**M1.**(a) **B**

**1**

(b) **D**

**1**

(c) **E**

**1**

(d) **C**

**1**

(e) 92.5 × 6 **and**
7× 7.5

**1**

$\frac{607.5}{100}$

**1**

6.075

**1**

6.08

**1**

*allow 6.08 with no working shown for **4** marks*

**[8]**

**M2.**(a) Y

**1**

(b) W

**1**

(c) V

**1**

(d) W

**1**

(e) X

**1**

**[5]**

**M3.**(a) (i) Na

*allow sodium*

**1**

(ii) Cu

*allow copper*

**1**

(iii) C

*allow carbon*

**1**

(iv) He

*allow helium*

**1**

(b) H

*allow hydrogen*

*do **not** allow $H_2$*

**1**

**[5]**

**M4.**(a) (i) atomic weight

**1**

(ii) groups

**1**

(iii) left a gap

**1**

(iv) had not been discovered by 1869

**1**

(b) protons

*must be in correct order*

**1**

electrons

**1**

(c) sodium and nickel are both metals

**1**

sodium is more reactive than nickel

**1**

(d) (i) bromine

*allow $Br_2$ / Br*

*do **not** allow bromide*

**1**

(ii) iodine is less reactive (than bromine)

*it = iodine*

*allow converse*

*do **not** allow bromide*

**1**

**[10]**

**M5.**(a) (i) E

**1**

(ii) C

**1**

(iii) A

**1**

(b) (i) quickly melted

*allow melts in contact with water,*

*allow bp 100 °C (of water) shows mp is low*

*ignore one other piece of information*

**1**

(ii) easily cut

*ignore one other piece of information*

**1**

(iii) effervescence / fizzing / bubbling

*ignore named gas*

*ignore one other piece of information*

**1**

**[6]**

**M6.**(a) 1 / one

**1**

(b) (i) protons

**1**

(ii) neutrons

**1**

(iii) 7

**1**

(c) (i) losing

**1**

(ii) a positive

**1**

(iii) electrostatic

**1**

(d) high melting points

**1**

strong bonds

**1**

(e) (i) 58.5

**1**

(ii) mole

**1**

(f) very small (particles) **or**

*ignore tiny / small / smaller / microscopic etc.*

1-100nm in size **or**

(particle with a) few hundred atoms

**1**

**[12]**

**M7.**(a) number

**1**

0

*allow 8*

**1**

(b) beryllium **or** magnesium **or** strontium **or** barium **or** radium

*allow correct symbols*

**1**

(c) (i) an alkali metal

**1**

(ii) a transition metal

**1**

(d) for undiscovered elements

*accept so elements with similar properties were in the same groups*

*accept so elements fitted the pattern of properties*

**1**

**[6]**

**M8.** (a) groups

**1**

(b) it is a non-metal

*allow it is not a metal*

**1**

(c) to the right of column 7 / Group 7

*accept in Group 0*

*ignore Group 8 / noble gases*

**1**

(d) (atomic) number

*allow proton number*

**1**

**[4]**

**M9.** (a) sodium has a lower density

**1**

sodium is more reactive

**1**

(b) hydrogen

**1**

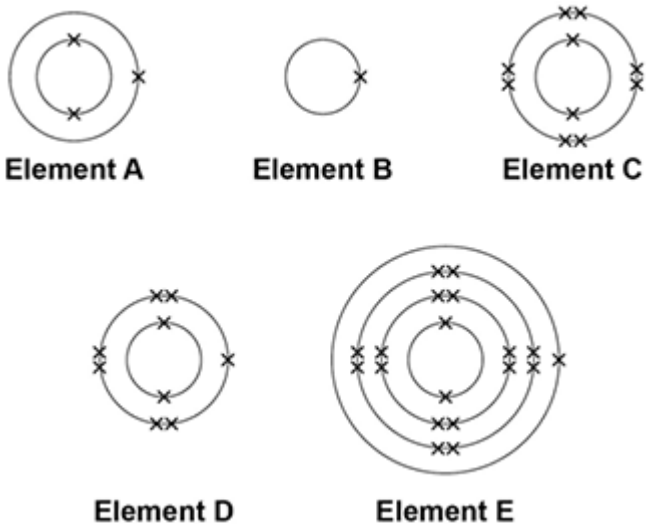
(c) $OH^-(aq)$

**1**

**[4]**

**Q1.** The electronic structure of the atoms of five elements are shown in the figure below.

The letters are **not** the symbols of the elements.




Choose the element to answer the question. Each element can be used once, more than once or not at all.

Use the periodic table to help you.

(a) Which element is hydrogen?

Tick **one** box.

**A** ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

**(1)**

(b) Which element is a halogen?

Tick **one** box.

**A** ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

**(1)**

(c) Which element is a metal in the same group of the periodic table as element **A**?

Tick **one** box.

**A** ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

**(1)**

(d) Which element exists as single atoms?

Tick **one** box.

**A** ☐ **B** ☐ **C** ☐ **D** ☐ **E** ☐

**(1)**

(e) There are two isotopes of element **A**. Information about the two isotopes is shown in the table below.

| | | |
|---|---|---|
| Mass number of the isotope | 6 | 7 |
| Percentage abundance | 92.5 | 7.5 |

Use the information in the table above above to calculate the relative atomic mass of element **A**.
Give your answer to 2 decimal places.

.....

.....

.....

.....

.....

.....

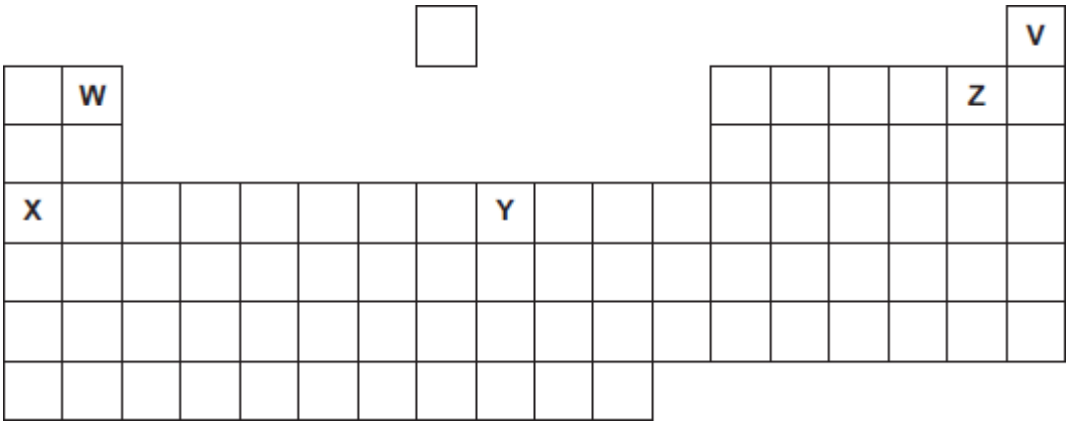
.....

Relative atomic mass = .....

**(4)**
**(Total 8 marks)**

**Q2.** Five elements, **V**, **W**, **X**, **Y** and **Z**, are shown in the periodic table.

The letters are **not** the chemical symbols of the five elements.




Use the correct letter, **V**, **W**, **X**, **Y** or **Z**, to answer each question.

(a) Which element is a transition metal?

**(1)**

(b) Which element is in Group 2?

**(1)**

(c) Which element is a noble gas?

**(1)**

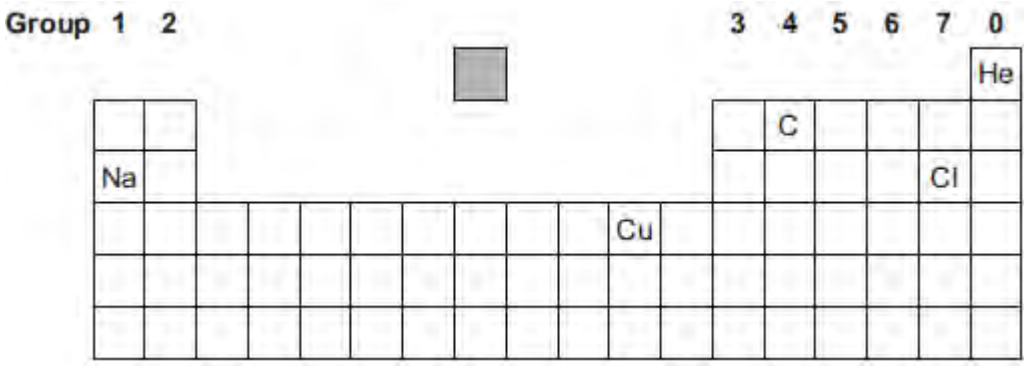
(d) Which element has an atomic (proton) number of 4?

**(1)**

(e) Which element forms only 1+ ions?

**(1)**
**(Total 5 marks)**

**Q3.** The diagram shows the chemical symbols of five elements in the periodic table.




(a) Choose the correct chemical symbol to complete each sentence.

(i) The element that is an alkali metal is ..... .

**(1)**

(ii) The element that is a transition metal is ..... .

**(1)**

(iii) The element in Group 4 is ..... .

**(1)**

(iv) The element with a full outer energy level (shell) of electrons is

..... .

**(1)**

(b) Which other element goes in the shaded box?

.....

**(1)**

**(Total 5 marks)**

**Q4.** This question is about the periodic table of elements.

Use the Chemistry Data Sheet to help you to answer these questions.

In 1869 Dmitri Mendeleev produced an early version of the periodic table.

(a) Draw a ring around the correct answer to complete each sentence.

(i)

Mendeleev first arranged the elements in order of their

| |
|---|
| atomic weight. |
| date of discovery. |
| electron number. |

**(1)**

(ii)

Mendeleev then placed elements with similar properties in columns called

| |
|---|
| groups. |
| periods. |
| shells. |

**(1)**

(iii) When the next element did not fit the pattern,

Mendeleev

| |
|---|
| ignored the element. |
| left a gap. |
| put the element at the end of the row. |

**(1)**

(iv) Mendeleev was not able to include the noble gases (Group 0) in his periodic table

because the noble gases

- are not elements.
- are not reactive.
- had not been discovered by 1869.

**(1)**

(b) Use the correct word from the box to complete each sentence.

| **electrons** | **molecules** | **neutrons** | **protons** |
|---|---|---|---|

In the modern periodic table elements are arranged in order of the number of ..... in their nucleus. Elements in the same group have the same number of ..... in their highest energy level (outer shell).

**(2)**

(c) Sodium (Na) is in Group 1 of the periodic table.

Nickel (Ni) is a transition element.

Tick (✓) **two** correct statements about sodium and nickel.

| **Statement** | **Tick (✓)** |
|---|---|
| Sodium and nickel are both metals. | |
| Sodium has a higher melting point than nickel. | |
| Sodium is more reactive than nickel. | |
| Sodium is harder than nickel. | |

**(2)**

(d) Chlorine, bromine and iodine are in Group 7 of the periodic table.

Chlorine is more reactive than bromine.

(i) Complete the word equation for the reaction between chlorine and sodium bromide.

chlorine + sodium bromide ⟶ ..... + sodium chloride

**(1)**

(ii) Why does iodine **not** react with sodium bromide solution?

.....

