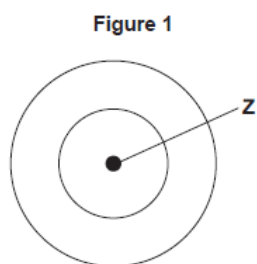


Q1.

There are eight elements in the second row (lithium to neon) of the periodic table.

- (a) **Figure 1** shows an atom with two energy levels (shells).



- (i) Complete **Figure 1** to show the electronic structure of a boron atom.

(1)

- (ii) What does the central part labelled **Z** represent in **Figure 1**?

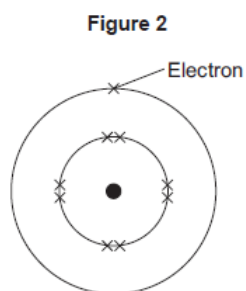
(1)

- (iii) Name the sub-atomic particles in part **Z** of a boron atom.

Give the relative charges of these sub-atomic particles.

(3)

- (b) The electronic structure of a neon atom shown in **Figure 2** is **not** correct.



Explain what is wrong with the electronic structure shown in **Figure 2**.

(3)

Q2.

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 \longrightarrow 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)

Q3.

- (a) The symbols for seven different elements are shown in **Figure 1**.

Figure 1

																	He
	Be																
Na														S		Ar	
	Ca						Fe										

Choose the correct symbol from **Figure 1** to answer each question.

You may use each symbol once, more than once or not at all.

Write the symbol that represents:

- (i) a Group 1 element

_____ (1)

- (ii) a transition metal

_____ (1)

- (iii) an element with electrons in the same number of energy levels as an atom of argon (Ar)

_____ (1)

- (iv) an element which forms an oxide that dissolves in water to form an acidic solution

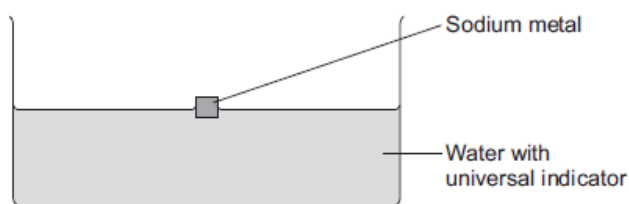
_____ (1)

- (v) an element that forms a chloride with the formula XCl

_____ (1)

- (b) A teacher put a cube of sodium metal into water containing universal indicator, as shown in **Figure 2**.

Figure 2



The equation for the reaction is:



- (i) The sodium floated on the surface of the water. The universal indicator turned purple.

Give **three other** observations that would be seen during the reaction.

1. _____
2. _____
3. _____

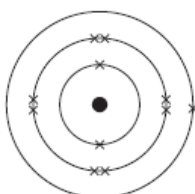
(3)

- (ii) Name the ion that made the universal indicator turn purple.

(1)

- (c) **Figure 3** represents the electronic structure of a sodium atom.

Figure 3



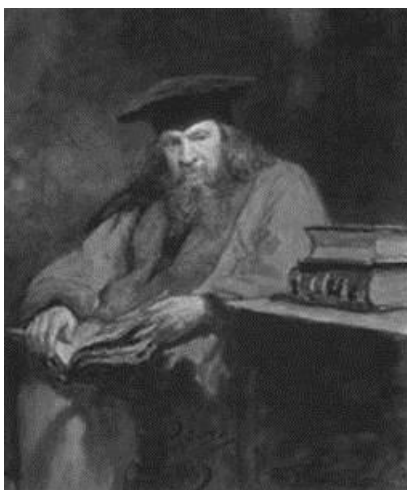
In the space below, draw the electronic structure of a sodium ion. Include the charge on the ion.

(2)

(Total 11 marks)

Q4.

Read the information about the periodic table.



Portrait of Dimitri Mendeleev by Ilya Repin

When the Russian chemist Dimitri Mendeleev put forward his periodic table in 1869, the atomic structure of elements was unknown.

Mendeleev tried to arrange the elements in a meaningful way based on their chemical reactions. First he put the elements in order of their increasing atomic weight. He then put elements with similar properties in the same column.

However, he left gaps, and sometimes did not follow the order of increasing atomic weight – for example, he placed iodine (atomic weight 127) after tellurium (atomic weight 128).

Within a few years there was sufficient evidence to prove that Mendeleev was correct.

Our modern periodic table has evolved from Mendeleev's table.

