

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⁻ 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]

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) 2nd shell / energy level can (only) have maximum of 8 electrons

accept no d-orbitals

or 2nd shell / energy level cannot have 18 electrons

1

[8]

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

hydrogen

allow H / H₂

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 O_2

1

because there is only a difference of 3°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 / 4th shell electrons 1

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

ignore shells overlap 1

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

or

2nd 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 / 3rd 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 / 4th 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]