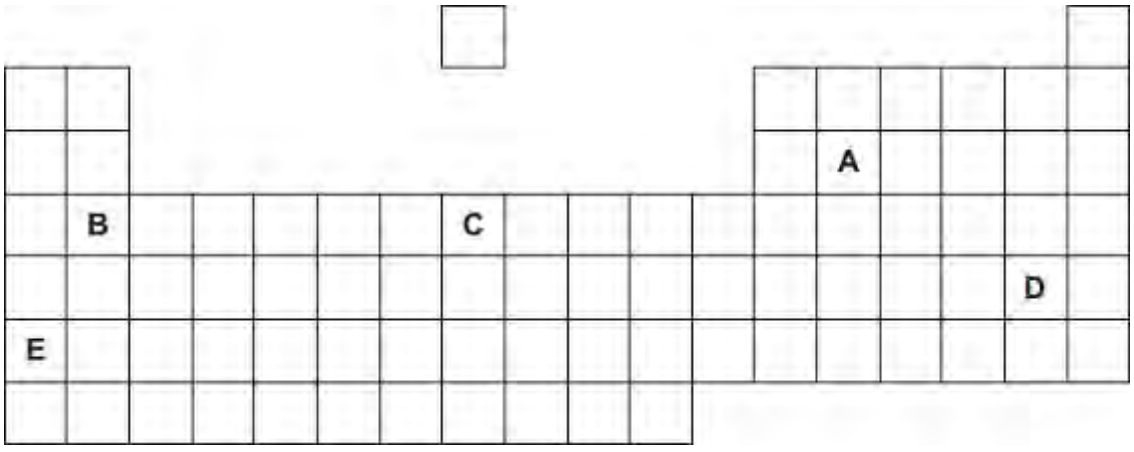
.....

**(1)**

**(Total 10 marks)**

**Q5.** The periodic table on the Data Sheet may help you to answer these questions.

Part of the periodic table is shown below.




The letters are **not** the symbols of these elements.

Choose your answers **only** from the letters shown in the periodic table above.

Which letter, **A**, **B**, **C**, **D** or **E**, represents:

(a) (i) an alkali metal Letter ☐

**(1)**

(ii) a transition element Letter ☐

**(1)**

(iii) a Group 4 element Letter ☐

**(1)**

(b) A chemistry teacher demonstrated the reaction between sodium and water to a class of students. One of the students wrote the following notes:

**The reaction between sodium and water**

A piece of sodium was cut easily into smaller pieces with a knife.

The sodium was added to some water in a trough.

The sodium:

- floated
- melted quickly to give a silvery ball
- moved on the surface of the water
- fizzed.

Use the information in the box to help you answer these questions.

What evidence is there that:

(i) sodium has a low melting point

.....

.....

**(1)**

(ii) sodium is soft

.....

.....

**(1)**

(iii) a gas was produced?

.....

.....

**(1)**

**(Total 6 marks)**

**Q6.**This question is about lithium and sodium.

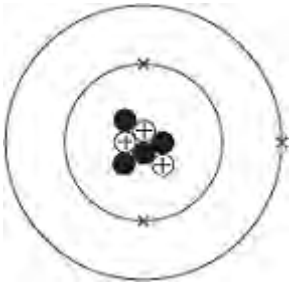
(a) Use the Chemistry Data Sheet to help you to answer this question.

In which group of the periodic table are lithium and sodium? Group ☐

**(1)**

(b) A lithium atom can be represented as $^{7}_{3}Li$

The diagram represents the lithium atom.



(i) Some particles in the nucleus have a positive charge.

What is the name of these particles? .....

**(1)**

(ii) Some particles in the nucleus have no charge.

What is the name of these particles? .....

**(1)**

(iii) Use the correct answer from the box to complete the sentence.

| | | |
|---|---|---|
| **3** | **4** | **7** |

The mass number of this atom of lithium is ☐

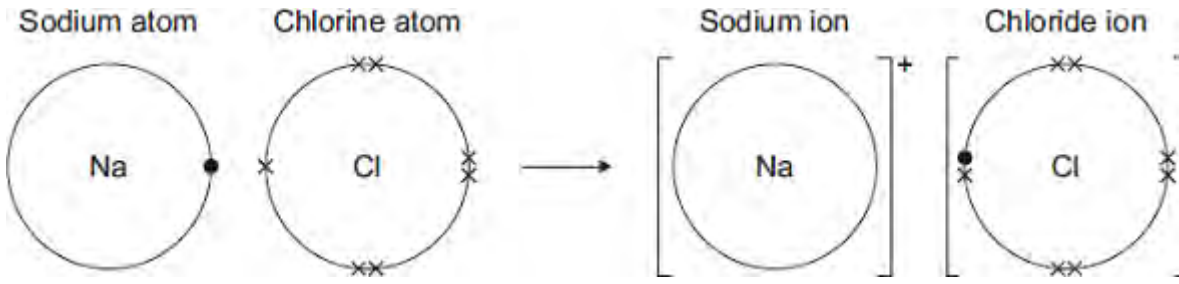
**(1)**

(c) Sodium reacts with chlorine to produce sodium chloride.

sodium + chlorine ⟶ sodium chloride

The diagram shows how the reaction happens.

Only the outer electrons are shown.




Draw a ring around the correct answer to complete each sentence.

(i)

A sodium atom changes into a sodium ion by

gaining / losing / sharing

an electron.

**(1)**

(ii)

a negative

A sodium ion has

| | |
|---|---|
| no | charge. |
| a positive | |

**(1)**

(iii)

The ions in sodium chloride are held together by strong

| | |
|---|---|
| covalent | |
| electrostatic | forces. |
| magnetic | |

**(1)**

(d) Sodium chloride is an ionic compound.

Tick (✓) **two** properties of ionic compounds.

| **Property** | **Tick (✓)** |
|---|---|
| Do **not** dissolve in water | |
| High melting points | |
| Low boiling points | |
| Strong bonds | |

**(2)**

(e) (i) The formula of sodium chloride is NaCl

Calculate the relative formula mass of sodium chloride.

Relative atomic masses: Na = 23; Cl = 35.5

.....

.....

Relative formula mass = .....

**(1)**

(ii) Draw a ring around the correct answer to complete each sentence.

The relative formula mass of a substance, in grams, is one

| | |
|---|---|
| ion | |
| isotope | of the substance. |
| mole | |

**(1)**

(f) Nanoparticles of sodium chloride (salt) are used to flavour crisps.

What are nanoparticles?

.....

.....

**(1)**
**(Total 12 marks)**

**Q7.** This question is about the periodic table.

Use the Chemistry Data Sheet to help you answer these questions.

(a) Complete the sentences.

Elements in the periodic table are arranged in order of atomic ..... .

The elements in Group ..... are called the noble gases.

**(2)**

(b) Calcium (Ca) is in Group 2.

Name **one** other element in Group 2.

.....

**(1)**

(c) Draw a ring around the correct answer to complete each sentence.

(i)

Sodium (Na) is

- an alkali metal.
- a non-metal.
- a transition metal.

**(1)**

(ii)

Nickel (Ni) is

- an alkali metal.
- a non-metal.
- a transition metal.

**(1)**

(d) In 1869 Mendeleev produced his periodic table.

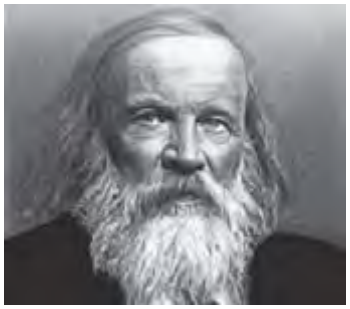
Why did Mendeleev leave gaps in his periodic table?

.....

.....

**(1)**
**(Total 6 marks)**

**Q8.** By 1869, about 60 elements had been discovered.
Mendeleev arranged these elements in a table, in order of their atomic weight.
He put elements with similar chemical properties in the same column.
Mendeleev and part of his table are shown below.



| Column | | | | | | |
|---|---|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| H | | | | | | |
| Li | Be | B | C | N | O | F |
| Na | Mg | Al | Si | P | S | Cl |

By unknown / неизвестен (here / здесь) [Public domain], via Wikimedia Commons

Use the periodic table on the Data Sheet to help you to answer these questions.

(a) Draw a ring around the correct answer to complete the sentence.

In the periodic table the columns are known as

groups.

periods.

rows.

**(1)**

(b) Suggest **one** reason why hydrogen should **not** have been put in column 1.

.....

**(1)**

(c) In 1895, the first of a new family of elements was discovered.
One of the new elements was called helium.

Where has this new family of elements been placed in the modern periodic table?

.....

**(1)**

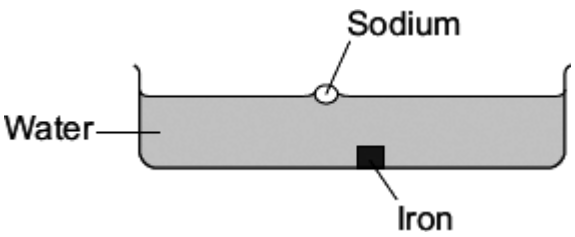
(d) Complete the sentence.

In the periodic table on your Data Sheet, the elements are arranged in order of their atomic ..... .

**(1)**
**(Total 4 marks)**

**Q9.** How a metal is used depends on its properties.

A teacher demonstrated some of the properties of sodium (an alkali metal) and iron (a transition element) by placing a small cube of each metal into water.




A student observed that:

| Sodium | Iron |
|---|---|
| floated on the surface of the water | sank to the bottom of the water |
| melted to form a molten ball of sodium | did not melt |
| reacted to produce a gas | did not react |
| no sodium was left after 5 minutes | the cube of iron remained after 5 minutes |

(a) Tick (✓) **two** properties of sodium compared with iron that are shown by the student's observations.

| Sodium compared with iron | Tick(✓) |
|---|---|
| sodium has a higher boiling point | |
| sodium has a lower density | |
| sodium is harder | |
| sodium is more reactive | |
| sodium is softer | |

**(2)**

(b) Draw a ring around the correct answer to complete the word equation.

sodium + water → sodium hydroxide + [carbon dioxide / hydrogen / oxygen]

**(1)**

(c) Draw a ring around the correct answer to complete the sentence.

Sodium hydroxide is an alkali because it produces [$H^+(aq)$ / $OH^-(aq)$ / $Na^+(aq)$] ions

in aqueous solution.

**(1)**
**(Total 4 marks)**

**M1.**(a) 13 (protons)

*The answers must be in the correct order.*

*if no other marks awarded, award **1** mark if number of protons and electrons are equal*

**1**

14 (neutrons)

**1**

13 (electrons)

**1**

(b) has three electrons in outer energy level / shell

*allow electronic structure is 2.8.3*

**1**

(c) **Level 3 (5–6 marks):**
A detailed and coherent comparison is given, which demonstrates a broad knowledge and understanding of the key scientific ideas. The response makes logical links between the points raised and uses sufficient examples to support these links.

**Level 2 (3–4 marks):**
A description is given which demonstrates a reasonable knowledge and understanding of the key scientific ideas. Comparisons are made but may not be fully articulated and / or precise.

**Level 1 (1–2 marks):**
Simple statements are made which demonstrate a basic knowledge of some of the relevant ideas. The response may fail to make comparisons between the points raised.

