Q1.

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

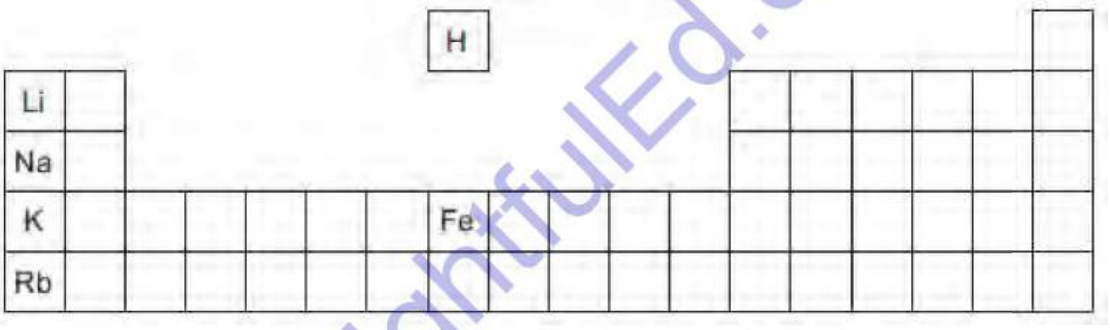
Newlands' and Mendeleev's periodic tables show the elements in order of their _____ .

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?

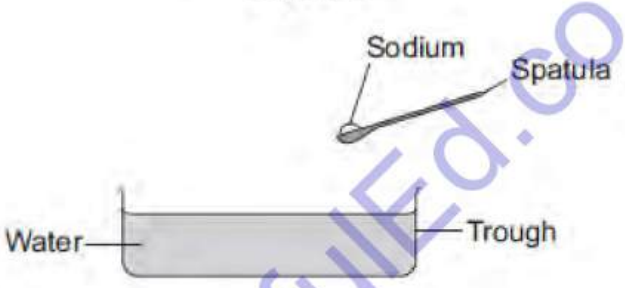
Tick (✓) **two** boxes.

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)

Q2.

This question is about Group 1 elements.

(a) Complete **Table 1** to show the electronic structure of a potassium atom.

Table 1

Atom	Number of electrons	Electronic structure
Sodium	11	2,8,1

Potassium	19	

(1)

(b) Why do Group 1 elements have similar chemical properties?

Tick (✓) **one** box.

They have the same number of electron shells. ☐

They have the same number of outer shell electrons. ☐

They have two electrons in the first shell. ☐

(1)

(c) What is the type of bonding in sodium?

Tick (✓) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

(1)

Table 2 shows observations made when lithium, potassium and rubidium react with water.

Table 2

Element	Observations
Lithium	Bubbles slowly Floats Moves slowly
Sodium	1 _____ 2 _____
Potassium	Bubbles very quickly Melts into a ball Floats Moves very quickly Flame
Rubidium	Sinks Melts into a ball

	Explodes with a flame

(d) Give **two** observations you could make when sodium reacts with water.

Write your answers in **Table 2**.

(2)

(e) How does the reactivity of the elements change going down Group 1?

_____

_____

(1)

(f) Give **two** ways in which the observations in **Table 2** show the change in reactivity going down Group 1.

1 _____

_____

2 _____

_____

(2)

(g) Which gas is produced when Group 1 elements react with water?

Tick (✓) **one** box.

Carbon dioxide ☐

Hydrogen ☐

Nitrogen ☐

Oxygen ☐

(1)

