



## Mark schemes

<b>1</b>	(a) <b>B</b>	1
	(b) <b>D</b>	1
	(c) <b>E</b>	1
	(d) <b>C</b>	1
	(e) $92.5 \times 6$ <b>and</b> $7 \times 7.5$	1
	$\frac{607.5}{100}$	1
	6.075	1
	6.08	1
	<i>allow 6.08 with no working shown for 4 marks</i>	1
		<b>[8]</b>
<b>2</b>	(a) 13 (protons) <i>The answers must be in the correct order. if no other marks awarded, award 1 mark if number of protons and electrons are equal</i>	1
	14 (neutrons)	1
	13 (electrons)	1
	(b) has three electrons in outer energy level / shell <i>allow electronic structure is 2.8.3</i>	1

**(c) Level 3 (5–6 marks):**

A detailed and coherent comparison is given, which demonstrates a broad knowledge and understanding of the key scientific ideas. The response makes logical links between the points raised and uses sufficient examples to support these links.

**Level 2 (3–4 marks):**

A description is given which demonstrates a reasonable knowledge and understanding of the key scientific ideas. Comparisons are made but may not be fully articulated and / or precise.

**Level 1 (1–2 marks):**

Simple statements are made which demonstrate a basic knowledge of some of the relevant ideas. The response may fail to make comparisons between the points raised.

**0 marks:**

No relevant content.

**Indicative content**

## Physical

## Transition elements

- high melting points
- high densities
- strong
- hard

## Group 1

- low melting points
- low densities
- soft

## Chemical

## Transition elements

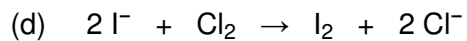
- low reactivity / react slowly (with water or oxygen)
- used as catalysts
- ions with different charges
- coloured compounds

## Group 1

- very reactive / react (quickly) with water / non-metals
- not used as catalysts
- white / colourless compounds
- only forms a +1 ion

6  
[10]

- |          |  |   |
|----------|--|---|
| <b>3</b> | (a) The forces between iodine molecules are stronger | 1 |
|          | (b) anything in range +30 to +120                    | 1 |
|          | (c) Brown  | 1 |



1

(e) It contains ions which can move

1

(f) hydrogen iodine

1

**[6]****4**

(a) Y

1

(b) W

1

(c) V

1

(d) W

1

(e) X

1

**[5]****5**

(a) (i) Proton

1

(ii) Neutron

1

(b) In order of increasing atomic number

1

(c) (i) 9

1

(ii) Gas

1

(d) (i) gains (one) electron

1

(to gain a) full outer energy level **or** noble gas configuration  
*allow because it has seven outer electrons*

1

- (ii) add sodium hydroxide (solution)  
*allow ammonia (solution) or ammonium hydroxide or any other soluble hydroxide or flame test*

1

(forms a) blue precipitate

*second mark dependent on suitable reagent being added  
 allow blue-green / blue / green if flame test given*

1

**[9]****6**

- (a) gold

1

- (b) atom (s)

1

- (c) (i) protons

*any order  
 allow proton*

1

neutrons

*allow neutron*

1

- (ii) 3 / three

1

- (d) (i) Al

*ignore any numbers / charges*

1

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

- limited resource
- expensive in terms of energy / mining
- effects on the environment, such as, landfill, atmospheric pollution, quarrying

*allow uses a lot of energy to extract.*

2

- (e) resistant to corrosion

1

does not react (with water or food)

*allow **one** mark for low density with a suitable reason given*

1

**[10]**

- 7** (a) (i) protons  
*allow "protons or electrons", but do not allow "protons and electrons"* 1
- (ii) protons plus / and neutrons 1
- (b) (because the relative electrical charges are)  $- (1)$  for an electron and  $+ (1)$  for a proton  
*allow electrons are negative and protons are positive* 1
- and the number of electrons is equal to the number of protons  
*if no other mark awarded, allow 1 mark for the charges cancel out* 1
- (c) (the electronic structure of) fluorine is 2,7 and chlorine is 2,8,7  
*allow diagrams for the first marking point* 1
- (so fluorine and chlorine are in the same group) because they have the same number of or 7 electrons in their highest energy level or outer shell  
*if no other mark awarded, allow 1 mark for have the same / similar properties* 1
- (d) S 1
- (e) (i) ions 1
- (ii) molecules 1
- [9]
- 8** (a) (i) Na  
*allow sodium* 1
- (ii) Cu  
*allow copper* 1
- (iii) C  
*allow carbon* 1
- (iv) He  
*allow helium* 1