**0 marks:**
No relevant content.

**Indicative content**

Physical
Transition elements

- high melting points
- high densities
- strong
- hard

Group 1

- low melting points
- low densities
- soft

Chemical

Transition elements

- low reactivity / react slowly (with water or oxygen)
- used as catalysts
- ions with different charges
- coloured compounds

Group 1

- very reactive / react (quickly) with water / non-metals
- not used as catalysts
- white / colourless compounds
- only forms a +1 ion

**6**

**[10]**

**M2.**(a) The forces between iodine molecules are stronger

**1**

(b) anything in range +30 to +120

**1**

(c) Brown

**1**

(d) $2\ I^- + Cl_2 \rightarrow I_2 + 2\ Cl^-$

**1**

(e) It contains ions which can move

**1**

(f) hydrogen iodine

**1**

**[6]**

**M3.**(a) (i) protons

*allow "protons or electrons", but do not allow "protons and electrons"*

**1**

(ii) protons plus / and neutrons

**1**

(b) (because the relative electrical charges are) −(1) for an electron and +(1) for a proton

*allow electrons are negative and protons are positive*

**1**

and the number of electrons is equal to the number of protons

*if no other mark awarded, allow 1 mark for the charges cancel out*

**1**

(c) (the electronic structure of) fluorine is 2,7 and chlorine is 2,8,7

*allow diagrams for the first marking point*

**1**

(so fluorine and chlorine are in the same group) because they have the same number of or 7 electrons in their highest energy level or outer shell

*if no other mark awarded, allow 1 mark for have the same / similar properties*

**1**

(d) S

**1**

(e) (i) ions

**1**

(ii) molecules

**1**

**[9]**

**M4.**(a) (iron) is a metal

*accept transition element*

*allow (iron) had different properties (to oxygen and sulfur)*

*ignore electrons*

**1**

(b) so that elements with similar properties could be placed together

*allow to make the pattern fit*

*ignore undiscovered elements*

**1**

(c) atomic number(s)

*allow proton number(s)*

**1**

(d) all have one electron in the outer shell (highest energy level)

*allow same number of electrons in the outer shell (highest energy level)*

**1**

(so they) have similar properties

**or**

react in the same way

*allow specific reactions e.g. with water*

**1**

**[5]**

**M5.**(a) increase

**1**

(b) (i) $Na^+$ **and** $Br^-$

*both required*

**1**

(ii) sodium chloride

*allow NaCl*

*do **not** allow sodium chlorine*

**1**

(iii) chlorine is more reactive than bromine

*allow converse argument*

*allow symbols Cl, $Cl_2$, Br and $Br_2$*

*allow chlorine / it is more reactive*

*do **not** allow chloride **or** bromide*

**1**

(iv) fluorine

*allow F / $F_2$*

*do **not** allow fluoride.*

**1**

**[5]**

**M6.**(a) Li **and** K

*either order*

*allow lithium **and** potassium*

**1**

(b) Fe

*allow iron*

**1**

(c) N **and** As

*either order*

*allow nitrogen **and** arsenic*

**1**

(d) Cu

*allow copper*

**1**

**[4]**

**M7.**(a) similar properties

*allow same properties*

*allow correct example of property*

*ignore answers in terms of atomic structure*

**1**

(b) (i) in order of atomic / *proton* number

*allow increasing number (of protons)*

**1**

(ii) elements in same group have same number (*of electrons*) in outer shell **or** *highest energy level*

*allow number (of electrons) increases across a period*

**1**

(c) any **two** from:

*statements must be comparative*

- stronger / harder

*ignore higher densities*

- less reactive
- higher melting points

*ignore boiling point*

**2**

(d) *reactivity increases down group*

*allow converse throughout*

*for next three marks, outer electron needs to be mentioned once otherwise max = **2***

**1**

*outer electron is further from nucleus*

*allow more energy levels / shells*

*allow larger atoms*

**1**

*less attraction between outer electron and nucleus*

*allow more shielding*

**1**

*therefore outer electron lost more easily*

**1**

**[9]**

**M8.**(a) (i) hydrogen

*accept $H_2$*

*allow H*

**1**

(ii) hydroxide

*accept $OH^-$*

*allow OH*

*do **not** accept lithium hydroxide*

***1***

*(b) any **two** from:*

*'it' = potassium*

*potassium:*

*accept converse for lithium*

- *reacts / dissolves faster*

  *allow reacts more vigorously / quickly / violently / explodesignore reacts more*

- *bubbles / fizzes faster*

  *allow fizzes more*

  *allow more gas*

- *moves faster (on the surface)*

  *allow moves more*

- *melts*

  *allow forms a sphere*

- *produces (lilac / purple) flame*

  *allow catches fire / ignites*

  *do **not** accept other colours*

***2***

***[4]***

***M9.*** *(a) any **two** from:*

- *<u>react</u> with water **or** <u>very reactive</u>*
- *(react with water) releasing gas / hydrogen / fizzing*
- *(react with water) to form an alkaline / hydroxide solution*
- *form ions with a <u>1+</u> charge*
  *allow lose one electron from the outer shell*
  *ignore other references to electronic structure*
  *ignore physical properties*

***2***

*(b) any **three** from:*

- *some boxes contain two elements*
  *allow specific examples:*
  *Co, Ni **or** Ce, La **or** Di, Mo **or** Ro, Ru **or** Ba, V **or** Pt, Ir*
- *groups / columns contain elements with different properties*
  *allow groups / columns contain both metals and non-metals*
  *ignore examples*
- *Newlands not a well-known / respected scientist*
  *ignore references to sugar factory*
- *new idea (not readily accepted by other scientists)*
  *allow musical scales thought to be silly by some scientists*

***3***

*(c) one for improvement **and** one for explanation from:*

- *left gaps (for undiscovered elements) (1)*
- *so that elements were in their correct group (1)*
  *allow so the elements fitted the pattern of properties*

***or***

- *did not always follow order of relative atomic weights / masses (1)*
  *ignore references to atomic number / electronic structure*

- *so that elements were in their correct group (1)*

  *allow so the elements fitted the pattern of properties*

**2**

**[7]**

**Q1.** An atom of aluminium has the symbol $^{27}_{13}Al$

(a) Give the number of protons, neutrons and electrons in this atom of aluminium.

Number of protons .....

Number of neutrons .....

Number of electrons .....

**(3)**

(b) Why is aluminium positioned in Group 3 of the periodic table?

.....

.....

**(1)**

(c) In the periodic table, the transition elements and Group 1 elements are metals.

Some of the properties of two transition elements and two Group 1 elements are shown in the table below.

| | **Transition elements** | | **Group 1 elements** | |
|---|---|---|---|---|
| | Chromium | Iron | Sodium | Caesium |
| **Melting point in °C** | 1857 | 1535 | 98 | 29 |
| **Formula of oxides** | CrO<br>$Cr_2O_3$<br>$CrO_2$<br>$CrO_3$ | FeO<br>$Fe_2O_3$<br>$Fe_3O_4$ | $Na_2O$ | $Cs_2O$ |

Use your own knowledge **and** the data in the table above to compare the chemical and physical properties of transition elements and Group 1 elements.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**(6)**
**(Total 10 marks)**

**Q2.** This question is about halogens and their compounds.

The table below shows the boiling points and properties of some of the elements in Group 7 of the periodic table.

| **Element** | **Boiling point in °C** | **Colour in aqueous solution** |
|---|---|---|
| Fluorine | −188 | colourless |
| Chlorine | −35 | pale green |
| Bromine | X | orange |
| Iodine | 184 | brown |

(a) Why does iodine have a higher boiling point than chlorine?

Tick **one** box.

Iodine is ionic and chlorine is covalent ☐

Iodine is less reactive than chlorine ☐

The covalent bonds between iodine atoms are stronger ☐

The forces between iodine molecules are stronger ☐

**(1)**

(b) Predict the boiling point of bromine.

.....

**(1)**

(c) A redox reaction takes place when aqueous chlorine is added to potassium iodide solution.

The equation for this reaction is:

$$Cl_2(aq) + 2KI(aq) \rightarrow I_2(aq) + 2KCl(aq)$$

Look at table above.

What is the colour of the final solution in this reaction?

Tick **one** box.

Brown ☐

Orange ☐

Pale green ☐

Colourless ☐

**(1)**

(d) What is the ionic equation for the reaction of chlorine with potassium iodide?

Tick **one** box.

$Cl_2 + 2K \rightarrow 2KCl$ ☐

$2I^- + Cl_2 \rightarrow I_2 + 2Cl^-$ ☐

$I^- + Cl \rightarrow I + Cl^-$ ☐

$I^- + K^+ \rightarrow KI$ ☐

**(1)**

(e) Why does potassium iodide solution conduct electricity?

Tick **one** box.

It contains a metal ☐

It contains electrons which can move ☐

It contains ions which can move ☐

It contains water ☐

**(1)**

(f) What are the products of electrolysing potassium iodide solution?

Tick **one** box.

| **Product at cathode** | **Product at anode** | |
|---|---|---|
| hydrogen | iodine | ☐ |
| hydrogen | oxygen | ☐ |
| potassium | iodine | ☐ |
| potassium | oxygen | ☐ |

**(1)**
**(Total 6 marks)**

**Q3.** This question is about atomic structure and elements.

(a) Complete the sentences.

(i) The atomic number of an atom is the number of .....

**(1)**

(ii) The mass number of an atom is the number of .....

.....

**(1)**

(b) Explain why an atom has no overall charge.

Use the relative electrical charges of sub-atomic particles in your explanation.

.....

.....

.....

.....

**(2)**

(c) Explain why fluorine and chlorine are in the same group of the periodic table.

Give the electronic structures of fluorine and chlorine in your explanation.

.....

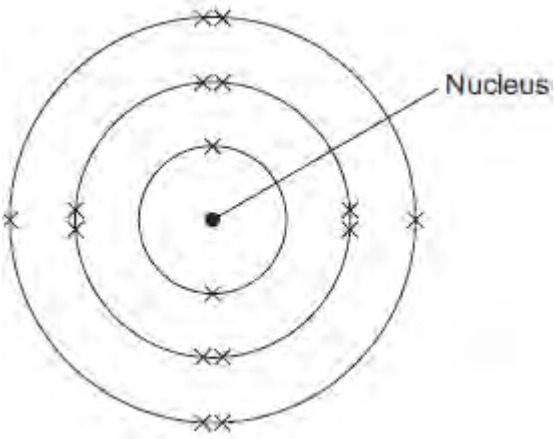
.....

.....

.....

**(2)**

(d) The diagram shows the electronic structure of an atom of a non-metal.




What is the chemical symbol of this non-metal?

Tick (✓) **one** box.

Ar ☐

O ☐

S ☐

Si ☐

**(1)**

(e) When elements react, their atoms join with other atoms to form compounds.

Complete the sentences.

(i) Compounds formed when non-metals react with metals consist of

particles called ..... .

**(1)**

(ii) Compounds formed from only non-metals consist of

particles called ..... .

**(1)**

**(Total 9 marks)**

**Q4.**In 1866 John Newlands produced an early version of the periodic table.

Part of Newlands' periodic table is shown below.

| Column | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| | H | Li | Be | B | C | N | O |
| | F | Na | Mg | Al | Si | P | S |
| | Cl | K | Ca | Cr | Ti | Mn | Fe |

Newlands' periodic table arranged all the known elements into columns in order of their atomic weight.

Newlands was trying to show a pattern by putting the elements into columns.

(a) Iron (Fe) does **not** fit the pattern in column 7.

Give a reason why.

.....

.....

**(1)**

(b) In 1869 Dmitri Mendeleev produced his version of the periodic table.

Why did Mendeleev leave gaps for undiscovered elements in his periodic table?

.....

.....

**(1)**

(c) Newlands and Mendeleev placed the elements in order of atomic weight.

Complete the sentence.

The modern periodic table places the elements in order of

..... .

**(1)**

(d) Lithium, sodium and potassium are all in Group 1 of the modern periodic table.

Explain why.

.....

.....

.....

.....

**(2)**
**(Total 5 marks)**

**Q5.** This question is about the halogens (Group 7).

(a) How do the boiling points of the halogens change down the group from fluorine to iodine?

.....

.....

**(1)**

(b) Sodium bromide is produced by reacting sodium with bromine.

Sodium bromide is an ionic compound.

(i) Write down the symbols of the **two** ions in sodium bromide.

.....

**(1)**

(ii) Chlorine reacts with sodium bromide solution to produce bromine and one other product.