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

- (a) (i) State why Mendeleev left gaps.

(1)

- (ii) State why some elements were **not** placed in order of increasing atomic weight.

(1)

- (b) (i) The periodic table is now based on atomic structure.

Explain how.

(3)

- (ii) Suggest why it is impossible to have an undiscovered element that would fit between sodium and magnesium.

(1)

- (c) Explain, in terms of electrons, why fluorine is the most reactive element in Group 7.

(3)

(Total 9 marks)

Q5.

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.



- (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.



(2)

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

(3)

(Total 8 marks)

Q6.

This question is about Group 7 elements.

Chlorine is more reactive than iodine.

- (a) Name the products formed when chlorine solution reacts with potassium iodide solution.

(1)

- (b) Explain why chlorine is more reactive than iodine.

(3)

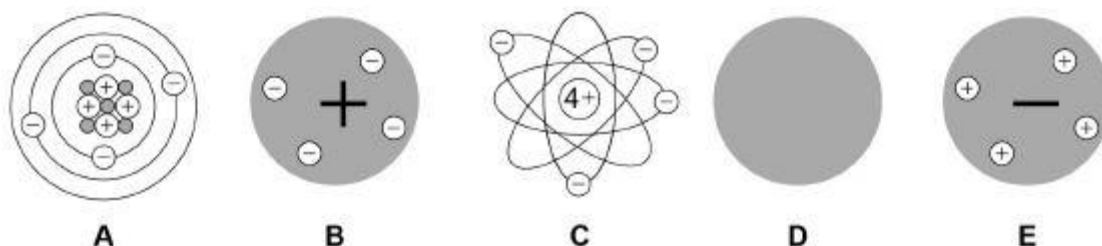
- (c) Chlorine reacts with hydrogen to form hydrogen chloride.

Explain why hydrogen chloride is a gas at room temperature.

Answer in terms of structure and bonding.

Q7.

The diagram below represents different models of the atom.



- (a) Which diagram shows the plum pudding model of the atom?

Tick **one** box.

A		B		C		D		E	
---	--	---	--	---	--	---	--	---	--

(1)

- (b) Which diagram shows the model of the atom developed from the alpha particle scattering experiment?

Tick **one** box.

A		B		C		D		E	
---	--	---	--	---	--	---	--	---	--

(1)

- (c) Which diagram shows the model of the atom resulting from Bohr's work?

Tick **one** box.

A		B		C		D		E	
---	--	---	--	---	--	---	--	---	--

(1)

- (d) Define the mass number of an atom.

(1)

- (e) Element **X** has two isotopes. Their mass numbers are 69 and 71

The percentage abundance of each isotope is:

- 60% of ^{69}X
- 40% of ^{71}X

Estimate the relative atomic mass of element **X**.

Tick **one** box.

< 69.5

☐

Between 69.5 and 70.0

☐

Between 69.5 and 70.0

☐

Between 70.0 and 70.5

☐

> 70.5

☐

(1)

- (f) Chadwick's experimental work on the atom led to a better understanding of isotopes.

Explain how his work led to this understanding.

(3)

(Total 8 marks)

Mark schemes

Q1.

- (a) (i) electronic structure 2,3 drawn
allow any representation of electrons, such as, dots, crosses, or numbers (2,3) 1
- (ii) nucleus 1
- (iii) protons and neutrons
*do **not** allow electrons in nucleus* 1
- (relative charge of proton) +1
allow positive 1
- (relative charge of neutron) 0
allow no charge/neutral 1
- ignore number of particles*
- (b) too many electrons in the first energy level or inner shell
allow inner shell can only have a maximum of 2 electrons 1
- too few electrons in the second energy level or outer shell
*allow neon has 8 electrons in its outer shell **or** neon does not have 1 electron in its outer shell*
allow neon has a stable arrangement of electrons or a full outer shell 1
- neon does not have 9 electrons **or** neon has 10 electrons
allow one electron missing
allow fluorine has 9 electrons 1
- ignore second shell can hold (maximum) 8 electrons or 2,8,8 rule or is a noble gas or in Group 0*
max 2 marks if the wrong particle, such as atoms instead of electrons
if no other mark awarded allow 1 mark for the electronic structure of neon is 2,8

[8]

Q2.

- (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, Cl₂, Br and Br₂
allow chlorine / it is more reactive
*do **not** allow chloride **or** bromide*
 1
- (iv) fluorine
allow F / F₂.
*do **not** allow fluoride.*
 1
- [5]

Q3.