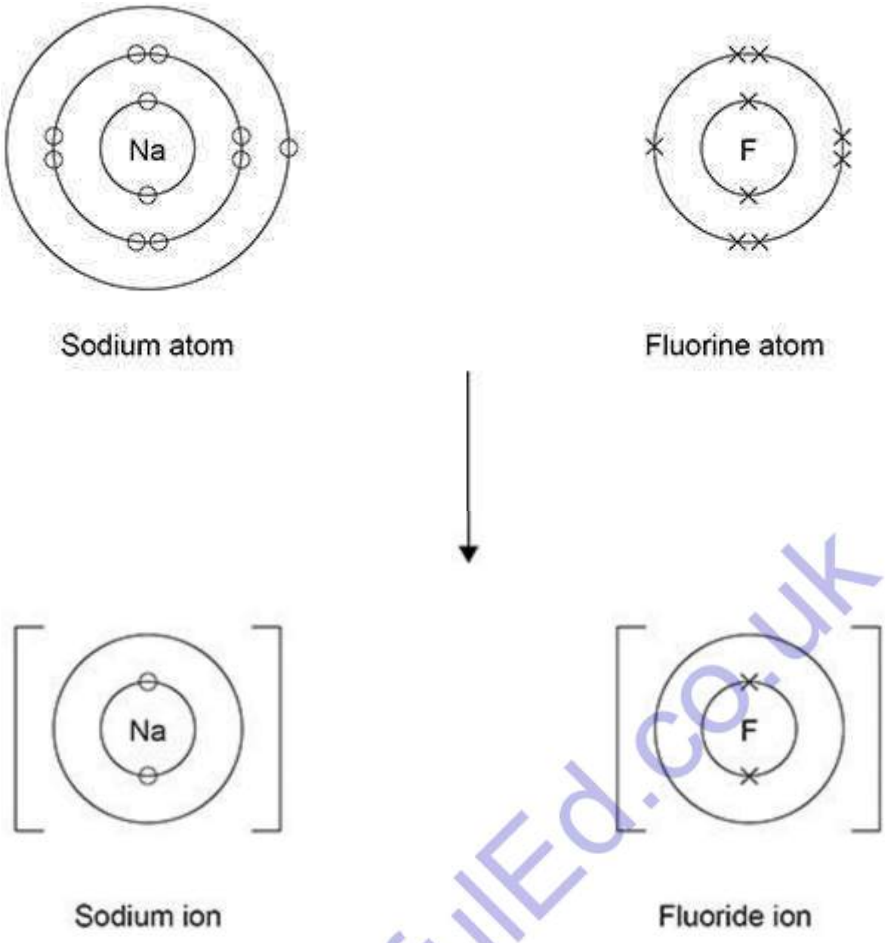
(h) Sodium fluoride is an ionic compound.

The diagram below shows dot and cross diagrams for a sodium atom and a fluorine atom.

Complete the diagram below to show what happens when a sodium atom and a fluorine atom react to produce sodium fluoride.

You should:

- complete the electronic structures of the sodium ion and the fluoride ion
- give the charges on the sodium ion and the fluoride ion.



(3)

(Total 12 marks)

Q3.

This question is about groups in the periodic table.

The elements in Group 1 become more reactive going down the group.

Rubidium is below potassium in Group 1.

(a) Rubidium and potassium are added to water.

Predict **one** observation you would see that shows that rubidium is more reactive than potassium.

_____

_____

(1)

(b) Explain why rubidium is more reactive than potassium.

_____

_____

_____

_____

(3)

(c) Complete the equation for the reaction of rubidium with water.

You should balance the equation.

$$Rb + H_2O \rightarrow \quad +$$

(3)

The noble gases are in Group 0.

(d) Which is a correct statement about the noble gases?

Tick (✓) **one** box.

The noble gases all have atoms with eight electrons in the outer shell.	☐
The noble gases have boiling points that increase going down the group.	☐
The noble gases have molecules with two atoms.	☐
The noble gases react with metals to form ionic compounds.	☐

(1)

(e) The table below shows information about the three isotopes of neon.

Mass number	Percentage abundance (%)
20	90.48
21	0.27
22	9.25

Calculate the relative atomic mass (A_r) of neon.

Give your answer to 3 significant figures.

Relative atomic mass (3 significant figures) = _____

(3)

(Total 11 marks)

Q4.

The following article appeared recently in the *Manchester Gazette*.

Sodium Drum Blaze Scare

A 20 litre drum containing sodium burst into flames when it reacted violently with rainwater at a Manchester factory. It is believed that the sodium, which is normally stored under oil, had been accidentally left outside with the lid off.

A factory worker put out the blaze before the fire services arrived, and a leading fire fighter said, "It was fortunate that potassium wasn't involved as it would have reacted more violently and exploded. These Group 1 *alkali metals* can be very dangerous".

(a) Group 1 metals are stored under oil.

Suggest why.

_____

(1)

(b) Balance the equation which represents the reaction between sodium and water.

$$Na + H_2O \rightarrow NaOH + H_2$$

(1)

(c) Explain why the Group 1 metals are called the *alkali metals*.

_____

_____

(1)

(d) Explain, in terms of electrons, why potassium reacts more violently than sodium.