(b) H

*allow hydrogen**do not allow H<sub>2</sub>*

1

**[5]****9**

(a) (iron) is a metal

*accept transition element**allow (iron) had different properties (to oxygen and sulfur)**ignore electrons*

1

(b) so that elements with similar properties could be placed together

*allow to make the pattern fit**ignore undiscovered elements*

1

(c) atomic number(s)

*allow proton number(s)*

1

(d) all have one electron in the outer shell (highest energy level)

*allow same number of electrons in the outer shell (highest energy level)*

1

(so they) have similar properties

**or**

react in the same way

*allow specific reactions e.g. with water*

1

**[5]****10**

(a) increase

1

(b) (i) Na<sup>+</sup> and Br<sup>-</sup>*both required*

1

(ii) sodium chloride

*allow NaCl**do not allow sodium chlorine*

1

(iii) chlorine is more reactive than bromine

*allow converse argument**allow symbols Cl, Cl<sub>2</sub>, Br and Br<sub>2</sub>**allow chlorine / it is more reactive**do not allow chloride or bromide*

1

(iv) fluorine

*allow F / F<sub>2</sub>*

*do **not** allow fluoride.*

1

**[5]****11**

(a) Li **and** K

*either order*

*allow lithium **and** potassium*

1

(b) Fe

*allow iron*

1

(c) N **and** As

*either order*

*allow nitrogen **and** arsenic*

1

(d) Cu

*allow copper*

1

**[4]****12**

(a) (i) an electron

1

(ii) a neutron

1

(iii) 11

1

(iv) boron

1

(b) (i) GH<sub>3</sub>

1

(ii) covalent

1

**[6]****13**

(a) (i) Na

*allow sodium / phonetic spelling*

*if more than one answer is given apply list principle*

1

(ii) Fe

*allow iron / phonetic spelling*

*if more than one answer is given apply list principle*

1



(iii) Na **or** S

allow sodium or sulfur / sulphur / phonetic spelling  
if more than one answer is given apply list principle

1

(iv) S

allow sulfur / sulphur / phonetic spelling  
if more than one answer is given apply list principle

1

(v) Na

allow sodium / phonetic spelling  
if more than one answer is given apply list principle

1

(b) (i) any **three** from:

- effervescence / fizzing **or** bubbles **or** gas produced  
*do not allow incorrectly named gas*
- sodium melts **or** turns into a ball
- sodium moves (on the surface)
- steam / mist / vapour is produced  
*ignore heat / temperature / flame / spark*
- sodium gets smaller / disappears  
*allow dissolves*
- colour of indicator is darker / more intense near the sodium  
*Must be linked to near the sodium.*

3

(ii) hydroxide **or** OH<sup>-</sup>

allow OH without a charge  
do **not** allow OH<sup>+</sup>

1

(c)

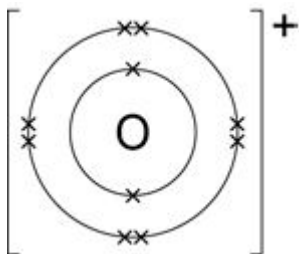


diagram showing electron configuration of ion is 2,8

1

charge on ion is +

Bracket not necessary

[2,8]<sup>+</sup> is worth 1 mark as there is no diagram

1

[11]

14

(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]**

- 15**
- (a) (i) atomic weight 1
- (ii) groups 1
- (iii) left a gap 1
- (iv) had not been discovered by 1869 1
- (b) protons  
*must be in correct order* 1
- electrons 1
- (c) sodium and nickel are both metals 1
- sodium is more reactive than nickel 1
- (d) (i) bromine  
*allow Br<sub>2</sub> / Br*  
*do not allow bromide* 1
- (ii) iodine is less reactive (than bromine)  
*it = iodine*  
*allow converse*  
*do not allow bromide* 1
- [10]

