

Name: \_\_\_\_\_

# Atomic Structure & Periodic Table part 2 AQA Triple Chemistry

Date: \_\_\_\_\_

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Time: **93 minutes**

Marks: **89 marks**

Comments:

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1.

This question is about atoms.

Atoms contain three types of particle:

- electrons
- neutrons
- protons.

(a) Which particle has no electrical charge?

Tick (✓) **one** box.

Electron	<input type="checkbox"/>
Neutron	<input type="checkbox"/>
Proton	<input type="checkbox"/>

(1)

(b) Which particles have the same relative mass?

Tick (✓) **one** box.

An electron and a neutron	<input type="checkbox"/>
An electron and a proton	<input type="checkbox"/>
A neutron and a proton	<input type="checkbox"/>

(1)

(c) The formula of a compound is  $N_2O$

How many of each type of atom are in one molecule of  $N_2O$ ?

Nitrogen \_\_\_\_\_  
Oxygen \_\_\_\_\_

(2)

An atom of element **Z** contains:

- 3 electrons
- 4 neutrons
- 3 protons.

(d) Give the name of element **Z**.

Use the periodic table.

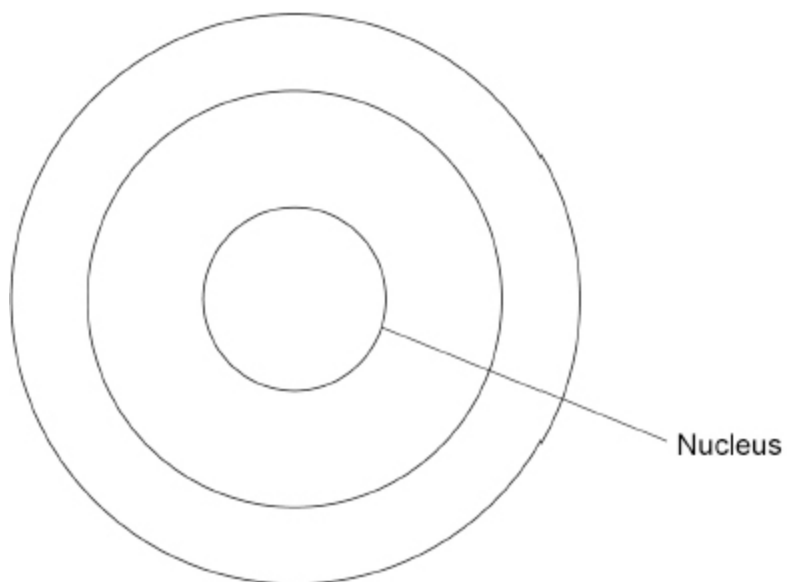
\_\_\_\_\_

(1)

(e) Complete the figure below to show the position of the particles in an atom of element **Z**.

Use the symbols:

- × = electron
- = neutron
- = proton



(4)

(Total 9 marks)

2.

This question is about carbon.

(a) Which type of substance is carbon?

Tick (✓) **one** box.

Compound

Element

Mixture

(1)

(b) Carbon has isotopes with mass numbers 12, 13 and 14.

Complete the sentences.

Choose answers from the box.

electrons

ions

molecules

neutrons

protons

The isotopes of carbon have the same number of \_\_\_\_\_.

The isotopes of carbon have a different number of \_\_\_\_\_.

(2)

(c) 12 g of carbon contains  $6.02 \times 10^{23}$  atoms.

Which expression is used to calculate the mass of one atom of carbon?

Tick (✓) **one** box.

$$\frac{12}{6.02 \times 10^{23}}$$

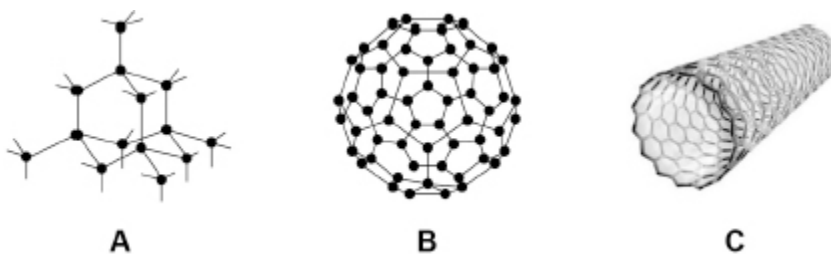
$$\frac{6.02 \times 10^{23}}{12}$$

$$12 \times 6.02 \times 10^{23}$$

(1)

(d) **Figure 1** shows diagrams that represent different forms of carbon.