_____

_____

_____

_____

_____

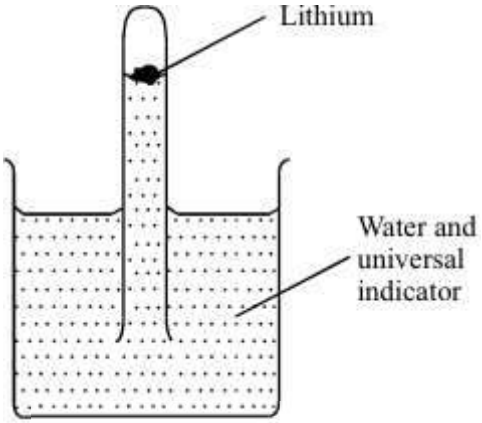
_____

(3)

(Total 6 marks)

Q5.

The diagram shows an experiment to study the reaction of lithium with water.



(a) Describe, as fully as you can, what you would see as the lithium reacts with the water in this experiment.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

_____

_____

_____

_____

_____

(3)

(b) The reaction has two products. Complete the word equation for this reaction by choosing the correct substances from the box.

hydrogen	**lithium hydride**	**lithium hydroxide**
lithium oxide		**oxygen**

lithium + water → _____ + _____

(2)

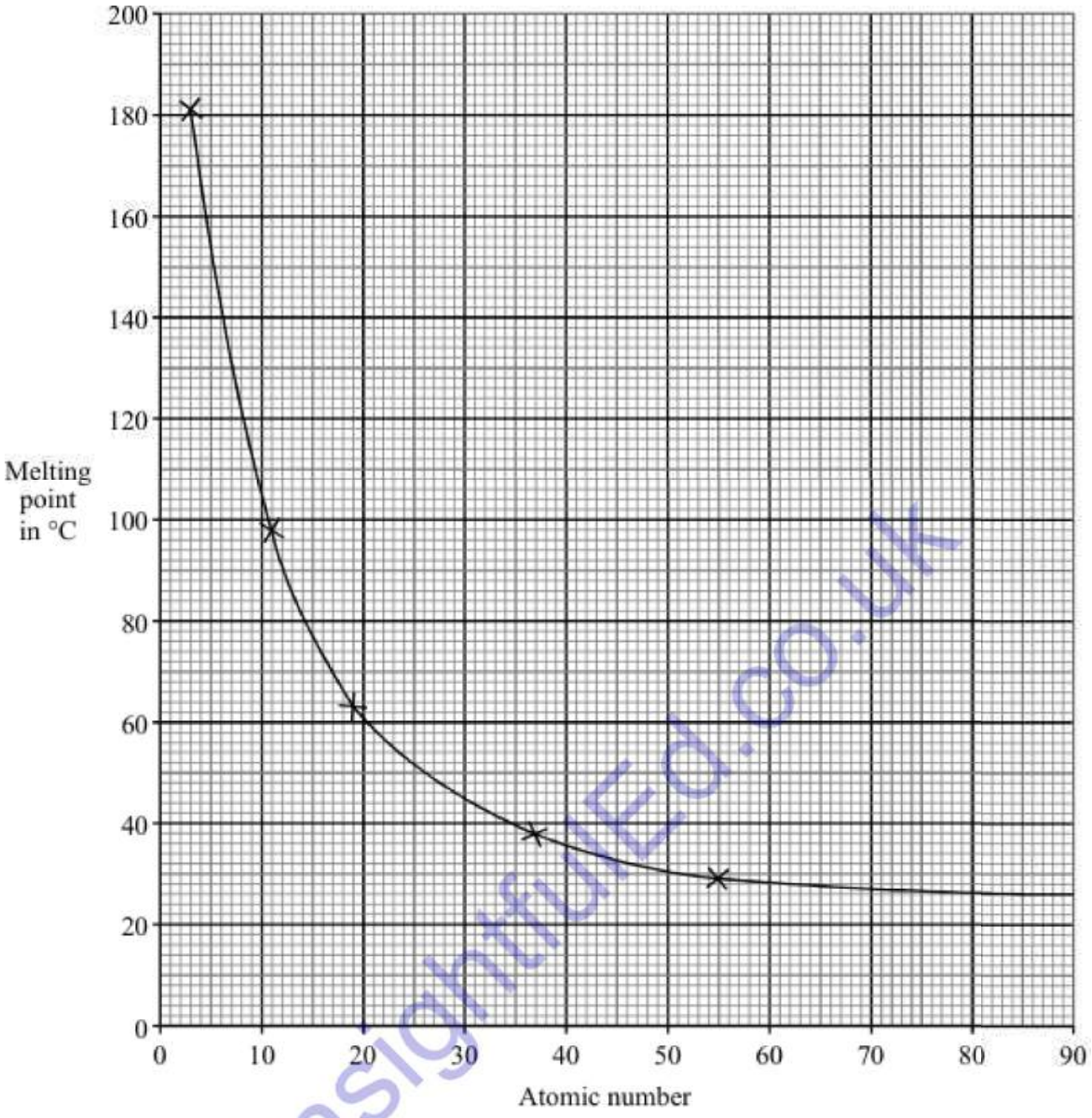
(c) Caesium is lower down in Group 1 of the periodic table than lithium.
Suggest how the reaction of caesium with water might be different from lithium's reaction.