- 16** (a) similar properties  
*allow same properties*  
*allow correct example of property*  
*ignore answers in terms of atomic structure* 1
- (b) (i) in order of atomic / proton number  
*allow increasing number (of protons)* 1
- (ii) elements in same group have same number (of electrons) in outer shell **or**  
*highest energy level*  
*allow number (of electrons) increases across a period* 1
- (c) any **two** from:  
*statements must be comparative*
- stronger / harder  
*ignore higher densities*
  - less reactive
  - higher melting points  
*ignore boiling point*
- 2
- (d) *reactivity increases down group*  
*allow converse throughout*  
*for next three marks, outer electron needs to be mentioned once*  
*otherwise max = 2* 1
- outer electron is further from nucleus*  
*allow more energy levels / shells*  
*allow larger atoms* 1
- less attraction between outer electron and nucleus*  
*allow more shielding* 1
- therefore outer electron lost more easily* 1
- [9]**
- 17** (a) (i) E 1
- (ii) C 1
- (iii) A 1

- (b) (i) quickly melted  
*allow melts in contact with water,*  
*allow bp 100 °C (of water) shows mp is low*  
*ignore one other piece of information* 1
- (ii) easily cut  
*ignore one other piece of information* 1
- (iii) effervescence / fizzing / bubbling  
*ignore named gas*  
*ignore one other piece of information* 1
- 18** (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

[6]

- (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]

19

- (a) (i) any **two** from:

- bubbles / effervescence / fizzing  
*ignore hydrogen / gas produced*
- lithium disappears / gets smaller  
*allow dissolves*  
*do **not** allow melts / burns*
- lithium moves on the surface of the water  
*ignore floats*
- (universal indicator) turns blue / purple

2

- (ii) 2

*left-hand side correct*

1

2

*right-hand side correct*

*allow multiples for full credit*

1

- (iii) light / burn, which will give a (squeaky) pop / explosion

1

- (iv) all have 1 electron in their outer shell / energy level

*allow have the same number of electrons in their outer shell / energy level*

1

- (b) They react with oxygen

1

They have low melting points

1

- (c) (i) electronic structure [2,8,8] is drawn

*incomplete inner shells scores a maximum of 1 mark*

1

charge is +

*allow [2,8,8]<sup>+</sup> for 1 mark*

1

- (ii) because (in potassium) the outer shell electron is further away from the nucleus  
 or because potassium atoms are larger than sodium atoms

*it should be clear that the candidate is referring to the outer shell electron: if this is not clear a maximum of 2 marks can be awarded*

1

therefore the outer shell electron is less strongly attracted to the nucleus or is more shielded from the attraction of the nucleus and so the outer shell electron in potassium is more easily lost

1

*3 marks can be scored for answering the question in terms of sodium*

1

**[13]****20**

- (a) 1 / one

1

- (b) (i) protons

1

- (ii) neutrons

1

- (iii) 7

1

- (c) (i) losing

1

- (ii) a positive

1

- (iii) electrostatic

1

- (d) high melting points

1

strong bonds

1

- (e) (i) 58.5

1

- (ii) mole

1

- (f) very small (particles) or

*ignore tiny / small / smaller / microscopic etc.*

1-100nm in size or

(particle with a) few hundred atoms

1

**[12]**

<b>21</b>	(a) number	1
	0	
	<i>allow 8</i>	1
	(b) beryllium <b>or</b> magnesium <b>or</b> strontium <b>or</b> barium <b>or</b> radium	
	<i>allow correct symbols</i>	1
	(c) (i) an alkali metal	1
	(ii) a transition metal	1
	(d) for undiscovered elements	
	<i>accept so elements with similar properties were in the same groups</i>	
	<i>accept so elements fitted the pattern of properties</i>	1
		<b>[6]</b>
<b>22</b>	(a) (i) gas	1
	(ii) Increases	1
	(b) (i) -1	
	<i>allow Cl<sup>-</sup></i>	
	<i>allow -</i>	
	<i>allow negative</i>	1
	(ii) sodium + chlorine → sodium chloride	
	<i>allow correct symbol equation</i>	1
	(c) reduce microbes	
	<i>accept sterilise</i>	
	<i>accept prevent diseases</i>	
	<i>allow disinfect</i>	
	<i>allow kill bacteria / germs / microbes / micro-organisms</i>	
	<i>allow to make it safe to drink</i>	
	<i>ignore get rid of bacteria</i>	1