**Figure 1**



Which diagram in **Figure 1** represents Buckminsterfullerene?

Tick (✓) **one** box.

A

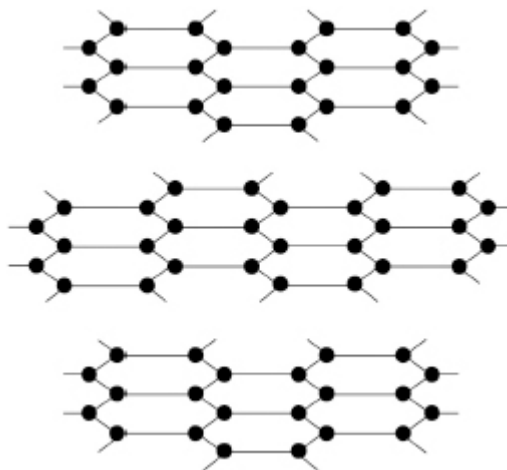
B

C

(1)

(e) **Figure 2** represents part of the structure of graphite.

**Figure 2**



Draw **one** line from each property of graphite to the structural feature that is the reason for that property.

Property	Structural feature
Graphite conducts electricity.	Graphite has hexagonal rings of carbon atoms.
	The bonds between carbon atoms in the layers are strong.
Graphite is soft.	There are no covalent bonds between layers of atoms.
	There are delocalised electrons in graphite.

(2)

(Total 7 marks)

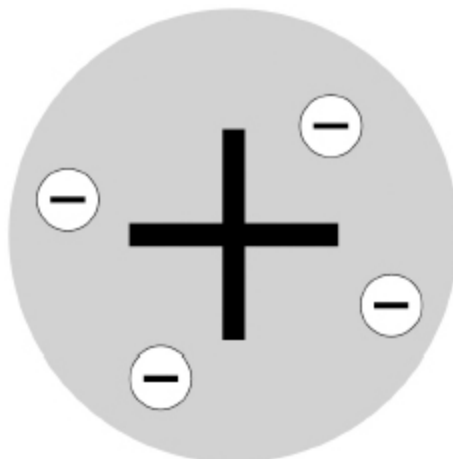
3.

Discoveries in chemistry led to a better understanding of atomic structure.

(a) Atoms were originally thought to be tiny spheres that could not be divided.

The plum pudding model of the atom was then developed.

The figure below represents the plum pudding model of the atom.



Describe the plum pudding model of the atom.

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(2)

(b) Atoms contain electrons, neutrons and protons.

Write these three particles in order of their discovery.

Earliest \_\_\_\_\_

\_\_\_\_\_

Latest \_\_\_\_\_

(1)

Very few atoms of the element tennessine (Ts) have ever been identified.

The atomic number of tennessine is 117

(c) Predict the number of outer shell electrons in an atom of tennessine.

Give **one** reason for your answer.

Use the periodic table.

Number of outer shell electrons \_\_\_\_\_

Reason \_\_\_\_\_

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(2)

(d) Tennessine was first identified by a small group of scientists in 2010.

Suggest **one** reason why tennessine was **not** accepted as a new element by other scientists until 2015.

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(1)

- (e) The discovery of isotopes explained why some relative atomic masses are not whole numbers.

Element **R** has two isotopes.

The table below shows the mass numbers and percentage abundances of the isotopes of element **R**.

Mass number	Percentage abundance (%)
6	7.6
7	92.4

Calculate the relative atomic mass ( $A_r$ ) of element **R**.

Give your answer to 1 decimal place.

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Relative atomic mass (1 decimal place) = \_\_\_\_\_

(3)

(Total 9 marks)

4.

This question is about elements in the periodic table.

- (a) Argon has the atomic number 18

Explain why argon does **not** form compounds.

Answer in terms of electrons.

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(2)

(b) Phosphorus (P) is the element below nitrogen in the periodic table.

Predict the formula of the compound formed between phosphorus and hydrogen.

Formula = \_\_\_\_\_

(1)

(c) Tellurium is the element with atomic number 52

Predict whether tellurium reacts with metals.