_____

_____

(1)

(d) The graph shows the melting points of the Group 1 metals plotted against their atomic numbers.



(i) Describe fully how the melting points change as the atomic number increases.

_____

_____

_____

(2)

(ii) Francium has an atomic number of 87.
Use the graph to estimate the melting point of francium.

Estimate of melting point _____ °C

(1)

(Total 9 marks)

Q6.

Potassium reacts violently with cold water.

It forms an alkaline solution of potassium hydroxide and hydrogen.

potassium + water → potassium hydroxide + hydrogen

(a) In what physical state is hydrogen given off?

Choose your answer from the words in the box.

gas	liquid	solid	solution

_____

(1)

(b) (i) What type of substance will neutralise potassium hydroxide solution?

_____

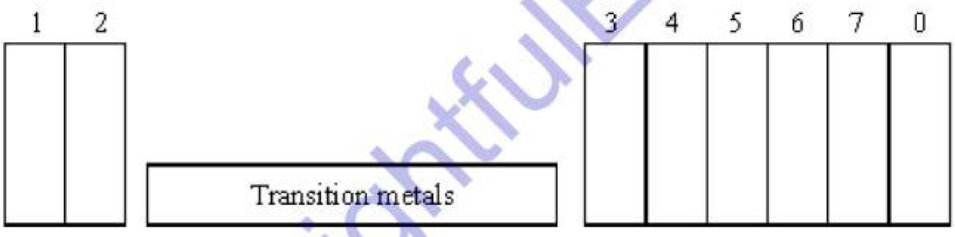
(1)

(ii) What is the pH of the neutral solution?

_____

(1)

(c) In the Periodic Table there are eight main groups.



What is the number of the group that has potassium in it?

_____

(1)

(d) Sodium is in the same group as potassium.

(i) How does sodium react with cold water and what is formed?

_____

_____

(2)

(ii) How can you prove that an alkaline solution is formed when sodium reacts with water?

_____

_____

(2)

(e) Lithium reacts more slowly with cold water than sodium.

State **two** ways the reaction can be made to go faster.

_____

_____

(2)

(Total 10 marks)

Q7.

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 _____ .

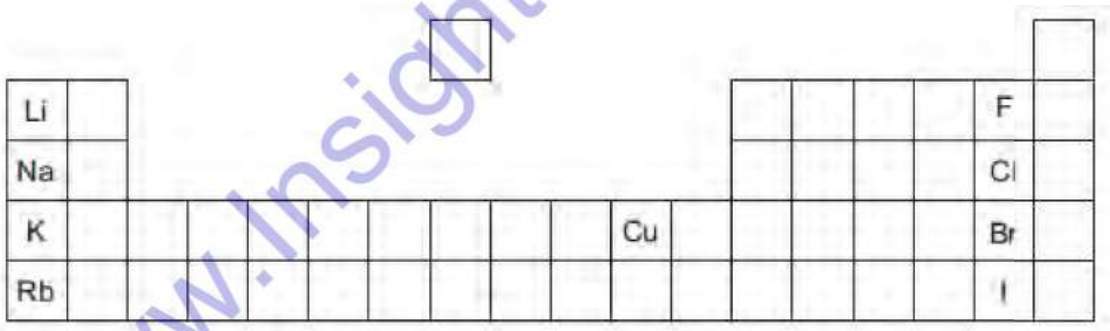
(1)

(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)

Mark schemes

Q1.

(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]

Q2.

