Atomic Structure 2

Name: _____

Class: _____

Date: _____

Time: **77 minutes**

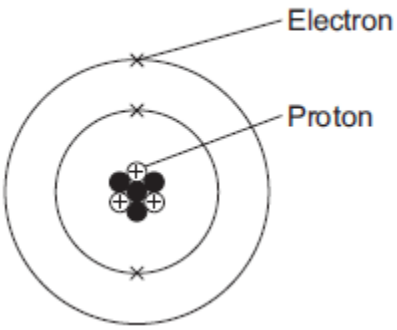
Marks: **77 marks**

Comments:

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

(a) **Figure 1** shows a lithium atom.

Figure 1



(i) What is the mass number of the lithium atom in **Figure 1**?

Tick (✓) **one** box.

3 ☐

4 ☐

7 ☐

(1)

(ii) What is the charge of an electron?

Tick (✓) **one** box.

–1 ☐

0 ☐

+1 ☐

(1)

(iii) Protons are in the nucleus.

Which other sub-atomic particles are in the nucleus?

Tick (✓) **one** box.

ions ☐

molecules ☐

neutrons ☐

(1)

(b) What is **always** different for atoms of different elements?

Tick (✓) **one** box.

number of neutrons ☐

number of protons ☐

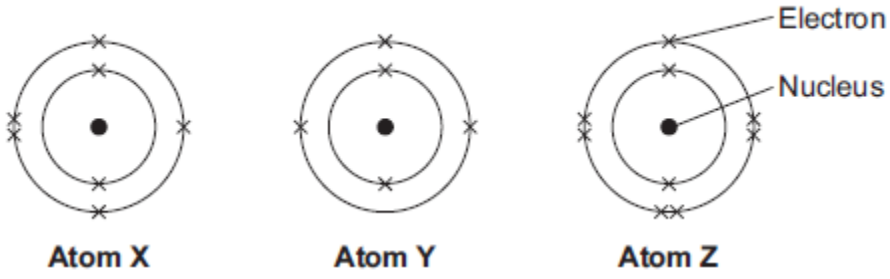
number of shells ☐

(1)

(c) **Figure 2** shows the electron arrangements of three different atoms, **X**, **Y** and **Z**.

These atoms are from elements in the second row (lithium to neon) of the periodic table.

Figure 2



Which atom is from an element in Group 3 of the periodic table?

Tick (✓) **one** box.

Atom X ☐

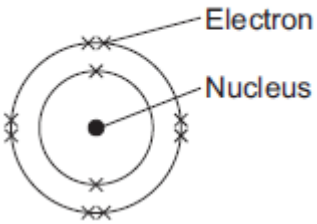
Atom Y ☐

Atom Z ☐

(1)

(d) **Figure 3** shows the electron arrangement of a different atom from an element in the second row of the periodic table.

Figure 3



(i) Give the chemical symbol of this element.

_____

(1)

(ii) Why is this element unreactive?

_____

_____

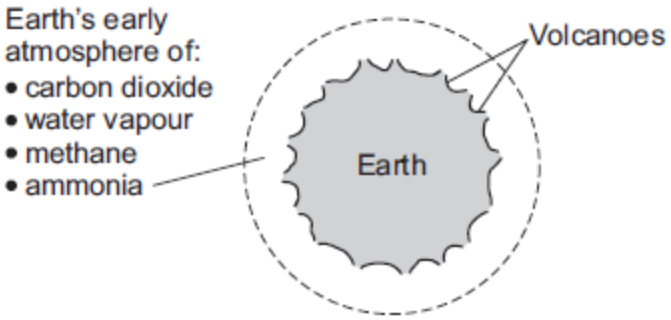
(1)

(Total 7 marks)

2. This question is about the Earth and its atmosphere.

(a) **Figure 1** shows the Earth and its atmosphere billions of years ago.

Figure 1



The boiling point of water is 100 °C.