Complete the word equation for the reaction.

chlorine + sodium bromide ⟶ bromine + .....

**(1)**

(iii) Why does chlorine displace bromine from sodium bromide?

.....

.....

**(1)**

(iv) Use the Chemistry Data Sheet to help you to answer this question.

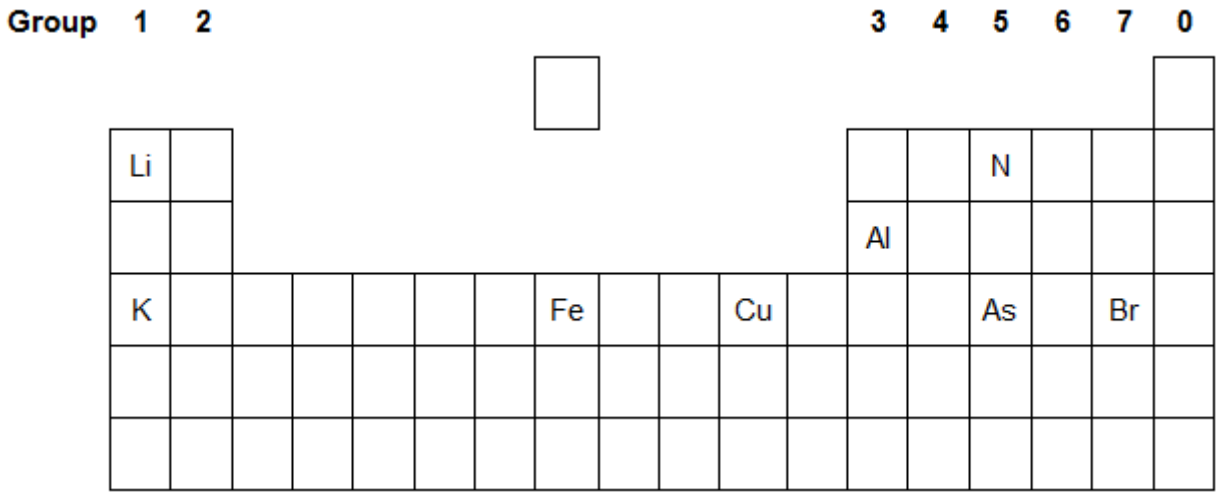
Suggest which halogen could react with sodium chloride solution to produce chlorine.

.....

**(1)**

**(Total 5 marks)**

**Q6.**The positions of eight elements in the modern periodic table are shown below.




Choose the correct chemical symbols to complete each sentence.

(a) The **two** metals that react vigorously with water are ..... and ..... .

**(1)**

(b) The element used as a catalyst in the Haber process is ..... .

**(1)**

(c) The **two** elements with five electrons in their outer shell (highest energy level) are ..... and ..... .

**(1)**

(d) Iron has ions with different charges.

The other metal that has ions with different charges is ..... .

**(1)**

**(Total 4 marks)**

**Q7.** In 1869, Dmitri Mendeleev produced his periodic table of the elements.

Mendeleev placed the alkali metals in the same group.

(a) What evidence did Mendeleev use to decide that the alkali metals should be in the same group?

.....

.....

**(1)**

(b) Describe how the elements in the modern periodic table are arranged:

(i) in terms of protons

.....

.....

**(1)**

(ii) in terms of electrons.

.....

.....

**(1)**

(c) State **two** properties of transition elements that make them more useful than alkali metals for making water pipes.

.....

.....

.....

.....

.....

**(2)**

(d) Describe and explain the trend in reactivity of the alkali metals (Group 1).

.....

.....

.....

.....

.....

.....

.....

.....

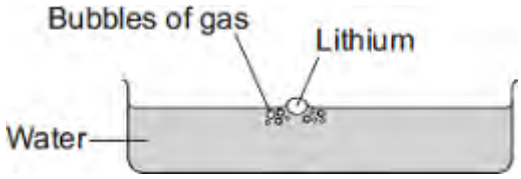
.....

.....

**(4)**
**(Total 9 marks)**

**Q8.** Lithium is in Group 1 of the periodic table.

Lithium reacts with water to produce a gas and an alkaline solution.




(a) (i) Name the gas produced.

.....

**(1)**

(ii) Which ion causes the solution to be alkaline?

.....

**(1)**

(b) Potassium is also in Group 1 of the periodic table.
Potassium reacts with water in a similar way to lithium.

Write down **two** differences you would see between the reactions of potassium and lithium with water.

1 .....

.....

2 .....

.....

**(2)**
**(Total 4 marks)**

**Q9.** John Newlands was a chemist who worked in a sugar factory.

In 1866 he designed a periodic table.
He arranged the elements in order of their relative atomic masses.

He found a repeating pattern for some of the elements.
Newlands wrote, 'the eighth element starting from a given one, is a kind of repetition of the first, like the eighth note in an octave of music'.

| | | | | | | |
|---|---|---|---|---|---|---|
| **H** | **Li** | **G** | **Bo** | **C** | **N** | **O** |
| **F** | **Na** | **Mg** | **Al** | **Si** | **P** | **S** |
| **Cl** | **K** | **Ca** | **Cr** | **Ti** | **Mn** | **Fe** |
| **Co, Ni** | **Cu** | **Zn** | **Y** | **In** | **As** | **Se** |
| **Br** | **Rb** | **Sr** | **Ce, La** | **Zr** | **Di, Mo** | **Ro, Ru** |
| **Pd** | **Ag** | **Cd** | **U** | **Sn** | **Sb** | **Te** |
| **I** | **Cs** | **Ba, V** | **Ta** | **W** | **Nb** | **Au** |
| **Pt, Ir** | **Tl** | **Pb** | **Th** | **Hg** | **Bi** | **Os** |

**Newlands' periodic table**

(a) In Newlands' periodic table, the elements lithium, sodium and potassium are grouped together.

Give **two** properties of these elements which support the idea that they should be grouped together.

1 .....

.....

2 .....

.....

**(2)**

(b) Newlands' periodic table was not accepted by most chemists in 1866.

Suggest reasons why.
Use the Newlands' periodic table above to help you to answer this question.

.....

.....

.....

.....

.....

.....

.....

.....

**(3)**

(c) State **and** explain **one** way in which Mendeleev improved Newlands' periodic table.

.....

.....

.....

.....

**(2)**
**(Total 7 marks)**

**M1.**(a) (i) any **one** from:

- one electron in the outer shell / energy level
- form ions with a 1+ charge

**1**

(ii) any **one** from:

- hydrogen is a non-metal
- (at RTP) hydrogen is a gas
- hydrogen does not react with water
- hydrogen has only one electron shell / energy level
- hydrogen can gain an electron **or** hydrogen can form a negative / hydride / $H^-$ ion
- hydrogen forms covalent bonds **or** shares electrons

*accept answers in terms of the Group 1 elements*

**1**

(b) (i) (bromine) gains electrons

*it = bromine*

*do **not** accept bromide ion gains electrons*

*ignore loss of oxygen*

**1**

(ii) $I_2$

*must both be on the right hand side of the equation*

**1**

$+ 2e^-$

*$2I^- - 2e^- \rightarrow I_2$ for **2** marks*

**1**

(iii) fluorine is the smallest atom in Group 7 **or** has the fewest energy levels in Group 7 **or** has the smallest distance between outer shell and nucleus

*the outer shell **must** be mentioned to score 3 marks*

**1**

fluorine has the least shielding **or** the greatest attraction between the nucleus and the outer shell

**1**

therefore fluorine can gain an electron (into the outer shell) more easily

**1**

**[8]**

**M2.**(a) if placed consecutively, then elements would be in wrong group / have wrong properties

*allow some elements didn't fit pattern*

**1**

left gaps

**1**

(b) (elements placed in) atomic / proton number order

**1**

(elements in ) same group have same number of <u>outer</u> electrons

**1**

any **one** from:

- number of protons = number of electrons
- reactions/(chemical) properties depend on the (outer) electrons
- number of shells gives the period

*allow number of shells increases down the group*

**1**

(c) (i) (transition elements usually) have same / similar number of outer / 4th shell electrons

*allow 2 electrons in outer shell*

**1**

(because) inner (3rd ) shell / energy level is being filled

*ignore shells overlap*

**1**

(ii) <u>2nd shell</u> / energy level can (only) have maximum of 8 electrons

*accept no d-orbitals*

**or** 2nd shell / energy level cannot have 18 electrons

**1**

**[8]**

**M3.** (a) (i) *incorrect or no element = **0** marks*

hydrogen

*allow H / $H_2$*

**1**

all the other elements are metals

*allow hydrogen is a not an (alkali / group 1) metal*

*ignore hydrogen is a gas*

**OR**

copper (1)

*allow Cu*

(copper) is not an alkali metal (1)

*allow Cu is a transition element / metal*

*allow any valid specific chemical property eg Cu does not react with water*

*ignore references to electronic structure*

*ignore physical properties*

**1**

(ii) Group 0 / noble gases

*ignore Group 8*

**1**

(b) (i) scandium / gallium / germanium

*accept Sc / Ga / Ge*

*allow Krypton / Kr*

**1**

(ii) predicted they were metals

*allow atomic mass / weight*

*ignore atomic structure*

**1**

predicted their (chemical/physical) properties / reactivity

*accept any chemical / physical property*

*allow similar properties if mentioned in context of a group*

**1**

(c) (i) (both) have <u>one</u> / <u>an</u> electron in the outer energy level / shell

*ignore form single plus ions*

**1**

(ii) *accept shell for energy level*

*accept converse explanation for lithium*

*if 'outer' not mentioned, max 2 marks*

*ignore sodium reacts more easily*

sodium loses one outer electron <u>more</u> easily (than lithium)

**1**

because outer electrons/energy level furth<u>er</u> from the nucleus in sodium **or** because sodium has <u>more</u> shells (than lithium)

*do **not** accept 'more outer shells'*

*allow sodium (atom) is larger*

**1**

because forces/attraction to hold outer electron are weak<u>er</u> in sodium (than lithium)

*accept more shielding in sodium (than lithium)*

**1**

**[10]**

**M4.** (a) because the nitrogen from dry air contained noble/Group 0 gases

*ignore other gases*

**or**

(because the nitrogen from dry air) contained argon / krypton / xenon

*ignore helium and neon*

**1**

and three / some of these gases, (argon, krypton, xenon) have a greater density than nitrogen

*ignore helium and neon*

**or**

and argon / krypton / xenon has a greater density than nitrogen

**1**

(b) (i) carbon dioxide would form / is a solid

*accept carbon dioxide freezes or its freezing point is > –200°C*

*ignore melting point*

**or**

(solid) carbon dioxide would block pipes

**1**

(ii) helium **(and)** neon

*both needed for **1** mark*

*accept He and Ne*

**1**

(iii) argon **(and)** oxygen

*accept Ar and $O_2$*

**1**

because there is only a difference of 3°C in their boiling points

*accept because they have boiling points that are almost the same*

**1**

**[6]**

**M5.** (a) all have seven electrons in their outer shell / energy level

**1**

(b) *must be comparative in all points or converse*

chlorine atom is smaller than bromine atom

**or**
chlorine atom has fewer shells than bromine atom

**1**

outer shell / energy level of chlorine has stronger (electrostatic) attraction to the nucleus than bromine

**or**
outer shell of chlorine is less shielded from the nucleus than bromine

**1**

so chlorine more readily gains an extra electron

**1**

**[4]**

**M6.** (a) left gaps

**1**

if placed consecutively, then elements would be in wrong group / have wrong properties / owtte

*allow some elements didn't fit pattern*

**1**

(b) (elements placed in) atomic / proton number order

**1**

(elements in) same group have same number of <u>outer</u> electrons

**1**

any **one** from:

- number of protons = number of electrons
- reactions (chemical) properties depend on the (outer) electrons
- number of shells gives the period

*allow number of shells increases down the group*

**1**

(c) (i) (transition elements usually) have same / similar number of outer / 4th shell electrons

**1**

inner (3rd ) shell / energy level is being filled

*ignore shells overlap*

**1**

(ii) <u>2nd</u> shell / energy level can (only) have maximum of 8 electrons

**or**

2nd shell / energy level cannot have 18 electrons

**1**

**[8]**

**M7.** (a) 40 (Ca) + 137 (Ba) ÷ 2 = 88.5

*accept a recognition that the average is near 88*
***or*** *it is the average of the other two*

*accept Sr is midway between Ca and Ba*

**1**

(b) eg newly discovered elements / atoms didn't fit (into triads) **or** didn't apply to all elements / atoms **or** lot of exceptions

*he = Döbereiner*

*ignore Mendeleev left spaces **or** not enough evidence*

**1**

(c) any **two** from:

- fizzes / bubbles / gas

  *hydrogen alone is insufficient*

  *ignore incorrect name if 'gas' stated*

- violent / vigorous / explodes / very fast reaction

  *accept container explodes*

  *ignore strong reaction*

- floats / on surface

  *ignore sinks*

- moves (very quickly)

- melts (into a ball)

- bursts into flame

  *accept (bright) light*

  *ignore colour / glow*

- gets smaller / (reacts to) form a solution / dissolves / disappears etc

- steam / gets hot (owtte)

  *ignore alkaline solutions **or** change in colour etc*

**2**

(d) (i) same number of electrons in outer shell

*accept energy level for shell*

*accept a correct reference to a specific group*

*eg (all) have one electron in outershell / (all) lose one electron (when they react)*

**1**

(ii) electrons fill an inner / 3rd shell

*accept energy level for shell*
*accept d-level being filled*
*accept specific reference to 3rd shell*
*accept descriptions in terms of 3d & 4s etc*

**1**

(usually) same number of outer / 4th shell electrons

**1**

(iii)

*it = lithium*

*accept energy level for shell **or** converse reasoning for potassium*

outer shell electron closer to nucleus

*accept fewer shells / smaller atom*

**1**

more (electrostatic) attraction (to nucleus) / electrons less likely to be lost

*accept less shielding / isn't much shielding*

*ignore nucleus has more influence but accept nucleus has more influence over the outer electron(s)*

*do **not** accept magnetic / gravitational attraction*

**1**

**[9]**

**Q1.** Use the periodic table and the information in the table below to help you to answer the questions.

The table shows part of an early version of the periodic table.

| Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 |
|---|---|---|---|---|---|---|
| H | | | | | | |
| Li | Be | B | C | N | O | F |
| Na | Mg | Al | Si | P | S | Cl |

(a) Hydrogen was placed at the top of Group 1 in the early version of the periodic table.

The modern periodic table does **not** show hydrogen in Group 1.

(i) State one **similarity** between hydrogen and the elements in Group 1.

.....

.....

**(1)**

(ii) State one **difference** between hydrogen and the elements in Group 1.

.....

.....

**(1)**

(b) Fluorine, chlorine, bromine and iodine are in Group 7, the halogens.

The reactivity of the halogens decreases down the group.

Bromine reacts with a solution of potassium iodide to produce iodine.

$$Br_2 + 2KI \longrightarrow 2KBr + I_2$$

(i) In the reaction between bromine and potassium iodide, there is a reduction of bromine to bromide ions.

In terms of electrons, what is meant by reduction?

.....

.....

**(1)**

(ii) Complete the half equation for the oxidation of iodide ions to iodine molecules.

$2I^- \longrightarrow$

**(2)**

(iii) Explain, in terms of electronic structure, why fluorine is the most reactive element in Group 7.

.....

.....

.....

.....

.....

.....

.....

.....

**(3)**
**(Total 8 marks)**

**Q2.**(a) Dmitri Mendeleev was one of the first chemists to classify the elements by arranging them in order of their atomic weights. His periodic table was published in 1869.

How did Mendeleev know that there must be undiscovered elements **and** how did he take this into account when he designed his periodic table?

.....

.....

.....

.....

.....

**(2)**

(b) By the early 20th century protons and electrons had been discovered.

Describe how knowledge of the numbers of protons and electrons in atoms allow chemists to place elements in their correct order and correct group.

.....

.....

.....

.....

.....

.....

**(3)**

(c) The transition elements are a block of elements between Groups 2 and 3 of the periodic table.

(i) Transition elements have similar properties.

Explain why, in terms of electronic structure.

.....

.....

.....

.....

**(2)**

(ii) There are **no** transition elements between the Group 2 element magnesium and the Group 3 element aluminium.

Give a reason why, in terms of electronic structure.

.....

.....

.....

**(1)**
**(Total 8 marks)**

**Q3.** By 1869, about 60 elements had been discovered.
Mendeleev arranged these elements in a table, in order of their atomic weight.
He also put elements with similar chemical properties in the same columns.

Mendeleev and part of his table are shown below.

| | Group | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| **Period 1** | H | | | | | | | |
| **Period 2** | Li | Be | B | C | N | O | F | |
| **Period 3** | Na | Mg | Al | Si | P | S | Cl | |
| **Period 4** | K<br>Cu | Ca<br>Zn | –<br>– | Ti<br>– | V<br>As | Cr<br>Se | Mn<br>Br | Fe Co Ni |

(a) (i) Name **one** element in Group 1 of Mendeleev's table that is not in Group 1 of the periodic table on the Data Sheet.
Give a reason why this element should not be in Group 1.

Name of element .....

Reason .....

.....

**(2)**

(ii) Which group of the periodic table on the Data Sheet is missing from Mendeleev's table?

.....

**(1)**

(b) The gaps (–) in Mendeleev's table were for elements that had not been discovered.

(i) Compare Mendeleev's table with the periodic table on the Data Sheet.

Name **one** of the elements in Period 4 that had not been discovered by 1869.

.....

**(1)**

(ii) Mendeleev was able to make predictions about the undiscovered elements. This eventually led most scientists to accept his table.

Suggest what predictions Mendeleev was able to make about these undiscovered elements.

.....

.....

.....

.....

.....

**(2)**

(c) In terms of their electronic structure:

(i) state why lithium and sodium are both in Group 1

.....

.....

.....

**(1)**

(ii) explain why sodium is more reactive than lithium.

.....

.....

.....

.....

.....

.....

.....

.....

**(3)**
**(Total 10 marks)**

**Q4.** The table shows some properties of gases in dry air

| Gas in dry air | Density in kg/m$^3$ | Melting point in °C | Boiling point in °C | Percentage (%) in air |
|---|---|---|---|---|
| Nitrogen | 1.2506 | –210 | –196 | 78.08 |
| Oxygen | 1.4290 | –219 | –183 | 20.95 |
| Carbon dioxide | 1.977 | –57 | –57 | 0.033 |
| Helium | 0.1785 | –272 | –269 | 0.00052 |
| Neon | 0.8999 | –249 | –246 | 0.0019 |
| Argon | 1.7837 | –189 | –186 | 0.934 |
| Krypton | 3.74 | –157 | –153 | 0.00011 |
| Xenon | 5.86 | –112 | –108 | 0.0000087 |

(a) In 1895, Lord Rayleigh isolated nitrogen from dry air by removing the other known gases, oxygen and carbon dioxide.
He then discovered that nitrogen from dry air had a different density to pure nitrogen produced from chemical reactions.
He concluded that nitrogen extracted from dry air was mixed with another gas.
The density of nitrogen extracted from dry air was higher than the density of pure nitrogen.

Use the information above to explain why.

.....

.....

.....

.....

**(2)**

(b) Gases from the air are separated to provide raw materials used in many different industrial processes.

Steps in dry air separation:

**Step 1:** Filter to remove solid particles

**Step 2:** Remove carbon dioxide

**Step 3:** Cool the remaining air to –200 °C

**Step 4:** Separate by allowing the liquefied gases to warm up.

(i) Carbon dioxide is removed before the air is cooled to –200 °C.

Suggest **one** reason why.

.....

.....

**(1)**

(ii) Which two gases do **not** condense when the remaining air is cooled to –200 °C?

.....and .....

**(1)**

(iii) Two gases in air do **not** separate completely when the liquefied gases are allowed to warm up.

Name these **two** gases and give a reason for your answer.

.....

.....

.....

.....

**(2)**
**(Total 6 marks)**

**Q5.** The halogens are in Group 7 of the periodic table.

(a) Why, in terms of electrons, are the halogens in Group 7?

.....

.....

**(1)**

(b) Sea water contains bromide ions ($Br^-$).
The bromide ions can be changed to bromine by bubbling chlorine gas into sea water.
Chlorine is able to displace bromine from sea water because chlorine is more reactive than bromine.

$2Br^-(aq) + Cl_2(g) \rightarrow Br_2(g) + 2Cl^-(aq)$

Explain, in terms of electrons, why chlorine is more reactive than bromine.

.....

.....

.....

.....

.....

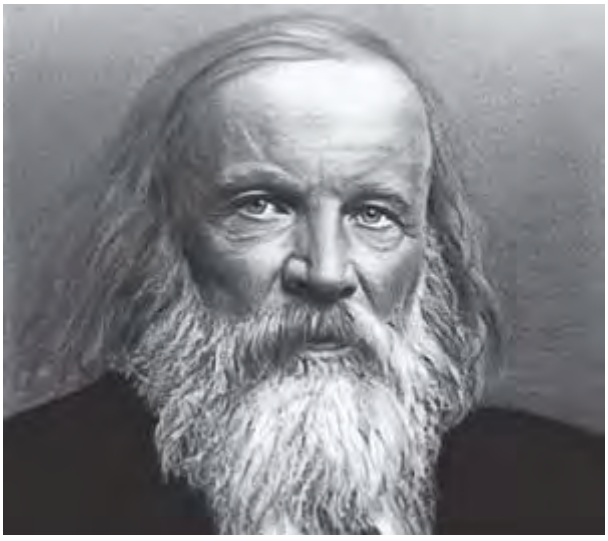
.....

.....

.....

**(3)**
**(Total 4 marks)**

**Q6.** (a) Dimitri Mendeleev was one of the first chemists to classify the elements by arranging them in order of their atomic weights. His periodic table was published in 1869.



By unknown / неизвестен (here / здесь) [Public domain], via Wikimedia Commons

How did Mendeleev know that there must be undiscovered elements and how did he take this into account when he designed his periodic table?

.....

.....

.....

.....

.....

**(2)**

(b) By the early 20th century protons and electrons had been discovered.

Describe how this discovery allowed chemists to place elements in their correct order and correct group.

.....

.....

.....

.....

.....

.....

.....

**(3)**

(c) The transition elements are a block of elements between Groups 2 and 3 of the periodic table.

(i) Transition elements have similar properties.

Explain why in terms of electronic structure.

.....

.....

.....

.....

.....

**(2)**

(ii) There are **no** transition elements between the Group 2 element magnesium and the Group 3 element aluminium.

Explain why in terms of electronic structure.

.....

.....

.....

**(1)**
**(Total 8 marks)**

**Q7.** Read the information about the development of the periodic table and answer the questions that follow:

Johann Döbereiner was a chemist who realised there was a link between atomic weight and chemical properties. Although it was difficult to measure atomic weights accurately, by 1829 Döbereiner had arranged many elements with similar chemical reactions in groups of three. He noticed that the middle element had an atomic weight that was approximately the average of the other two. These groupings were known as triads. Three of these triads are shown below:

| | | |
|---|---|---|
| Li 7 | S 32 | Cl 35.5 |
| Na 23 | Se 79 | Br 80 |
| K 39 | Te 128 | I 127 |

As new elements were discovered, it became difficult to group them in triads, and it was left to others to build on Döbereiner's work. The result was the first periodic table, suggested by Dimitri Mendeleev in 1869.