Explain your answer.

Answer in terms of the position of tellurium in the periodic table.

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(2)

Barium (Ba) is an element in Group 2 of the periodic table.

Barium reacts with hydrochloric acid.

(d) Suggest **two** observations that could be made when barium reacts with hydrochloric acid.

1 \_\_\_\_\_  
\_\_\_\_\_

2 \_\_\_\_\_  
\_\_\_\_\_

(2)

(e) Write a balanced symbol equation for the reaction between barium and hydrochloric acid.

\_\_\_\_\_ + \_\_\_\_\_ → \_\_\_\_\_ + \_\_\_\_\_

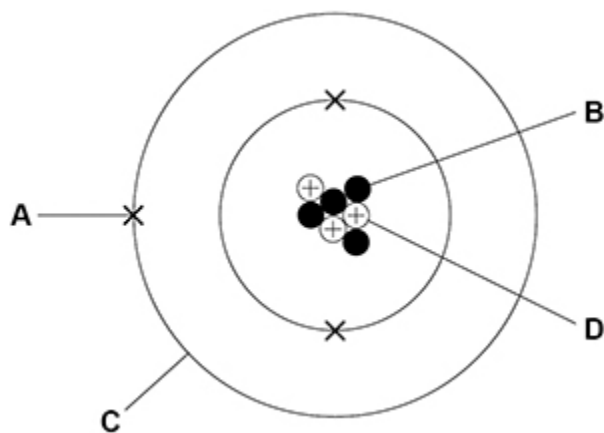
(3)

(Total 10 marks)

5.

This question is about atoms.

(a) The figure below represents an atom of an element.



Draw **one** line from each name to the correct label.

Name	Label
Neutron	A
	B
Proton	C
	D

(2)

(b) An atom of element Y has:

- an atomic number of 9
- a mass number of 19.

Give the number of electrons and the number of neutrons in this atom.

Choose answers from the box.

1	9	10	19	28
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Number of electrons \_\_\_\_\_

Number of neutrons \_\_\_\_\_

(2)

The table below shows information about two isotopes of element **Z**.

	<b>Mass number</b>	<b>Percentage abundance (%)</b>
Isotope <b>A</b>	39	93.3
Isotope <b>B</b>	41	6.7

(c) Calculate the relative atomic mass ( $A_r$ ) of element **Z**.

Use the table above and the equation:

$$A_r = \frac{(\text{mass number} \times \text{percentage}) \text{ of isotope A} + (\text{mass number} \times \text{percentage}) \text{ of isotope B}}{100}$$

Give your answer to 3 significant figures.

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$$A_r \text{ (3 significant figures)} = \underline{\hspace{2cm}}$$

(3)

(d) Suggest the identity of element **Z**.

Use the periodic table.

Element **Z** \_\_\_\_\_

(1)

(e) Complete the sentence.

Choose the answer from the box.

<b>electrons</b>	<b>neutrons</b>	<b>protons</b>
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Isotopes of the same element have different mass numbers because the isotopes have different numbers of \_\_\_\_\_.

(1)

(Total 9 marks)

**6.**

This question is about the periodic table.

The figure below shows an early version of the periodic table published by a scientist.

H									
Li	Be	B	C	N	O	F			
Na	Mg	Al	Si	P	S	Cl			
K	Cu	Ca	Zn	? ?	Ti ?	V As	Cr Se	Mn Br	Fe Co Ni
Rb	Ag	Sr	Cd	Y In	Zr Sn	Nb Sb	Mo Te	? I	Ru Rh Pd

- (a) The scientist left gaps in the periodic table in the figure above.

Each gap is represented by a question mark (?).

Give **one** reason why the scientist left gaps in this periodic table.

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**(1)**

- (b) Which scientist published the periodic table in above figure?

Tick (✓) **one** box.

Bohr

Chadwick

Mendeleev

**(1)**

(c) The modern periodic table is different from the periodic table in above figure.

One extra group of elements has been added.

What is the name of the extra group of elements in the modern periodic table?

Tick (✓) **one** box.

Alkali metals

Halogens

Noble gases

(1)

(d) Why do the elements in Group 1 of the modern periodic table have similar chemical properties?

Tick (✓) **one** box.

