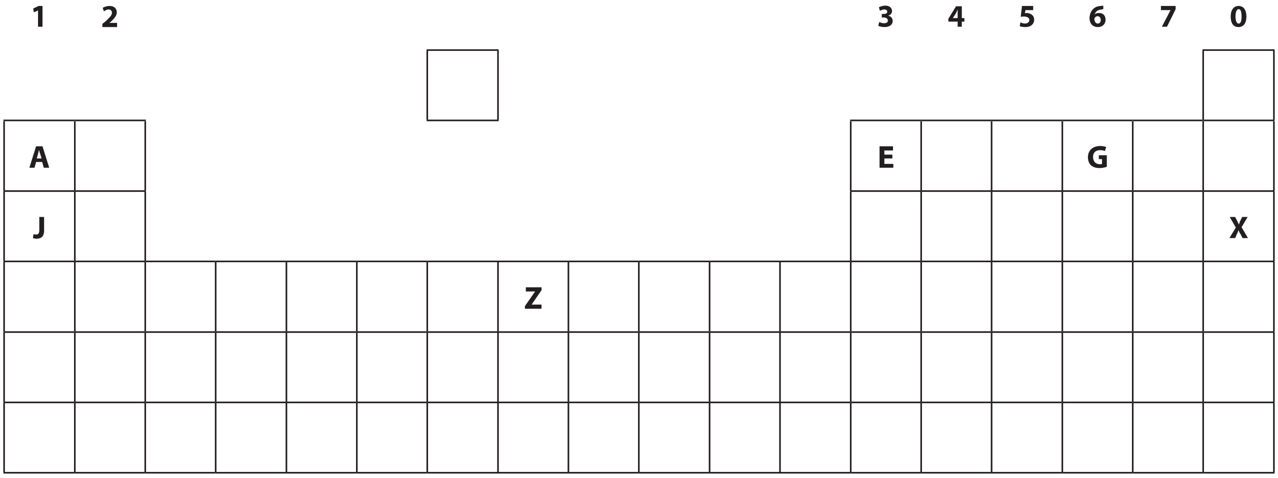


Figure 8

(a) Using the letters **A**, **E**, **G**, **J**, **X** and **Z**

(i) give the letters of the **two** elements that are non-metals

(1)

E, G

(ii) give the letters of **two** elements in period 2

(1)

A, E

(iii) give the letter of an element that normally forms an ion with a charge of +1.

(1)

A/J

(b) Element **E** has an atomic number of 5.
In a sample of **E** there are two isotopes. One isotope has a mass number of 10 and the other isotope has a mass number of 11.

(i) Explain, in terms of subatomic particles, what is meant by the term **isotopes**.

(2)

• (atoms with) same number of protons

• (atoms with) different number of neutrons

(ii) All atoms of element **E** in this sample contain **(1)**

- ☒ **A** 5 protons
- ☐ **B** 5 neutrons
- ☐ **C** 6 protons
- ☐ **D** 6 neutrons

(c) Element **X** has an atomic number of 18.

State the electronic configuration of an atom of element **X**. **(1)**

2.8.8

(d) In an experiment, 3.5 g of element **A** reacted with 4.0 g of element **G** to form a compound.

Calculate the empirical formula of this compound.
(relative atomic masses: **A** = 7, **G** = 16)

You must show your working. **(3)**

~~MP1 for~~ dividing by atomic mass

A : G

3.5 : 4.0

7 16

MP2 for deriving ratio from MP1

0.5 : 0.25

empirical formula of this compound = ...

MP3 for ratio in MP2 to formula empirical formula A_2G

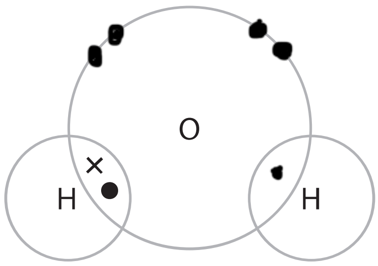
(e) An oxygen atom has six electrons in its outer shell.

A hydrogen atom has one electron in its outer shell.

Complete the dot and cross diagram of a molecule of water, H_2O.

Show outer shell electrons only.

(2)



(Total for Question 8 = 12 marks)

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9 (a) Water, acidified with sulfuric acid, is decomposed by electrolysis.
The water is decomposed to produce hydrogen and oxygen.

(i) A sample of hydrogen is mixed with air and ignited.

State what would happen.

(1)

gas burns

(ii) Throughout the experiment the volume of hydrogen and the volume of oxygen are measured at two-minute intervals.

The results are shown in Figure 9.

time in minutes	volume of hydrogen in cm^3	volume of oxygen in cm^3
0	0	0
2	4	2
4	8	4
6	12	6
8	16	8

Figure 9

Describe, using the data in Figure 9, what the results show about the volumes of hydrogen and of oxygen produced in this experiment.

(2)

volumes going up:
(oxygen/ hydrogen/ gas) increase (with time) / volume (directly) proportional to time
• quantitative comparing hydrogen and oxygen:
(volume of) hydrogen double
(volume of) oxygen / ORA / 2:1

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P 5 6 4 0 6 A 0 2 6 3 6

(b) Molten lead bromide is electrolysed.

The products of this electrolysis are

(1)

☐ **A** hydrogen and bromine

☐ **B** hydrogen and oxygen

☒ **C** lead and bromine

☐ **D** lead and oxygen

(c) Calcium nitrate and calcium carbonate are both ionic compounds.