Suggest **one** reason why there was no liquid water on the Earth's surface billions of years ago.

_____

_____

(1)

(b) The Earth's atmosphere today contains nitrogen, oxygen, argon, carbon dioxide and other gases.

(i) Draw **one** line from each substance to a description of the substance.

Substance	Description of the substance
air	compound
carbon dioxide	element
argon	hydrocarbon
	metal
	mixture

(3)

(ii) Which gas in the Earth's atmosphere is used when hydrocarbons burn?

Tick (✓) **one** box.

carbon dioxide ☐

nitrogen ☐

oxygen ☐

(1)

(iii) What percentage of the Earth's atmosphere is nitrogen?

Tick (✓) **one** box.

about 40% ☐

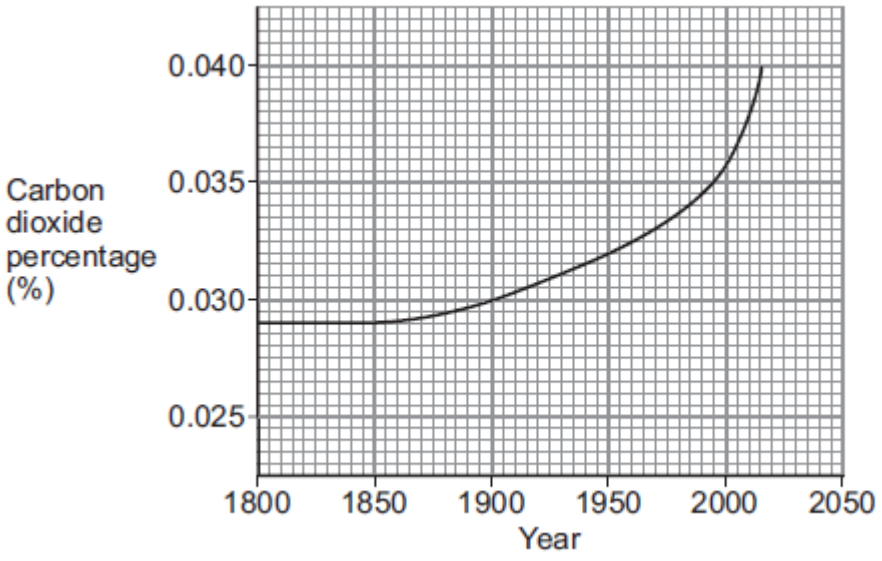
about 60% ☐

about 80% ☐

(1)

(c) **Figure 2** shows the carbon dioxide percentage (%) in the Earth's atmosphere since the year 1800.

Figure 2



(i) What was the carbon dioxide percentage in 1900?

_____ %

(1)

(ii) Describe, in detail, how the carbon dioxide percentage changed from 1900 to 2015.

_____

_____

_____

_____

(2)

(iii) Suggest **two** reasons for the change in the carbon dioxide percentage from 1900 to 2015.

1. _____

_____

2. _____

_____

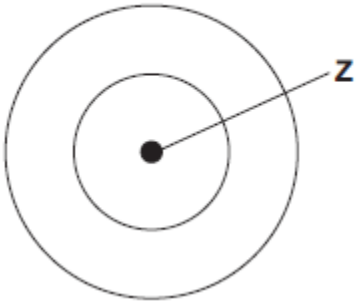
(2)

(Total 11 marks)

3. 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).

Figure 1



(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.