The elements all form negative ions.

The elements all have one electron in the outer shell.

The elements all have the same number of shells.

(1)

(e) **Table 1** shows the melting points of the first five elements going down Group 1.

**Table 1**

<b>Element</b>	<b>Melting point in °C</b>
Lithium	181
Sodium	98
Potassium	<b>X</b>
Rubidium	39
Caesium	29

Predict value **X**.

**X** = \_\_\_\_\_ °C

(1)

- (f) Give **one** observation you would see when a small piece of potassium is added to water.

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(1)

- (g) **Table 2** shows information about the first five elements going down Group 7.

**Table 2**

<b>Element</b>	<b>State at 150 °C</b>	<b>Symbol</b>	<b>Formula of the compound with hydrogen</b>
Fluorine	gas	F	HF
Chlorine	_____	Cl	HCl
Bromine	gas	Br	HBr
Iodine	liquid	I	HI
Astatine	solid	At	_____

Complete **Table 2**.

(2)

(h) The elements in Group 7 consist of molecules.

What is the formula of a molecule of bromine?

Tick (✓) **one** box.

Br

Br<sub>2</sub>

Br<sup>2</sup>

2Br

(1)

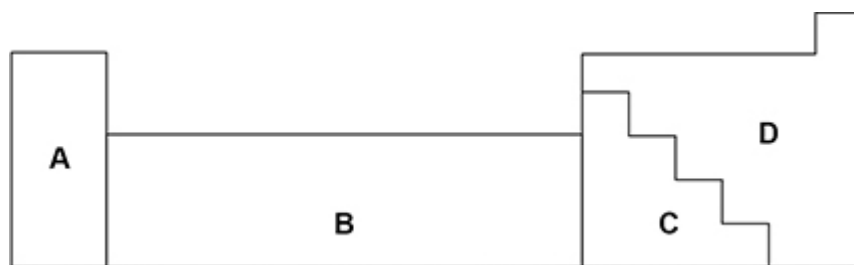
(Total 9 marks)

7.

This question is about metals and non-metals.

**Figure 1** shows an outline of part of the periodic table.

**Figure 1**



(a) Element **Q** is a dull solid with a melting point of 44 °C.

Element **Q** does not conduct electricity.

Which section of the periodic table in **Figure 1** is most likely to contain element **Q**?

Tick (✓) **one** box.

A

B

C

D

(1)

(b) Element **R** forms ions of formula  $R^{2+}$  and  $R^{3+}$

Which section of the periodic table in **Figure 1** is most likely to contain element **R**?

Tick (✓) **one** box.

A

B

C

D

(1)

(c) Give **two** differences between the physical properties of the elements in Group 1 and those of the transition elements.

1 \_\_\_\_\_

\_\_\_\_\_

2 \_\_\_\_\_

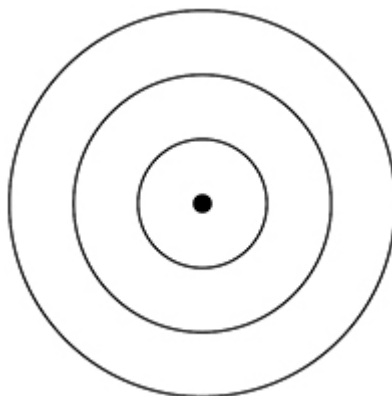
\_\_\_\_\_

(2)

(d) Complete **Figure 2** to show the electronic structure of an aluminium atom.

Use the periodic table.

**Figure 2**



(1)

(e) Aluminium is a metal.

Describe how metals conduct electricity.

Answer in terms of electrons.

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(3)

(f) Name the type of bonding in compounds formed between metals and non-metals.

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(1)

(g) Magnesium oxide is a compound formed from the metal magnesium and the non-metal oxygen.

Describe what happens when a magnesium atom reacts with an oxygen atom.

You should refer to electrons in your answer.

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(4)

(Total 13 marks)

8.

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.

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(1)

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

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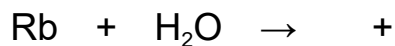
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(3)

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

You should balance the equation.



(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.

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Relative atomic mass (3 significant figures) = \_\_\_\_\_

(3)

(Total 11 marks)

9.