Calcium nitrate mixed with water behaves as an electrolyte.
Calcium carbonate mixed with water does not behave as an electrolyte.

Explain, in terms of solubility and movement of ions, this difference in behaviour.

(2)

- (calcium) nitrate is soluble. Calcium carbonate is insoluble
- so ions {free to move in solution / not free in solid}

*(d) Impure copper can be purified using electrolysis.

In this electrolysis
- the anode is made of impure copper
- the cathode is made from pure copper
- the electrolyte is copper sulfate solution.

The apparatus at the start of the experiment is shown in Figure 10.

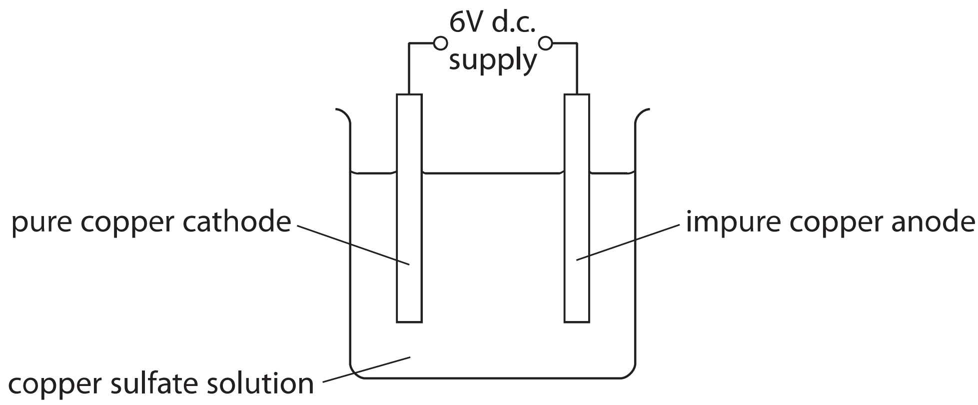

Figure 10

During the electrolysis three observations are made
- the sizes of both the anode and the cathode change
- a solid appears directly beneath the anode
- the colour of the copper sulfate solution does not change.

Explain all three observations.

(6)

- copper atoms form copper ions at anode
- (copper atoms are oxidised / lose electrons)
- $Cu \rightarrow Cu^{2+} + 2e$
- copper ions pass into solution
- copper ions move to / are attracted by the cathode
- cathode increases in size / gains mass
- pink/ brown colour on the surface of the cathode
- solid copper deposited on the cathode
- (copper ions are reduced/gain electrons)
- copper ions form copper atoms
- $Cu^{2+} + 2e \rightarrow Cu$
- copper sulfate solution is blue colour
- colour remains same since for every copper ion entering the solution at the anode, removed from the solution at the cathode
- concentration of copper sulfate (solution) remains the same
- solid is the insoluble impurities falling from the anode

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(Total for Question 9 = 12 marks)

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10 Calcium carbonate decomposes on heating to form calcium oxide and carbon dioxide.

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$$

(a) 8.000 g of $CaCO_3$ was heated strongly for about 10 minutes. 6.213 g of solid remained. Calculate the mass of carbon dioxide gas given off.

(1)

8.000- 6.213 = (1.787) (g)

mass of carbon dioxide = ... g

(b) A second sample of calcium carbonate is strongly heated in a crucible until there is no further loss in mass.
The mass of calcium oxide remaining in the crucible is 5.450 g.

(i) The theoretical yield of calcium oxide in this experiment is 5.600 g.

Calculate the percentage yield of calcium oxide.

(2)

$$\frac{5.450}{5.600} \times 100$$

= 97.3214…
= 97.3 (%)

percentage yield = ...

(ii) The mass of solid left in the crucible is less than the theoretical mass of calcium oxide that should be obtained.

A possible reason for this is that

(1)

☒ **A** some solid was lost from the crucible

☐ **B** the solid remaining absorbed some water from the air

☐ **C** some carbon dioxide remained in the crucible

☐ **D** the decomposition was incomplete

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(c) Another sample of calcium carbonate is heated and the mass of solid remaining is measured each minute.

The results are shown in Figure 11.

time in minutes	0	1	2	3	4	5	6	7
mass of solid remaining in g	9.0	8.1	7.2	6.4	6.0	5.6	5.3	5.2

Figure 11

(i) Explain the trend shown by the data in Figure 11.

(2)

rate/ mass loss is slowing down
as amount of reactant falls

(ii) It is impossible to be sure from this data that the reaction is complete.

State why.

(1)

mass may decrease further / not heated to constant mass/
last two figures not the same

(d) (i) Calculate the relative formula mass of calcium carbonate, $CaCO_3$.
(relative atomic masses: C = 12, O = 16, Ca = 40)

(2)

40 + 12 + 3 x 16
=100

relative formula mass = ...

(ii) Calculate the atom economy for the formation of calcium oxide in this reaction.

$$CaCO_3 \rightarrow CaO + CO_2$$

You must show your working.
(relative atomic masses: C = 12, O = 16, Ca = 40;
relative formula mass: calcium oxide = 56)

(2)

~~56~~
100 x 100 = 56 (%)

atom economy = ... %

(Total for Question 10 = 11 marks)

TOTAL FOR PAPER = 100 MARKS

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The periodic table of the elements

Key

relative atomic mass **atomic symbol** name atomic (proton) number

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

* 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.