Our modern periodic table has evolved from Mendeleev's Table. Lithium, sodium and potassium are still together in Group 1, and chlorine, bromine and iodine are in Group 7.

It was many years before chemists understood the nature of the transition elements.

The modern periodic table on the Data Sheet may help you to answer these questions.

(a) Döbereiner suggested that calcium (Ca), strontium (Sr) and barium (Ba) were also a triad.

Use relative atomic masses to explain why.

.....

.....

.....

.....

**(1)**

(b) Suggest why Döbereiner's ideas were replaced by those of Mendeleev.

.....

.....

**(1)**

(c) Lithium, sodium and potassium are in Group 1. All these elements react with water.

Describe what you **see** when potassium is added to water.

.....

.....

.....

**(2)**

(d) In terms of electronic structure, explain why:

(i) elements in the same group of the periodic table have similar chemical properties

.....

.....

**(1)**

(ii) transition elements have similar properties even though they are not in the same group

.....

.....

.....

.....

**(2)**

(iii) in Group 1, lithium is **less** reactive than potassium.

.....

.....

.....

.....

**(2)**
**(Total 9 marks)**

**M1.**(a) (i) central block

**1**

(ii) conducts electricity

**1**

(b) any **two** from:

- visual pollution
- noise pollution
- dust pollution
- habitat destruction.

**2**

(c) (i) to concentrate the ore / copper carbonate

**or**

to remove / separate the rock

**1**

(ii) 12 (tonnes)

*If answer is incorrect allow one mark for (127 + 132) − 247 or 259 - 247*

**2**

(iii) any **one** from:

- so no reactant is wasted / left unreacted
- so they know how much product they will make
- need to record / compensate for the carbon dioxide produced

*allow so they can work out their carbon footprint.*

**1**

**[8]**

**M2.** (a) (i) **A**

**1**

(ii) **F**

**1**

(iii) **E**

**1**

(iv) **C**

**1**

(v) **A or B**

**1**

(b) (i) Rb K Na

*allow rubidium, potassium, sodium*

*do **not** accept RB or NA*

**1**

(ii) decrease

**or**

become lower / smaller / less

*allow from 180° C to 27° C*

**1**

(c) They are harder than Group 1 metals.

**1**

They have higher melting points than Group 1 metals.

**1**

They often form coloured compounds but Group 1 compounds are usually white.

**1**

**[10]**

**M3.** (a) (i) elements

**1**

(ii) atomic weight

**1**

(iii) atomic (proton) number

**1**

(b) (i) transition metals

**1**

(ii) has a higher melting point is harder

**2**

**[6]**

**M4.** (a) tungsten

**1**

has the high(est) melting point

*accept that metals other than tungsten are likely to melt*

**1**

(b) argon

**1**

is an unreactive gas

*accept that gases other than argon are reactive*

*accept that argon is a noble gas or in Group 0*

**1**

**[4]**

**M5.** (a) (good)conductor of electricity

*conductor of electricity and heat (+/–) = 0*

*accept can be drawn into wires **or** ductile*

*ignore flexible*

**1**

(b) strong

*accept tough **or** hard **or** high tensile strength*

**1**

(c) reference to <u>colour</u>

**1**

**[3]**

**M6.** conducts heat

*list principle applies after 4 ticks*

**1**

forms coloured compounds

**1**

high melting point

**1**

strong

**1**

**[4]**

**M7.** (i) zinc

*accept Zn*

**1**

iron only

*accept Fe*

**1**

copper

*accept Cu*

*do not credit iron*

**1**

(ii) iron

**1**

(iii) copper **or** iron or manganese

*accept Cu **or** Fe **or** Mn*

**1**

**[5]**

**Q1.**Copper is a transition metal.

(a) (i) Where is copper in the periodic table?

Tick (✓) **one** box.

in the central block ☐

in Group 1 ☐

in the noble gas group ☐

**(1)**

(ii) What is a property of copper?

Tick (✓) **one** box.

breaks easily ☐

conducts electricity ☐

does not conduct heat ☐

**(1)**

(b) Copper ores are quarried by digging large holes in the ground, as shown in **Figure 1**.

**Figure 1**

© photllurg/iStock/Thinkstock

Give **two** reasons why quarrying is bad for the environment.

.....

.....

.....

.....

**(2)**

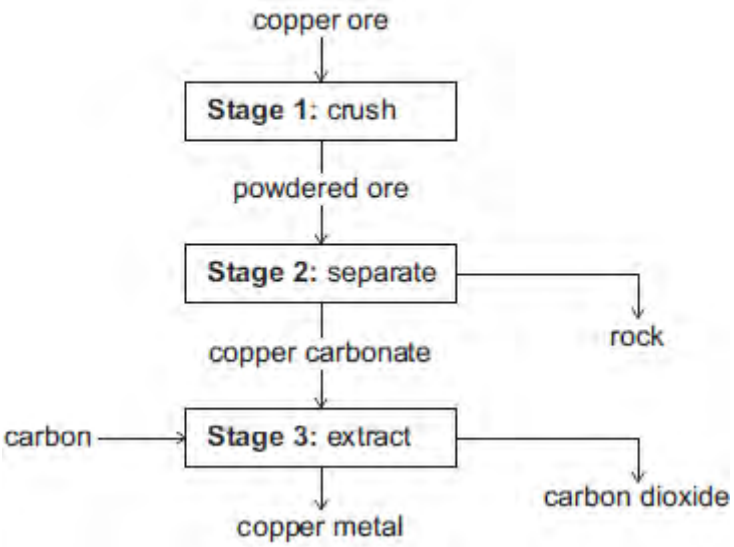
(c) Some copper ores contain only 2% copper.

Most of the ore is rock that is not needed.

In one ore, the main compound is copper carbonate ($CuCO_3$).

**Figure 2** shows the stages used in the extraction of copper from this ore.

**Figure 2**




(i) Why is **Stage 2** important?

.....

.....

**(1)**

(ii) The equation for the reaction in **Stage 3** is:

$$2\ CuCO_3 + C \longrightarrow 2\ Cu + 3\ CO_2$$

From the symbol equation, a company calculated that 247 tonnes of copper carbonate are needed to produce 127 tonnes of copper and 132 tonnes of carbon dioxide are released.

Calculate the mass of carbon needed to make 127 tonnes of copper.

| copper carbonate | + | carbon | ⟶ | copper | + | carbon dioxide |
|---|---|---|---|---|---|---|
| 247 tonnes | | ..... tonnes | | 127 tonnes | | 132 tonnes |

.....

.....

**(2)**

(iii) Suggest **one** reason why it is important for the company to calculate the mass of reactants in **Stage 3**.

.....

.....

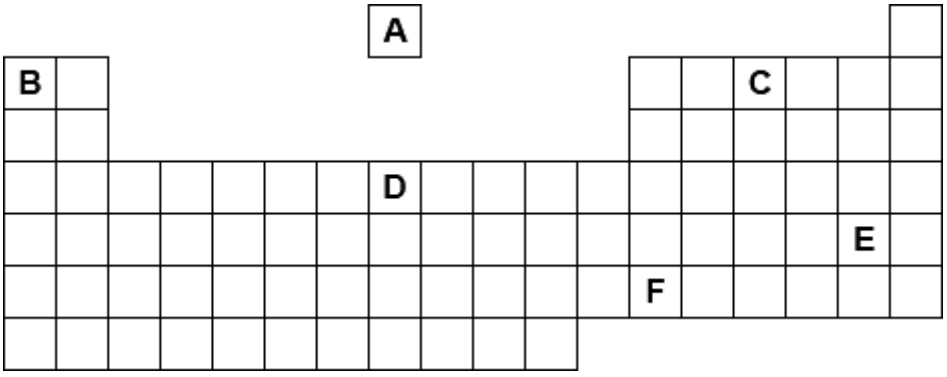
**(1)**

**(Total 8 marks)**

**Q2.** (a) Use the periodic table on the Data Sheet to help you answer these questions.

Part of the periodic table is shown below.

The letters are **not** the symbols of the elements.




Choose your answers **only** from the letters shown in the periodic table above.

Which letter, **A**, **B**, **C**, **D**, **E** or **F**, represents

(i) hydrogen Letter ☐

**(1)**

(ii) a Group 3 element Letter ☐

**(1)**

(iii) a halogen Letter ☐

**(1)**

(iv) the element with atomic (proton) number of 7 Letter ☐

**(1)**

(v) an element with one electron in its outer shell? Letter

**(1)**

(b) The table shows the melting points of the Group 1 metals arranged in alphabetical order.

| **Group 1 metal** | | |
|---|---|---|
| **Name** | **Symbol** | **Melting point in °C** |
| Caesium | Cs | 29 |
| Francium | Fr | 27 |
| Lithium | Li | 180 |
| Potassium | K | 64 |
| Rubidium | Rb | 39 |
| Sodium | Na | 98 |

(i) Arrange these metals in order of increasing melting point. Three have been done for you.

Fr Cs ..... ..... ..... Li

Lowest ⟶ Highest

**(1)**

(ii) Use the periodic table on the Data Sheet **and** your answer in part (b)(i) above to complete this sentence about how the melting points change.

Going down Group 1, the melting points .....

**(1)**

(c) The transition metals are a block of elements between Groups 2 and 3 of the periodic table. Transition metals have different properties to Group 1 metals.

Put ticks (✓) next to the **three** correct statements about transition metals in the table below.

| Statement | (✓) |
|---|---|
| They are harder than Group 1 metals | |
| They have lower densities than Group 1 metals | |
| They have higher melting points than Group 1 metals | |
| They are more reactive with water than Group 1 metals | |
| They often form coloured compounds but Group 1 compounds are usually white | |

**(3)**
**(Total 10 marks)**

**Q3.** The periodic table on the Data Sheet may help you to answer some of these questions.

(a) Draw a ring around the correct answer to complete these sentences.

(i)

| | |
|---|---|
| | compounds. |
| Dimitri Mendeleev attempted to classify | elements. |
| | mixtures. |

**(1)**

(ii)

| | |
|---|---|
| | atomic weight. |
| He arranged them in order of their | boiling point. |
| | electrical conductivity. |

**(1)**

(iii)

| | |
|---|---|
| | atomic (proton) number. |
| They are now arranged in order of their | atomic weight. |
| | mass number. |

**(1)**

(b) In the periodic table between Groups 2 and 3 there is a block of metals which includes chromium, iron and nickel.

(i) Which **one** of the following is the correct name for this block of metals?

Draw a ring around the correct answer.

**alkali metals** **reactive metals** **transition metals**

**(1)**

(ii) The properties of iron and those of the Group 1 metal sodium are different.

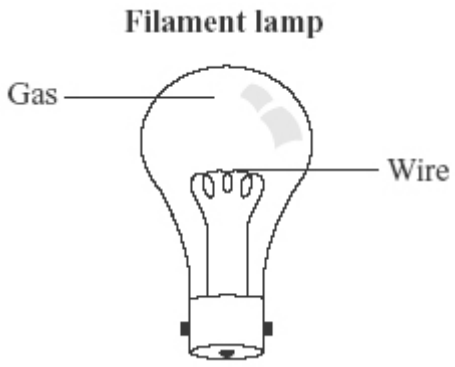
Put a tick (✓) next to the **two** correct phrases which could complete the following sentence.