_____

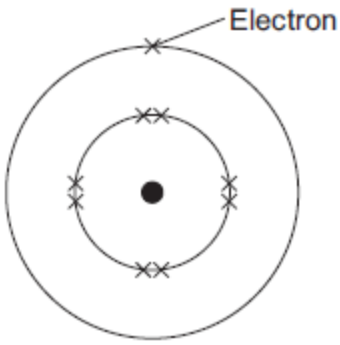
_____

_____

(3)

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

Figure 2



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

_____

_____

_____

_____

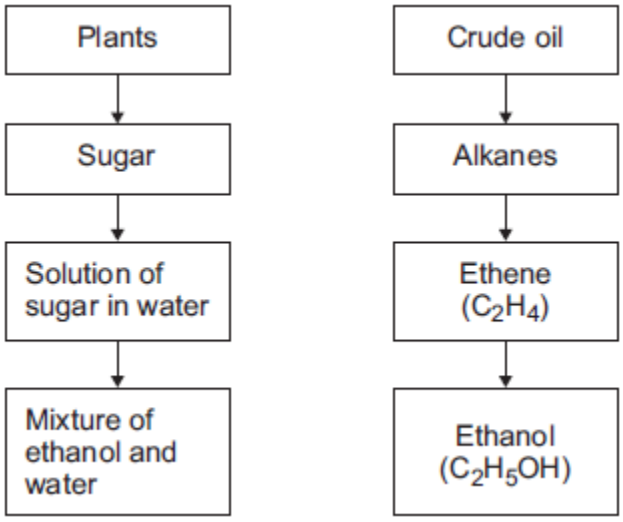
_____

_____

(3)

(Total 8 marks)

4. Ethanol can be made from plants and from crude oil as shown in the diagram below.



(a) Describe how the solution of sugar in water is used to produce the mixture of ethanol and water.

_____

_____

_____

_____

(2)

(b) Ethanol has a boiling point of 78 °C.
Water has a boiling point of 100 °C.

Describe how distillation is used to separate a mixture of ethanol and water.

_____

_____

_____

_____

_____

(3)

(Total 5 marks)

5. This question is about elements and the periodic table.

(a) Use the correct answers from the box to complete the sentences.

atoms	**atomic weights**	**electrons**	**proton numbers**

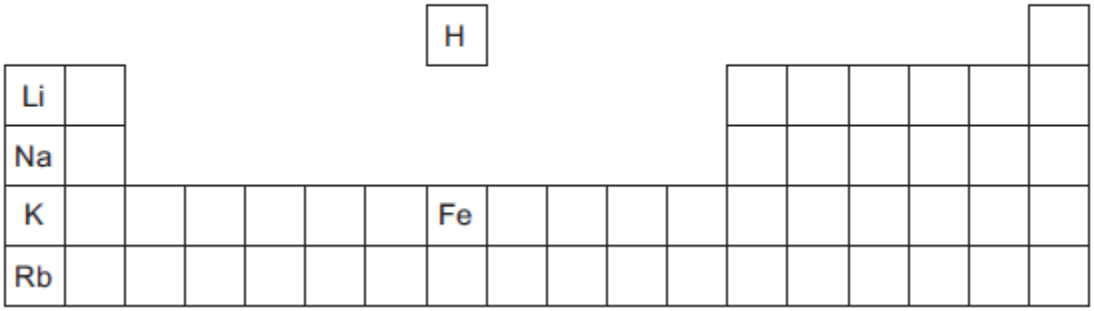
Newlands' and Mendeleev's periodic tables show the elements in order of their _____ .

Following the discovery of protons and _____, the modern periodic table shows the elements in order of their _____ .

(3)

(b) **Figure 1** shows the position of six elements in the modern periodic table.

Figure 1



(i) Which **one** of these six elements has the lowest boiling point?

_____

(1)

(ii) Complete the sentence.

In the periodic table, rubidium (Rb) is in Group _____ .

(1)

(iii) Which of these three elements is the most reactive?

Tick (✓) **one** box.

Lithium (Li) ☐

Sodium (Na) ☐

Potassium (K) ☐

(1)

(iv) Which **two** statements are correct?

Tick (✓) **two** boxes.

