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) I_2

must both be on the right hand side of the equation

1

$+ 2e^-$

*$2I^- - 2e^- \rightarrow I_2$ 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 <u>outer</u> 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) <u>2nd shell</u> / energy level can (only) have maximum of 8 electrons

accept no d-orbitals

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

1

[8]

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

hydrogen

allow H / H_2

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 <u>one</u> / <u>an</u> 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 <u>more</u> easily (than lithium)

1

because outer electrons/energy level furth<u>er</u> from the nucleus in sodium **or** because sodium has <u>more</u> shells (than lithium)

*do **not** accept 'more outer shells'*

allow sodium (atom) is larger

1

because forces/attraction to hold outer electron are weak<u>er</u> 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°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 <u>gains</u> 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 <u>outer</u> 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) <u>2nd</u> shell / energy level can (only) have maximum of 8 electrons

or

2nd shell / energy level cannot have 18 electrons

1

[8]

M7. (a) 40 (Ca) + 137 (Ba) ÷ 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]