Compared to sodium, iron

| | (✓) |
|---|---|
| has a higher melting point. | |
| has a lower density. | |
| is harder. | |
| is more reactive. | |
| is weaker. | |

**(2)**
**(Total 6 marks)**

**Q4.** When electricity passes through a thin wire, the wire gets hot. If the wire gets very hot, it may glow. This idea is used in filament lamps.




(a) The table shows some metals and their melting points.

| Metal | Melting point in °C |
|---|---|
| Aluminium | 660 |
| Copper | 1084 |
| Iron | 1540 |
| Tungsten | 3410 |

Which metal in the table should be used to make the wire in a filament lamp?

Give a reason for your answer.

.....

.....

.....

.....

**(2)**

(b) The table shows some gases.

| Gas |
| --- |
| Argon |
| Carbon dioxide |
| Oxygen |
| Sulfur dioxide |

Which gas in the table should be used in a filament lamp?

Give a reason for your answer.

.....

.....

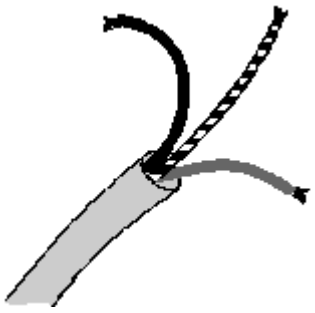
.....

.....

**(2)**
**(Total 4 marks)**

**Q5.** The properties of transition metals make them useful elements.

(a) Why is copper used for electrical wiring?

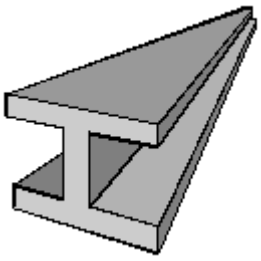


.....

.....

**(1)**

(b) Why is iron used for girders in buildings?



.....

.....

**(1)**

(c) Why are transition metal compounds added to glazes for pottery?

.....

.....

**(1)**
**(Total 3 marks)**

**Q6.** Niobium is a typical transition metal.

Put a tick (✓) next to each of the **four** properties in the table that you would expect for Niobium.

| Property | |
|---|---|
| brittle | |
| conducts heat | |
| dull | |
| forms coloured compounds | |
| high melting point | |
| low boiling point | |
| strong | |
| very reactive | |

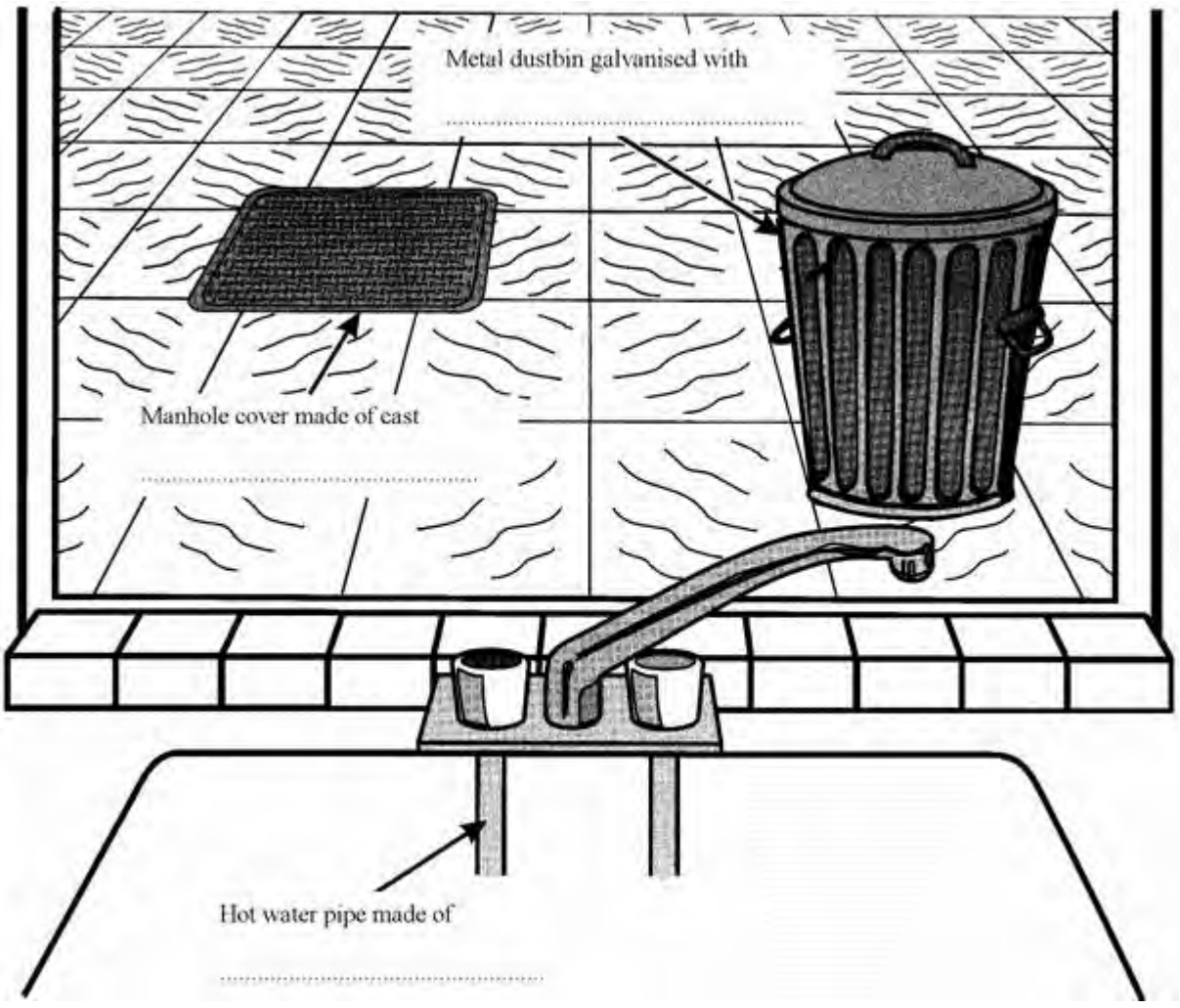
**(Total 4 marks)**

##

The word box contains the names of some metals.

| aluminium | copper | iron | manganese | zinc |
|---|---|---|---|---|

(i) The drawing shows the view from a window. Choose from the names of metals in the box to complete the **three** spaces.




**(3)**

(ii) What is the name of the metal in the word box which has the chemical symbol Fe?

.....

**(1)**

(iii) What is the name of **one** metal in the word box which often has coloured compounds?

.....

**(1)**

**(Total 5 marks)**

**M1.**(a) 13 (protons)

*The answers must be in the correct order.*

*if no other marks awarded, award **1** mark if number of protons and electrons are equal*

**1**

14 (neutrons)

**1**

13 (electrons)

**1**

(b) has three electrons in outer energy level / shell

*allow electronic structure is 2.8.3*

**1**

(c) **Level 3 (5–6 marks):**
A detailed and coherent comparison is given, which demonstrates a broad knowledge and understanding of the key scientific ideas. The response makes logical links between the points raised and uses sufficient examples to support these links.

**Level 2 (3–4 marks):**
A description is given which demonstrates a reasonable knowledge and understanding of the key scientific ideas. Comparisons are made but may not be fully articulated and / or precise.

**Level 1 (1–2 marks):**
Simple statements are made which demonstrate a basic knowledge of some of the relevant ideas. The response may fail to make comparisons between the points raised.

**0 marks:**
No relevant content.

**Indicative content**

Physical
Transition elements

- high melting points
- high densities
- strong
- hard

Group 1

- low melting points
- low densities
- soft

Chemical
Transition elements

- low reactivity / react slowly (with water or oxygen)
- used as catalysts
- ions with different charges
- coloured compounds

Group 1

- very reactive / react (quickly) with water / non-metals
- not used as catalysts
- white / colourless compounds
- only forms a +1 ion

**6**

**[10]**

**M2.** (a) (i) UI / solution turns blue / purple

*allow violet / lilac*

**1**

any **two** from:

- floats
- melts / forms a sphere
- moves

  *note: moves on surface = **2** marks (points 1 and 3)*
- effervescence / fizz / bubbles / gas

  *ignore the name of the gas*
- (yellow) flame

  *ignore sparks / ignites / burns*

  *allow dissolves*
- reduces in size

  *ignore 'reacts violently' unqualified*

  *ignore reference to exothermic / heat evolved*

**2**

(ii) **2**Na + **2**$H_2O$ → **2NaOH** + $H_2$

*correct equation = **2** marks*

*allow correct multiples / fractions*

*if this equation is unbalanced,*

*allow **1** mark for NaOH*

**2**

(b) *it = francium*

*<u>outer</u> electron / shell / energy level must be mentioned once for all*

***3** marks*

biggest atom **or** (outer) shell / energy level / electron furthest from nucleus **or** most (number of) shells

**1**

least attraction (to nucleus) **or** most shielding

*allow the attraction is <u>very</u> weak*

*do **not** allow less magnetic / gravitational attraction*

**1**

(outer) electron more easily lost / taken

*ignore francium reacts more easily / vigorously*

**1**

(c) any **two** from:

*ignore other properties / specific reactions*

*they / it = transition elements*

transition elements:

*allow if state group 1 elements*

- high melting point **or** high boiling point
  - *low melting point or low boiling point*
- high density
  - *low density*
- strong / hard
  - *weak / soft*
- not very reactive
  - *reactive*
- catalysts
  - *not catalysts*
- ions have different charges
  - *+1 ions*
- coloured compounds
  - *white compounds*

**2**

**[10]**

**M3.** (a) colour

**1**

(b) $Fe_2O_3$ or $(Fe^{3+})_2 (O^{2-})_3$

*2 and 3 should be below halfway on Fe and O*

**1**

(c) (i) 4 4

*or correct multiples*

**1**

(ii) any **two** from:

*ignore references to malleable / ductile / conductivity / stiff / boiling point / density*

- high melting point
  *accept can withstand high temperatures*
- strong / tough
  *accept <u>not</u> brittle*
- hard
  *do **not** accept flexible*
- not (very) reactive

**2**

**[5]**

##

(a) 75% Cu, 25% Ni

*for 1 mark*

**1**

(b) 70% segment shaded

*for 1 mark*

**1**

(c) (i) copper

*for 1 mark*

**1**

(ii) zinc

*for 1 mark*

**1**

(d) 1. hard so will not wear away/scratch

*for 1 mark*

**1**

2. unreactive
so does not corrode/dissolve/or other
acceptable reason
(not does not react unless acceptable reason)

(If given hard and unreactive allow 1 mark)

*for 1 mark*

**1**

**[6]**

**Q1.** An atom of aluminium has the symbol $^{27}_{13}Al$

(a) Give the number of protons, neutrons and electrons in this atom of aluminium.

Number of protons .....

Number of neutrons .....

Number of electrons .....

**(3)**

(b) Why is aluminium positioned in Group 3 of the periodic table?

.....

.....

**(1)**

(c) In the periodic table, the transition elements and Group 1 elements are metals.

Some of the properties of two transition elements and two Group 1 elements are shown in the table below.

| | **Transition elements** | | **Group 1 elements** | |
|---|---|---|---|---|
| | Chromium | Iron | Sodium | Caesium |
| **Melting point in °C** | 1857 | 1535 | 98 | 29 |
| **Formula of oxides** | CrO<br>$Cr_2O_3$<br>$CrO_2$<br>$CrO_3$ | FeO<br>$Fe_2O_3$<br>$Fe_3O_4$ | $Na_2O$ | $Cs_2O$ |

Use your own knowledge **and** the data in the table above to compare the chemical and physical properties of transition elements and Group 1 elements.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

**(6)**
**(Total 10 marks)**

**Q2.** Sodium is a Group 1 element.

(a) (i) A small piece of sodium is added to some water containing Universal Indicator solution.

