

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<sup>-</sup> 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<sub>2</sub>

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

1

+ 2e<sup>-</sup>

*2I<sup>-</sup> - 2e<sup>-</sup> → I<sub>2</sub> 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 outer 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) 2<sup>nd</sup> shell / energy level can (only) have maximum of 8 electrons

*accept no d-orbitals*

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

**1**

**[8]**

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

hydrogen

*allow H / H<sub>2</sub>*

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 one / an 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 more easily (than lithium)

1

because outer electrons/energy level further from the nucleus in sodium  
**or** because sodium has more shells (than lithium)

*do **not** accept 'more outer shells'*  
*allow sodium (atom) is larger*

1

because forces/attraction to hold outer electron are weaker 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  $> -200^{\circ}\text{C}$*   
*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  $\text{O}_2$*

1

because there is only a difference of  $3^{\circ}\text{C}$  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 outer 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 / 4<sup>th</sup> shell electrons 1

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

*ignore shells overlap* 1

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

**or**

2<sup>nd</sup> shell / energy level cannot have 18 electrons

**1**

**[8]**

- M7.** (a)  $40 (\text{Ca}) + 137 (\text{Ba}) \div 2 = 88.5$   
*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 / 3<sup>rd</sup> 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 / 4<sup>th</sup> 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]