Iron has a higher density than potassium. ☐

Iron is softer than potassium. ☐

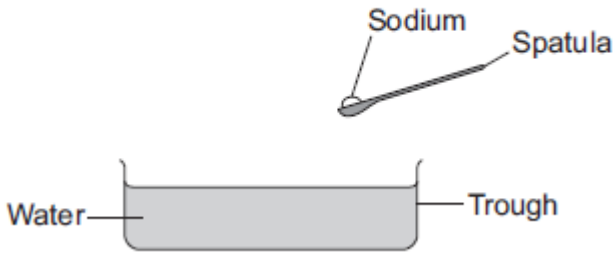
Iron reacts vigorously with water. ☐

Iron forms ions that have different charges. ☐

(2)

(c) **Figure 2** shows sodium being put into water.

Figure 2



Describe **three** observations that can be seen when sodium is put into water.

1. _____

_____

2. _____

_____

3. _____

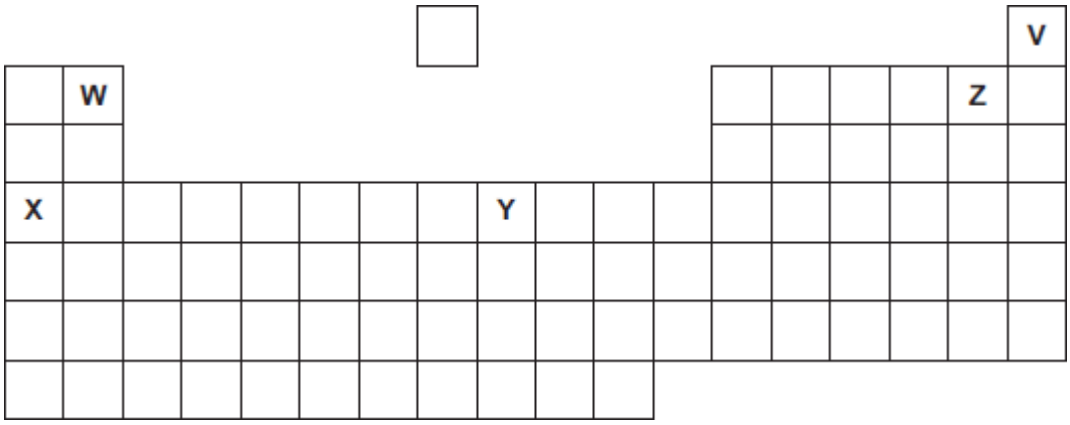
_____

(3)

(Total 11 marks)

6. 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)

7. This question is about elements and the periodic table.

(a) Newlands and Mendeleev both produced early versions of the periodic table.

(i) Complete the sentence.

In their periodic tables, Newlands and Mendeleev arranged the elements in

order of _____ .

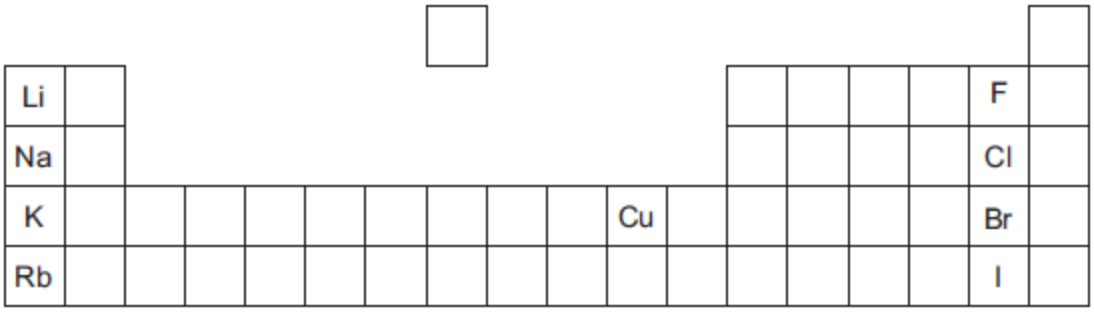
(1)

(ii) Name the particle that allowed the elements to be arranged in order of their atomic number in the modern periodic table.