(d) any **one** from:

- no freedom of choice  
*allow unethical*
- fluoride in toothpaste
- too much can cause fluorosis  
*allow too much can cause damage to teeth*

1

**[6]****23**

(a) (i) hydrogen

*accept  $H_2$*

*allow H*

1

(ii) hydroxide

*accept  $OH^-$*

*allow OH*

*do **not** accept lithium hydroxide*

1

(b) any **two** from:

*'it' = potassium*

potassium:

*accept converse for lithium*

- reacts / dissolves faster  
*allow reacts more vigorously / quickly / violently / explodes*  
*ignore reacts more*
- bubbles / fizzes faster  
*allow fizzes more*  
*allow more gas*
- moves faster (on the surface)  
*allow moves more*
- melts  
*allow forms a sphere*
- produces (lilac / purple) flame  
*allow catches fire / ignites*  
*do **not** accept other colours*

2

**[4]****24**

(a) groups

1

- (b) it is a non-metal  
*allow it is not a metal* 1
- (c) to the right of column 7 / Group 7  
*accept in Group 0*  
*ignore Group 8 / noble gases* 1
- (d) (atomic) number  
*allow proton number* 1

[4]

25

- (a) sodium has a lower density 1  
sodium is more reactive 1
- (b) hydrogen 1
- (c)  $\text{OH}^{\ominus}(\text{aq})$  1

[4]

26

- (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]

27

(a) (i) nucleus

1

(ii) protons

1

(b) protons / + / positive

electrons / - / negative

*both words needed in any order for 1 mark*

1

(c) nitrogen

*allow N or N<sub>2</sub>*

1

(d) **B and C**

*both letters needed in any order for 1 mark*

*allow Li **and** Na*

1

(both) have one electron **or** same number of electrons in the outer energy level / shell

*allow both are in Group 1*

*allow both are alkali metals*

*allow both can lose only one electron **or** become +1 ions*

*allow this mark if no letters given in boxes*

1

[6]

28

(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]

29

(a) transition elements

1

(b) These metals do not react with air

1

These metals do not react with water

1

[3]

30

(a) any **two** from:

- react with water **or** very reactive
- (react with water) releasing gas / hydrogen / fizzing
- (react with water) to form an alkaline / hydroxide solution
- form ions with a 1+ charge  
*allow lose one electron from the outer shell*  
*ignore other references to electronic structure*  
*ignore physical properties*

2

(b) any **three** from:

- some boxes contain two elements  
*allow specific examples:*  
*Co, Ni **or** Ce, La **or** Di, Mo **or** Ro, Ru **or** Ba, V **or** Pt, Ir*
- groups / columns contain elements with different properties  
*allow groups / columns contain both metals and non-metals*  
*ignore examples*
- Newlands not a well-known / respected scientist  
*ignore references to sugar factory*
- new idea (not readily accepted by other scientists)  
*allow musical scales thought to be silly by some scientists*

3

(c) one for improvement **and** one for explanation from:

- left gaps (for undiscovered elements) (1)
  - so that elements were in their correct group (1)  
*allow so the elements fitted the pattern of properties*
- or**
- did not always follow order of relative atomic weights / masses (1)  
*ignore references to atomic number / electronic structure*
  - so that elements were in their correct group (1)  
*allow so the elements fitted the pattern of properties*

2

[7]

31

(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]

32

(a) (i) B

1

(ii) E

1

(iii) F

1

(iv) D

1

(v) C

1

(b) (i) Br

*do not accept BR or br or bR  
ignore numbers  
allow written in table if answer blank*

1

(ii) I Br Cl

*allow iodine, bromine, chlorine  
allow I,B,C  
allow capitals or lower case  
allow 184, 58, -34  
ignore numbers*

1

(c) they are halogens

1

33

- (a) (i) a correct link between any two named elements eg same group / column same properties / number of outer electrons