(a) 2,8,8,1

1

(b) they have the same number of outer shell electrons

1

(c) metallic

1

(d) any **two** from:

- bubbles (very) quickly

- melts (into a ball)
- floats
- moves (very) quickly

allow flame

2

(e) (reactivity) increases (down the group)

1

(f) any **two** from:
- increasing speed of movement
- increasing rate of bubble production
- doesn't melt → melts
- no flame → flame

or

flame → explosion

2

(g) hydrogen

1

(h) sodium ion structure 2,8

1

fluoride ion structure 2,8

allow any combination of circles, dots, crosses or $e^{(-)}$

1

+ charge on sodium ion **and**
– charge on fluoride ion

an answer of

sodium ion fluoride ion

scores **3** marks

1

[12]

Q3.

(a) any **one** from:
- more vigorous bubbling (for rubidium)
- bigger / brighter flame (for rubidium)

allow converse statements for potassium
allow (rubidium) catches fire more quickly
allow (rubidium) moves around more quickly
allow (rubidium) explodes
allow (rubidium) disappears more quickly

allow (rubidium) melts more quickly

1

(b) (rubidium's) outer shell / electron is further from the nucleus

allow the (rubidium) atom is larger

allow (rubidium) has more shells

1

(so) there is less (electrostatic) attraction between the nucleus and the outer electron (in rubidium)

allow (so) there is more shielding between the outer electron and the nucleus (in rubidium)

1

(so) the outer electron (in rubidium) is more easily lost

allow (so) less energy is needed to remove the (outer) electron (in rubidium)

1

allow energy level for shell throughout

allow converse argument in terms of potassium

(c) $2\ Rb + 2\ H_2O \rightarrow 2\ RbOH + H_2$

ignore state symbols

allow multiples

*allow **1** mark for H_2*

*allow **1** mark for RbOH*

3

(d) the noble gases have boiling points that increase going down the group

1

(e) (relative atomic mass =) $\frac{(90.48 \times 20)+(0.27 \times 21)+(9.25 \times 22)}{100}$

allow (relative atomic mass =) $\frac{1809.6 + 5.67 + 203.5}{100}$

allow (relative atomic mass =) 18.096 + 0.0567 + 2.035

1

= 20.1877

1

= 20.2

allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses all of the values in the table

ignore units

1

[11]

Q4.

(a) acts as barrier between sodium and air / oxygen / water (vapour)

accept because they are reactive

ignore oil will not react

1

(b) $2Na + 2H_2O \rightarrow 2NaOH + H_2$

allow multiples / fractions

1

(c) these metals react with water producing an alkaline solution

or

produce solution with pH greater than 7 / high pH

owtte

allow produce OH. ions

not *these metals are / form alkalis*

ignore 'strong' pH

1

(d) *it = potassium*

*outer electron must be mentioned once for all **3** marks*

bigger atom
or
outer shell electron further from nucleus
or
more shells

or

converse argument for sodium less reactive provided sodium is specified

1

less attraction to nucleus
or
more shielding

not *less magnetic attraction*

1

outer electron more easily lost

ignore *potassium reacts more easily*

1

[6]

Q5.

(a) **Quality of Written Communication**

The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.

*maximum **2** marks if ideas not well expressed*

any **three** from:

*do **not** accept flames*

floats

fizzes / bubbles or produces a gas

ignore reference to heat

indicator goes blue / purple / violet (alkaline colour)

3

water level in test tube goes down **or** gas fills the test tube

lithium 'dissolves' (owtte)

moves around (on surface of water)

steam

(b) lithium hydroxide

1

hydrogen

1

(c) more violent / reactive

accept a description of the reaction which indicates greater violence

1

(d) (i) decreases

1

and then slows down **or** levels off

1

(ii) 26(°C)

1

[9]

Q6.

(a) gas

1

(b) (i) acid

ignore any reference to a particular kind of acid

1

(ii) 7

1

(c) 1

*credit potassium **or** K written into Group 1*

1

(d) (i) reacts rapidly **or** quickly **or** fast

*credit melts **or** fizzes **or** dissolves **or** violently **or** less violently (than K)*

1

sodium hydroxide **or** hydrogen

*credit NAOH **or** H2*

1

(ii) add universal indicator

*credit add indicator **or** litmus **or** use pH paper*

1

turns blue **or** purple

credit 'it goes purple' providing something has been added to the water

1

(e) any two from

heat **or** warm

cut it up **or** have smaller pieces or larger surface area

*do not accept more lithium **or** less water*

stir

2

[10]

Q7.

(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]