_____

(1)

(b) The diagram below shows the position of nine elements in the modern periodic table.



(i) Which **one** of the nine elements shown in the diagram above has the lowest boiling point?

_____

(1)

(ii) Copper and potassium have different melting points and boiling points.
Give **one other** difference between the properties of copper and potassium.

_____

_____

(1)

(iii) Explain why the reactivity of the elements increases going down Group 1 from lithium to rubidium but decreases going down Group 7 from fluorine to iodine.

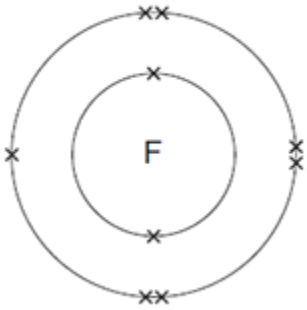
(4)

(Total 8 marks)

8. This question is about fluorine.

(a) **Figure 1** shows the arrangement of electrons in a fluorine atom.

Figure 1



(i) In which group of the periodic table is fluorine?

Group _____

(1)

(ii) Complete the table below to show the particles in an atom and their relative masses.

Name of particle	Relative mass
Proton	
Neutron	1
	Very small

(2)

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

alkalis	alloys	isotopes

Atoms of fluorine with different numbers of neutrons are

called _____ .

(1)

(b) Sodium reacts with fluorine to produce sodium fluoride.

(i) Complete the word equation for this reaction.

sodium + _____ → _____

(1)

(ii) Complete the sentence.

Substances in which atoms of two or more different elements are chemically

combined are called _____ .

(1)

(iii) The relative formula mass (M_r) of sodium fluoride is 42.

Use the correct answer from the box to complete the sentence.

ion	mole	molecule

The relative formula mass (M_r), in grams, of sodium fluoride is one

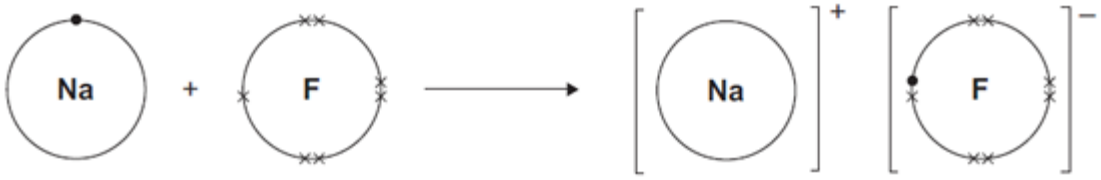
_____ of the substance.

(1)

(iv) **Figure 2** shows what happens to the electrons in the outer shells when a sodium atom reacts with a fluorine atom.

The dots (•) and crosses (×) represent electrons.

Figure 2



Use **Figure 2** to help you answer this question.

Describe, as fully as you can, what happens when sodium reacts with fluorine to produce sodium fluoride.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(v) Sodium fluoride is an ionic substance.

What are **two** properties of ionic substances?

Tick (✓) **two** boxes.

Dissolve in water	☐
Gas at room temperature	☐
High melting point	☐
Low boiling point	☐

(2)

(Total 13 marks)

9. 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.

_____

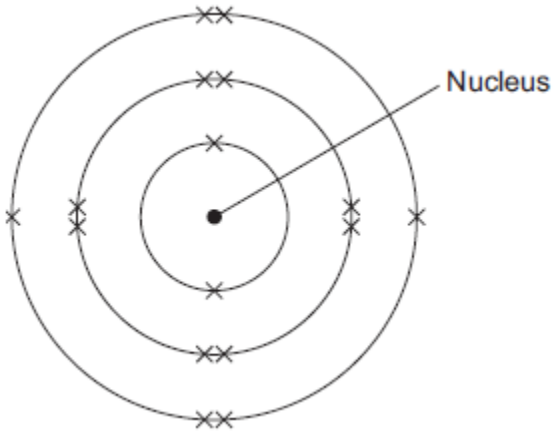
_____

_____

_____

(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)