*allow some link between any two elements in the same group (in both Newlands and or the modern periodic table)*

1

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

*ignore statements about lack of evidence / proof*

- elements still being discovered

**or**

no gaps for undiscovered elements

- some boxes have 2 elements in them
- metals and non-metals in same column / mixed up  
*accept some elements in same column have different properties. allow any sensible suggestion about misplaced elements eg copper in group 1 elements*
- pattern for first 16 or so elements only  
*allow did not work for all elements*

2

- (b) (i)  $\text{Cl} > \text{Br} > \text{I}$

*accept reactivity / it decreases down the group*

**or**

$\text{I} < \text{Br} < \text{Cl}$

1

Cl has 2 reactions, Br has 1 reaction, I doesn't react

*owtte*

*allow Cl has most / more reactions and I has least / less reactions (must be clear about where Br fits in)*

1

- (ii)  $\text{Br}_2$

*allow multiples / fractions if correctly completed and balanced*

1



(iii) (they) have 7 outer electrons

*allow (they) have 7 electrons in highest occupied (energy) level / shells / rings*

1

(c) *outer / last / final must be mentioned once in correct context, otherwise max 2 marks comparative required on all three points accept converse ie less reactive up group*

down group (atom / elements) bigger

**or**

outer electrons (level / shell / ring) further from nucleus / centre  
*ignore more electrons*

**or**

more shells / level / rings

*do **not** accept more outer shells for this mark*

1

force(s) / attraction(s) are weaker

*allow electron(s) attracted less easily*

*allow electron(s) less under influence (of nucleus)*

**or**

more shielding

**or**

1

attracts less

*do **not** accept magnetic / gravitational / intermolecular forces*

electron(s) lost more easily

*allow electron(s) more likely to be lost*

*allow easier to give away*

1

[10]

34

(a) (i) Sb

1

(ii) Se

1

(iii) Sn

1

- (iv) Si 1
- (b) (i) elements 1
- (ii) potassium (K) 1
- (iii) 0 1

[7]

35

- (a) (i) *it = copper*  
 (copper) stops barnacles / seaweed (sticking)  
*accept lead doesn't stop barnacles / seaweed (sticking)*  
*ignore all other properties* 1
- (ii) *it = Muntz Metal*  
 (Muntz Metal) is less expensive / cheaper / cheapest  
*must be a comparison*  
*accept copper is more expensive*  
*ignore other properties* 1
- (b) (i) atomic absorption spec(troscopy) / spectrometry **or** mass spec(trometry) / spectroscopy  
*accept spectroscopy / spectrometry alone*  
*allow AAS / MS*  
*do **not** allow NMR spectroscopy*  
***or** IR spectrometry **or** chromatography* 1
- (ii) *it = instrumental method*  
 sensitive **or** detect (very) small amounts  
**or** only small sample needed  
*allow (more) precise*  
*ignore accurate*  
*allow converse for chemical method*  
*ignore metal contains small amount / low concentration of iron* 1

(c) any **two** from:

*transition elements (= they)*

- unreactive / not very reactive  
*allow does not corrode*  
*ignore reference to rust*
- strong / hard  
*ignore tough / durable / hard wearing*
- malleable / easy to shape  
*ignore ductile / density / melting point*

2

**[6]****36**

(a) Group O / 8

*accept transition elements / metals*

**or** noble / rare / inert gases

*apply list principle*

1

(b) (chemically) similar elements (now) in the same group / column

*accept iodine has properties of Group 7 / halogens*

**or** *iodine does not have group 6 properties*

**or** *converse for tellurium*

*ignore 'it fits the pattern' or any reference to proton / atomic numbers / atomic structure*

1

(c) any **three** from:

*ignore not enough evidence / proof **or** Mendeleev not respected*

- (some) boxes had two elements  
*allow two correctly identified elements together (in the same box)*
- Group 1: copper / silver unreactive (not like the others)  
*allow copper / silver not alkali metals / Group 1*
- there are non-metals and metals in the same group / box  
*accept named examples*
- Mendeleev left spaces / gaps  
*accept (some chemists thought) there were no more elements to discover*
- Medeleev reversed the order (for some elements)