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)**

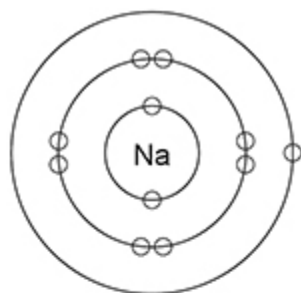
(h) Sodium fluoride is an ionic compound.

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

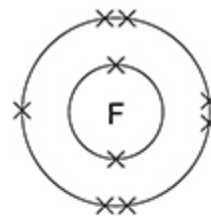
Complete the diagram below to show what happens when a sodium atom and a fluorine atom react to produce sodium fluoride.

You should:

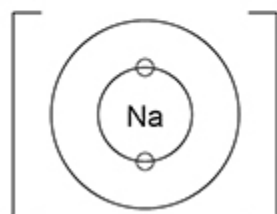
- complete the electronic structures of the sodium ion and the fluoride ion
- give the charges on the sodium ion and the fluoride ion.



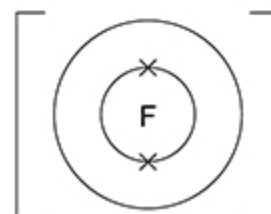
Sodium atom



Fluorine atom



Sodium ion



Fluoride ion

(3)  
(Total 12 marks)

## Mark schemes

1.

(a) neutron

1

(b) a neutron and a proton

1

(c) (nitrogen) 2 / two

1

(oxygen) 1 / one

1

(d) lithium

*allow Li*

1

(e) 3 x protons (○) in the nucleus

1

4 x neutrons (●) in the nucleus

1

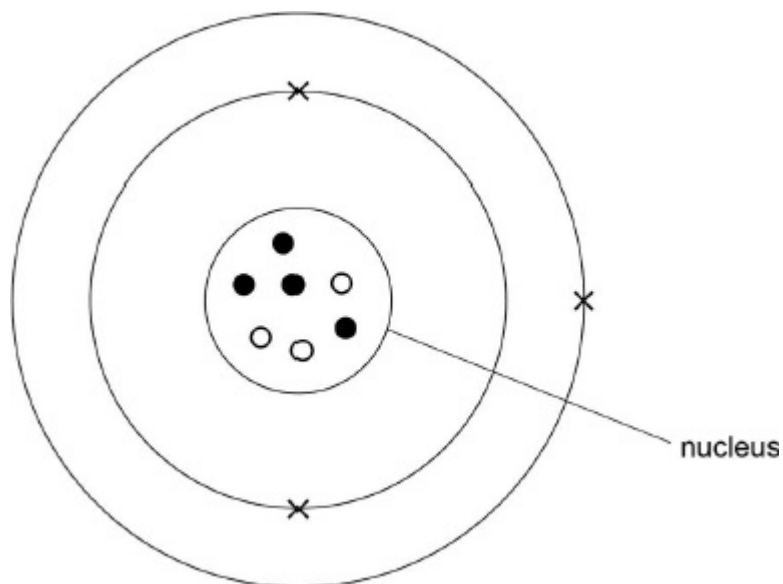
3 x electrons (×) in the shells

1

electrons (×) arranged 2, 1

1

an answer of



scores 4 marks

[9]

2.

(a) element

1

(b) protons

*allow electrons*

1

neutrons

*must be in this order*

1

(c)

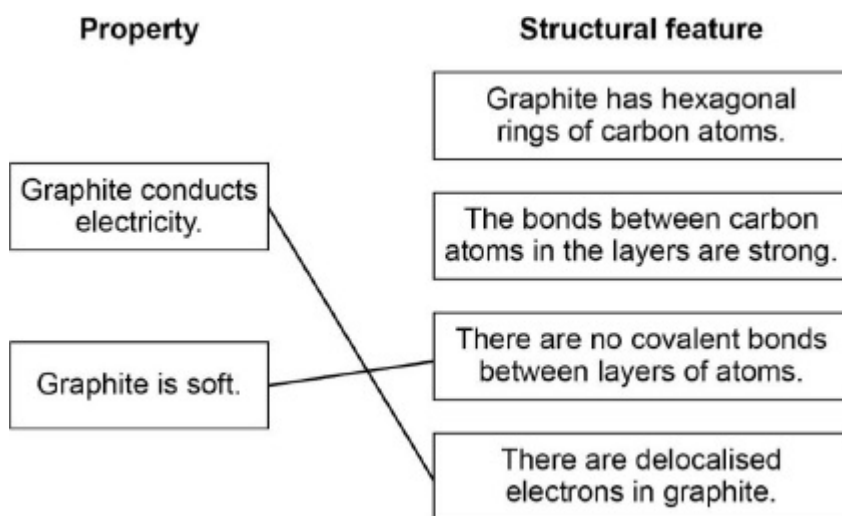
$$\frac{12}{6.02 \times 10^{23}}$$

1

(d) B

1

(e)