- (a) (i) Na
allow sodium / phonetic spelling
if more than one answer is given apply list principle
 1
- (ii) Fe
allow iron / phonetic spelling
if more than one answer is given apply list principle
 1
- (iii) Na **or** S
allow sodium or sulfur / sulphur / phonetic spelling
if more than one answer is given apply list principle
 1
- (iv) S
allow sulfur / sulphur / phonetic spelling
if more than one answer is given apply list principle
 1
- (v) Na
allow sodium / phonetic spelling
if more than one answer is given apply list principle
 1
- (b) (i) any **three** from:
- effervescence / fizzing **or** bubbles **or** gas produced
*do **not** allow incorrectly named gas*
 - sodium melts **or** turns into a ball
 - sodium moves (on the surface)
 - steam / mist / vapour is produced
ignore heat / temperature / flame / spark
 - sodium gets smaller / disappears

- allow dissolves
- colour of indicator is darker / more intense near the sodium
Must be linked to near the sodium.

3

- (ii) hydroxide **or** OH^-
allow OH without a charge
do **not** allow OH^+

1

(c)

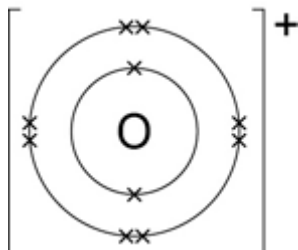


diagram showing electron configuration of ion is 2,8

1

charge on ion is +

Bracket not necessary

$[2,8]^+$ is worth 1 mark as there is no diagram

1

[11]

Q4.

- (a) (i) undiscovered elements owtte
- (ii) they would be in the wrong group / have the wrong / different properties / don't fit the pattern owtte

1

allow atomic weights may have been wrong

1

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

- elements arranged in proton / atomic number order
ignore mass number / atomic weight / neutrons throughout
- group: elements in the same group / column have same number of outer electrons owtte
- group: number of shells increase down group
- period: elements in the same period / row have the same number of shells / energy levels
- period: number of protons / electrons increase across period
- atomic number: link of atomic number to number of protons
- atomic number gives number of electrons

3

(ii) it would mean splitting a proton / electron

or

implication of splitting proton / electron

1

(c) *must be a comparison*

(outer) electron closer (to nucleus)

accept fewer (electron) shells / energy levels

fluorine is the smaller/est

1

stronger/est attraction (to nucleus) owtte

*do **not** allow magnetic / intermolecular forces*

or

less screening (by inner electrons)

1

electron gained more easily

need some indication of outer electron shell somewhere in explanation otherwise max of 2 marks

1

[9]

Q5.

(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) I₂

must both be on the right hand side of the equation

1

+ 2e⁻

2I⁻ - 2e⁻ → I₂ 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]

Q6.

- (a) potassium chloride **and** iodine

either order

allow KCl for potassium chloride and I₂ for iodine

1

- (b) (chlorine's) outer electrons / shell closer to the nucleus

allow chlorine has fewer shells

allow chlorine atom is smaller than iodine atom

ignore chlorine has fewer outer shells

1

(so) the chlorine nucleus has greater attraction for outer electrons / shell

allow chlorine has less shielding

*do **not** accept incorrect types of attraction*

1

(so) chlorine gains an electron more easily

1

max 2 marks can be awarded if the answer refers to chloride / iodide instead of chlorine / iodine

allow converse statements

allow energy levels for shells throughout

- (c) hydrogen chloride is made of small molecules

allow hydrogen chloride is simple molecular

1

(so hydrogen chloride) has weak intermolecular forces*

1

(intermolecular forces) require little energy to overcome*

1

do **not accept reference to bonds breaking unless applied to intermolecular bonds*

Q7.

- (a) B 1
- (b) C 1
- (c) A 1
- (d) sum of protons and neutrons
allow number of protons and neutrons 1
- (e) between 69.5 and 70.0 1
- (f) Chadwick provided the evidence to show the existence of neutrons
allow Chadwick discovered neutrons 1

(this was necessary because) isotopes have the same number of protons
*allow (this was necessary because) isotopes
have the same atomic number*

or

(this was necessary because) isotopes are atoms of the same element
*ignore isotopes have the same number of
electrons*

but with different numbers of neutrons
allow but with different mass (numbers) 1

[8]