Describe what you would **see** happening.

.....

.....

.....

.....

.....

.....

**(3)**

(ii) Complete **and** balance the equation for the reaction of sodium with water.

.....Na + .....$H_2O$ → ..... + $H_2$

**(2)**

(b) Francium is the most reactive element in Group 1.

Explain why in terms of electronic structure.

.....

.....

.....

.....

.....

.....

**(3)**

(c) The transition elements have different properties from the elements in Group 1.

Give **two** of these different properties of transition elements.

1 .....

.....

2 .....

.....

**(2)**
**(Total 10 marks)**

**Q3.** Transition elements and their compounds have many uses.

Iron oxide and cobalt oxide have been added to the glazes on pottery for hundreds of years.

(a) State why transition metal oxides are added to pottery glazes.

.....

**(1)**

(b) Use the table of ions on the Data Sheet to help you work out the formula of iron(III) oxide.

.....

**(1)**

(c) Cobalt oxide is reacted with hydrogen to form cobalt.

(i) Balance the equation for this reaction.

$$Co_3O_4 + \ldots\ldots H_2 \rightarrow 3\,Co + \ldots\ldots H_2O$$

**(1)**

(ii) Cobalt is mixed with other transition metals to make alloys.

These alloys are used to make cutting tools which remain sharp at very high temperatures. They can cut through other metals.


Suggest **two** properties of transition metals that make them suitable for making cutting tools.

1 .....

.....

2 .....

.....

**(2)**
**(Total 5 marks)**

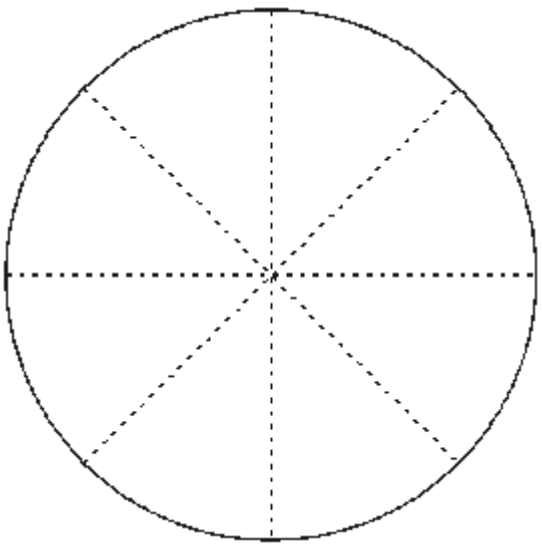
**Q4.** The table shows the % composition by mass of modern British coins.

| COIN | % COMPOSITION BY MASS | | | |
|---|---|---|---|---|
| | copper | nickel | tin | zinc |
| £1 | 70 | 5.5 | – | 24.5 |
| 20p | 84 | 16 | – | – |
| 5p, 10p, & 50p | | | | |
| 1p &2p (until 1991) | 97 | – | 0.5 | 2.5 |
| 1p &2p (1992 onwards) | Copper plated steel | | | |

(a) Use the Data Sheet to help you to complete the table by filling in the information about 5p, 10p and 50p coins which are made of cupronickel.

**(1)**

(b) Shade the pie chart to represent the % of copper in a £1 coin.



**(1)**

(c) Name the metal present in:

(i) all these coins,

.....

**(1)**

(ii) a £1 coin but **not** in a 20p coin.

.....

**(1)**

(d) The following is a list of properties.

- bends easily
- good conductor of electricity
- hard
- high melting point
- poor conductor of heat
- unreactive

From this list, choose two properties which coinage metals should have. For each property, give a reason for your answer.

Property 1 .....

Reason .....

Property 2 .....

Reason .....

**(2)**

**(Total 6 marks)**

**M1.**(a) The ore is not pure or contains impurities or the ore does not contain 100% of the metal compound

*allow to concentrate the metal or metal compound*

**1**

rock / other compounds need to be removed / separated

**1**

(b) (i) (cast iron is) brittle

*allow not strong*

*ignore weak*

**1**

(ii) the oxygen reacts with carbon

*allow carbon burns in oxygen or is oxidised*

**1**

reducing the percentage of carbon in the mixture
**or** producing carbon dioxide

**1**

(c) (i) aluminium has a low density

**1**

(ii) (because copper) is in the central / middle (block of the periodic table)

**1**

whereas aluminium is in Group 3 (of the periodic table)

**1**

(iii) iron is more reactive (than copper)

*ignore cost*

**1**

so copper is displaced / reduced

**1**

**[10]**

**M2.** (a) 8 marks Particularly well structured answer with most points mentioned.

7-6 marks Well structured answer. The two metals will have been compared rather than simply listing advantages/disadvantages. Most of the advantages and disadvantages of each metal have been mentioned.

5-3 marks Some structure to the answer. An attempt to compare the metals by giving some advantages and disadvantages.

2-1 marks Little structure or attempt to compare. Marks gained by listing a few advantages or disadvantages.

**Advantages of Nickel:**
Relatively low cost which makes the sparking plugs cheaper to produce.
Quite high melting point which is needed because the temperature in the engine is very high.
Good conductor of electricity needed to carry electricity into combustion chamber to produce spark.

**Disadvantages of Nickel:**
Subject to corrosion in engine which means they only last a short time *because nickel is higher in reactivity than platinum.*
Idea that this leads to reduced efficiency, unburnt petrol and air pollution.

**Advantages of Platinum:**
Less susceptible to corrosion (not corroded) because platinum is very low in reactivity.
Idea that this improves efficiency and reduces pollution.-
Higher melting point than nickel to withstand the high temperatures in the combustion chamber.
Last a lot longer than nickel electrodes due to low reactivity.

(Sensible extension here could be longer service intervals etc.)-
Good conductor of electricity as for nickel.
Extension here could be linked to the idea that the conductivity
does not deteriorate as quickly as nickel.)

**Disadvantages of Platinum:**
Cost *which will make the sparking plug more expensive.*
A good candidate might justify cost by longer life, better fuel consumption and less pollution.

**8**

(b) (i) giant structure/lattice/regular arrangements of atoms
*any for 1 mark*

of atoms/of ions (provided free electrons mentioned)
*either for 1 mark*

delocalised or free electrons
*for 1 mark*

**3**

(ii) electrons free/can move
*for 1 mark each*

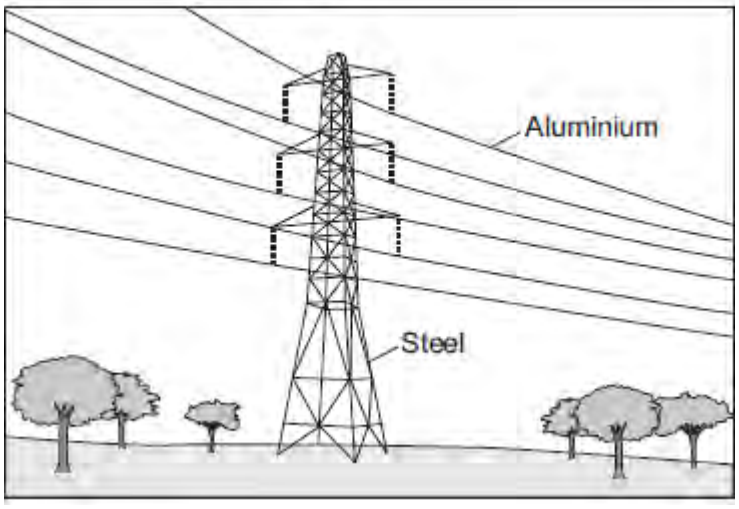
**2**

**[13]**

**Q1.**This question is about metals.

**Figure 1** shows the metals used to make pylons and the wires of overhead cables.

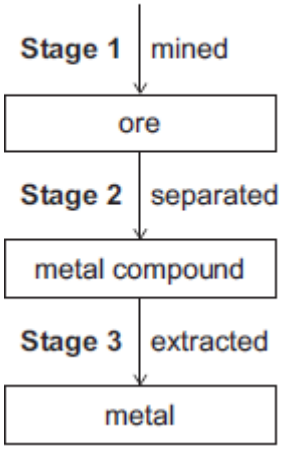
**Figure 1**




(a) An ore contains a metal compound.

A metal is extracted from its ore in three main stages, as shown in **Figure 2**.

**Figure 2**




Explain why **Stage 2** needs to be done.

.....

.....

.....

.....

**(2)**

(b) Cast iron from a blast furnace contains 96% iron and 4% carbon.

(i) Cast iron is not suitable for the manufacture of pylons.

Give **one** reason why.

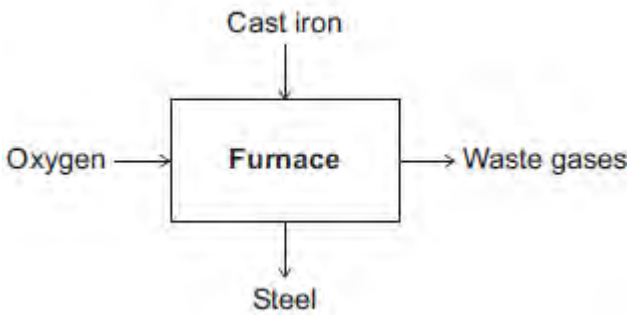
.....

.....

**(1)**

(ii) Most cast iron is converted into steel, as shown in **Figure 3**.

**Figure 3**




Describe how cast iron is converted into steel.

Use **Figure 3** to help you to answer this question.

.....

.....

.....

.....

**(2)**

(c) Aluminium and copper are good conductors of electricity.

(i) State **one** property that makes aluminium more suitable than copper for overhead cables.

.....

.....

**(1)**

(ii) How can you tell that copper is a transition metal and aluminium is **not** a transition metal from the position of each metal in the periodic table?

.....

.....

.....

.....

**(2)**

(iii) Copper can be extracted from solutions of copper salts by adding iron.

Explain why.

.....

.....

.....

.....

**(2)**
**(Total 10 marks)**

**Q2.** The extract below was taken from a leaflet on the uses of platinum. One of the uses described was in making electrodes for spark plugs in car engines. The spark plug produces the spark which ignites the fuel in the engine.

**Spark Plugs**

The electrodes in a spark plug have to conduct electricity very well. Since they project into the combustion chamber of the engine, they must also be able to withstand extremely high temperatures in a very corrosive atmosphere.

Nickel-based plugs have been produced for many years. They only last a fairly short time. As the electrodes wear, combustion becomes less efficient and the petrol is not burnt completely.

Platinum and other precious metals can now be used in spark plugs. These last much longer and are more efficient. This can help to reduce air pollution.

The table below gives some information about platinum and nickel.

| | MELTING POINT (° C) | BOILING POINT (° C) | POSITION IN REACTIVITY SERIES | COST (£/kg) |
|---|---|---|---|---|
| nickel | 1455 | 2920 | Higher than gold | 2.5 |
| platinum | 1769 | 4107 | below gold | 6110 |

(a) Compare nickel and platinum for use in making the electrodes in spark plugs.

A good answer should give advantages and disadvantages of each metal linking these to the properties of the metals. Marks will be given for the way in which you organise your answer.

***You will need a sheet of lined paper.***

**(8)**

(b) (i) Describe the structure and bonding in metals.

.....

.....

.....

.....

.....

.....

.....

.....

.....

**(3)**

(ii) Explain why metals such as nickel and platinum are good conductors of electricity.

.....

.....

.....

**(2)**
**(Total 13 marks)**