*do not accept more than one line from a box on the left*

2

[7]

3.

(a) a ball of positive charge

*do not accept references to protons, nuclei, neutrons*

1

with (negative) electrons embedded

1

(b) (earliest) electrons

protons

(latest) neutrons

1

(c) (number of outer shell electrons) 7 1

(reason) (tennessine is in) Group 7

*allow the number of outer electrons is the same as the group number*

*allow tennessine is a halogen*

1

*MP2 is dependent on MP1 being awarded*

(d) (time needed for) peer review

*allow the idea that other scientists had to check the results*

1

(e) ( $A_r =$ )

$$\frac{(6 \times 7.6) + (7 \times 92.4)}{100}$$

100

*allow*  $\frac{45.6 + 646.8}{100}$

*allow*  $(6 \times 0.076) + (7 \times 0.924)$

*allow*  $0.456 + 6.468$

1

$= 6.924$

1

$= 6.9$

*allow an answer correctly rounded to 1 decimal place from an incorrect calculation which uses all the data in the table*

1

[9]

4.

(a) (atoms of) argon have a stable arrangement of electrons

*allow (atoms of) argon have a full outer shell (of electrons)*

1

(so) argon (atoms) do not share / transfer electrons

1

(b)  $\text{PH}_3$

*allow  $\text{H}_3\text{P}$*

1

- (c) yes, because tellurium is towards the right of the periodic table  
*allow yes, because tellurium is in Group 6*

1

(so) tellurium is a non-metal  
*allow (so) tellurium will gain electrons (from a metal)*

1

*MP2 is dependent upon MP1 being awarded*

**OR**

yes, because tellurium is in the same group as oxygen / sulfur (1)

(and) oxygen / sulfur will react with metals (1)

*allow (so) tellurium is a non-metal*

*allow (so) tellurium will gain electrons (from a metal)*

**OR**

no, because tellurium is towards the bottom of the periodic table (1)

(so) tellurium is a metal (1)

*allow (so) difficult for tellurium to gain electrons (from a metal) (1)*

**OR**

cannot predict as tellurium is towards the bottom and to the right of the periodic table (1)

(so) don't know whether tellurium is a metal or non-metal (1)

*allow (so) don't know whether tellurium will gain electrons*

- (d) any **two** from:

- effervescence / fizzing / bubbles

*ignore produces a gas*

- barium disappears

*allow barium gets smaller*

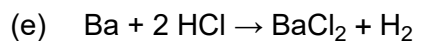
- forms a colourless solution

- temperature increases

*allow barium moves around*

2

*ignore references to floating / flames*



*allow multiples*

*allow 1 mark for  $\text{BaCl}_2$*

*allow 1 mark for  $\text{H}_2$*

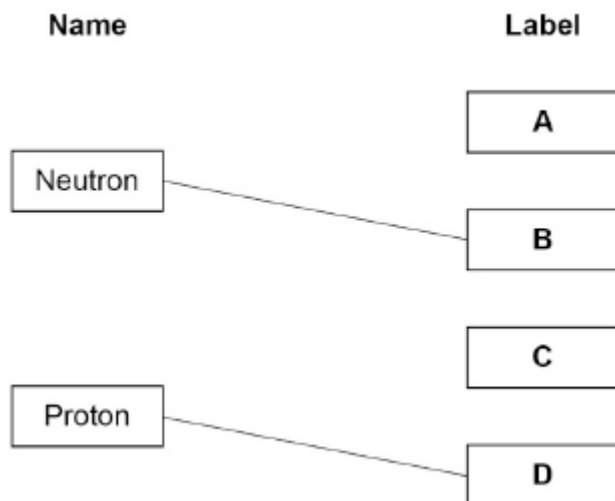
*ignore state symbols*

3

[10]

5.