1. (a) (i) 7

1

(ii) –1

1

(iii) neutrons

1

(b) number of protons

1

(c) atom **Y**

1

(d) (i) Ne

allow neon

1

(ii) has a full outer shell

allow in Group 0

allow a noble gas

or

full outer energy level

allow the shells are full

or

has 8 electrons in its outer shell

ignore in Group 8

1

[7]

2. (a) the Earth's (surface) temperature was high **or** at/above 100 °C

allow the Earth's (surface) temperature was too / very hot ***or*** *water evaporated / boiled* ***or*** *turned to steam / gas*

allow because of heat from volcanoes

ignore the Earth's (surface) was covered by volcanoes

ignore water turned to water vapour

1

(b) (i) air ——— mixture

1

carbon dioxide ——— compound

1

argon ——— element

1

allow only one line from each substance

(ii) oxygen

1

(iii) about 80 %

1

(c) (i) 0.03(0) (%)

1

(ii) increased

1

slowly then rapidly

1

allow figures from graph to indicate increase

(iii) any **two** from:

- use of fossil fuels
- deforestation

allow less trees / plants

- cars/transport
- industry/factories

ignore more people

2

[11]

3. (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]

4. (a) add yeast

1

and ferment **or** by fermentation

*allow in a warm place **or** temperatures within the range 20-45^{o}C **or** with an airlock / absence of air*

1

(b) heat (the mixture)

1

ethanol has a lower boiling point than water **or** more ethanol than water vaporises **or** ethanol evaporates first or when the temperature reaches 78^{o}C

allow ethanol and water boil at different temperatures

1

condense (the vapour)

allow condense at different temperatures for the last two marking points

if no other mark is awarded, allow repeat distillation or use fractional distillation apparatus for 1 mark

1

[5]

5. (a) atomic weights

must be in this order

1

electrons

1

proton numbers

1

(b) (i) H/hydrogen

allow H_2 or h

1

(ii) one / 1

allow alkali metals

1

(iii) Potassium (K)

1

(iv) Iron has a higher density than potassium

1

Iron forms ions that have different charges

1

(c) any **three** from:

- melts
- fizzes / bubbles / effervesces
  allow gas produced
- sodium floats
- size of the sodium decreases
  allow dissolves / disappears
- sodium moves
  allow two marks for moves around on the surface of the water

3

[11]

6. (a) Y

1

(b) W

1

(c) V

1

(d) W

1

(e) X

1

[5]

7. (a) (i) atomic weights

allow atomic masses

1

(ii) proton

allow proton number

1

(b) (i) F/fluorine

allow F_2

1

(ii) any **one** from:

- copper has a higher density
- copper is stronger
- copper is harder
- copper is less reactive

allow named property

ignore colour, conductivity, melting point and boiling point

allow converse for potassium

1

(iii) relative distance from nucleus

allow more / fewer energy levels / shells or larger / smaller atom

1

relative attraction to nucleus

allow more / less shielding

1

relative ease of gain or loss of electron

1

opposite explanation of ease of gain or loss of electron for other group

1

max 3 marks if 'outer' not mentioned

[8]

8. (a) (i) 7 / seven

1

(ii) 1

*do **not** accept –1*

1

Electron

1

(iii) isotopes

1

(b) (i) (sodium +) fluorine → sodium fluoride

1

(ii) compounds

1

(iii) mole

1

(iv) sodium (atom) loses

1

fluorine (atom) gains

1

one electron

1

ions formed

1

allow sodium forms positive (ion) ***or*** *fluorine forms negative (ion)*
allow form ionic bond
allow to gain a full outer shell of electrons
allow forms noble gas structure
max 3 *if reference to incorrect particle / bonding*

(v) Dissolve in water

1

High melting point

1

[13]

9. (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]