(a)



*do not accept more than one line from a box on the left*

2

(b) (number of electrons) 9

1

(number of neutrons) 10

1

(c) **Mark with part (d)**

$$(\text{relative atomic mass} =) \frac{(39 \times 93.3) + (41 \times 6.7)}{100}$$

*allow (relative atomic mass =)  $\frac{(3638.7) + (274.7)}{100}$*

*allow (relative atomic mass =)  $36.387 + 2.747$*

1

$$= 39.134$$

1

$$= 39.1$$

*allow an answer correctly calculated to 3 significant figures from an incorrect calculation which uses the values in the table*

1

(d) **Mark with part (c)**

potassium / K

*allow ecf from part (c)*

1

(e) neutrons

1

[9]

6.

(a) for elements that had not been discovered (at that time)

*allow for missing elements*

**or**

so that elements with similar properties are grouped together

*ignore references to atomic number / mass / weight*

1

(b) Mendeleev

1

(c) noble gases

1

(d) the elements all have one electron in the outer shell

1

(e) 63 (°C)

*allow a value in the range 49 to 88 (°C)*

1

(f) any **one** from:

- floats
- moves (on the surface)
- melts

*allow forms a ball*

- fizzes / bubbles
- flame

*ignore colour of flame*

*allow explodes / disappears*

*ignore references to heat / temperature / sounds*

1

(g)

Element	State at 150 °C	Symbol	Formula of the compound with hydrogen
Fluorine	gas	F	HF
Chlorine	<b>gas</b>	Cl	HCl
Bromine	gas	Br	HBr
Iodine	liquid	I	HI
Astatine	solid	At	<b>HAt</b>

2

(g) Br<sub>2</sub>

1

[9]

7.

(a) **D**

1

(b) **B**

1

(c) any **two** from:

(Group 1 elements)

- have lower melting / boiling points
- have lower densities
- are less strong
- are softer

*allow (Group 1 elements are) more malleable / ductile*

*allow (Group 1 elements) are not useful as catalysts*

*ignore transition elements form coloured compounds*

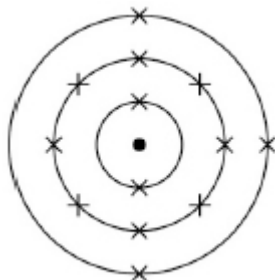
*ignore transition elements form ions with different charges*

*ignore references to chemical properties*

2

*allow converse statements for transition elements*

(d)



*allow any combination of x, •, o, e<sup>(-)</sup> for electrons*

1

- (e) delocalised electrons  
*allow free electrons* 1
- (the electrons) carry (electrical) charge  
*ignore current / electricity for charge* 1
- (the electrons move) through the metal / aluminium / structure  
*ignore throughout for through* 1
- (f) ionic 1
- (g) magnesium (atom) loses electrons 1
- oxygen (atom) gains electrons 1
- two electrons (are transferred) 1
- magnesium ions **and** oxide ions are formed  
*allow  $Mg^{2+}$  (ions) **and**  $O^{2-}$  (ions) are formed*  
*allow magnesium forms positive ions and oxygen forms negative ions*  
*allow (both) form a complete outer shell* 1

[13]

8.

- (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)  $2 \text{ Rb} + 2 \text{ H}_2\text{O} \rightarrow 2 \text{ RbOH} + \text{H}_2$   
*ignore state symbols*  
*allow multiples*  
*allow 1 mark for H<sub>2</sub>*  
*allow 1 mark for RbOH* 3

(d) the noble gases have boiling points that increase going down the group 1

(e) (relative atomic mass =)  $\frac{(90.48 \times 20) + (0.27 \times 21) + (9.25 \times 22)}{100}$   
 $\frac{1809.6 + 5.67 + 203.5}{100}$   
*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]

**9.** (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

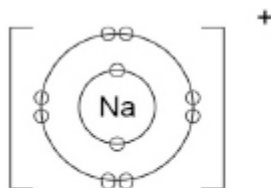
*allow any combination of circles, dots, crosses or  $e^{-}$*

1

+ charge on sodium ion **and**

- charge on fluoride ion

an answer of



sodium ion



fluoride ion

scores **3** marks

1

[12]