3

(d) any **two** from:

*ignore mass number / atomic weight / neutrons throughout*

- elements arranged in proton / atomic number order  
*allow number of protons / electrons increases across period*
- group: elements in same group / column have same number of outer electrons
- elements in same period / row have same number of (electron) shells / energy levels  
*allow number of (electron) shells / energy level increase down group*  
*allow electron rings*  
*allow orbits*

2

[7]

37

(a) (i) E

1

(ii) B

1

(iii) C

1

(iv) A

1

- (b) (i) quickly melted  
*allow melts in contact with water,*  
*allow bp 100 °C (of water) shows mp is low*  
*ignore one other piece of information* 1
- (ii) easily cut  
*ignore one other piece of information* 1
- (iii) effervescence / fizzing / bubbling  
*ignore named gas*  
*ignore one other piece of information* 1

[7]

38

- (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]**

**39**

(a) (i) **A**

1

(ii) **F**

1

(iii) **E**

1

(iv) **C**

1

(v) **A or B**

1

(b) (i) Rb K Na

*allow rubidium, potassium, sodium*

*do **not** accept RB or NA*

1

(ii) decrease

**or**

become lower / smaller / less

*allow from 180° C to 27° C*

1

(c) They are harder than Group 1 metals.

1

They have higher melting points than Group 1 metals.

1

They often form coloured compounds but Group 1 compounds are usually white.

1

**[10]**

**40**

(a) (i) UI / solution turns blue / purple

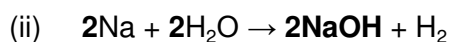
*allow violet / lilac*

1

any **two** from:

- floats
- melts / forms a sphere
- moves  
*note: moves on surface = 2 marks (points 1 and 3)*
- effervescence / fizz / bubbles / gas  
*ignore the name of the gas*
- (yellow) flame  
*ignore sparks / ignites / burns*  
*allow dissolves*
- reduces in size  
*ignore 'reacts violently' unqualified*  
*ignore reference to exothermic / heat evolved*

2



*correct equation = 2 marks*  
*allow correct multiples / fractions*  
*if this equation is unbalanced,*  
*allow 1 mark for NaOH*

2

(b)

*it = francium*  
*outer electron / shell / energy level must be mentioned once for all 3 marks*

biggest atom **or** (outer) shell / energy level / electron furthest from nucleus **or** most (number of) shells

1

least attraction (to nucleus) **or** most shielding

*allow the attraction is very weak*  
*do **not** allow less magnetic / gravitational attraction*

1

(outer) electron more easily lost / taken

*ignore francium reacts more easily / vigorously*

1

(c) any **two** from:

*ignore other properties / specific reactions*

*they / it = transition elements*

transition elements:

*allow if state group 1 elements*

- high melting point **or** high boiling point
  - *low melting point or low boiling point*
- high density
  - *low density*
- strong / hard
  - *weak / soft*
- not very reactive
  - *reactive*
- catalysts
  - *not catalysts*
- ions have different charges
  - *+1 ions*
- coloured compounds
  - *white compounds*

2

[10]

41

(a) (i) elements

1

(ii) atomic weight

1

(iii) atomic (proton) number

1

(b) (i) transition metals

1

(ii) has a higher melting point is harder

2

[6]



42

(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]

43

- (a) conducts (electricity) **or**  
*accept flexible*

allows electrons / current to flow

*ignore conducts heat*

1

- (b) electron

1

- (c) (i) lithium>copper>tungsten **or**

Li>Cu>W

*all correct*

*allow **1** mark for one metal in the correct position*

2

- (ii) has high / highest melting point  
*accept has high / highest boiling point*

**or**

can withstand the highest temperature

1

- (d) unreactive

1

**[6]**

**44**

- (a) Mendeleev

1

- (b) groups

1

- (c) undiscovered

1

- (d) compound

1

**[4]**

**45**

- (a) (i) Halogens

1

- (ii) They consist of molecules

1

They have coloured vapours

1

- (b) (i) 7 / seven

1

- (ii) liquid

1

- (iii) astatine

*allow obvious mis-spelling*

*ignore At*

1

(c) chlorine reacts with (the) bromide [owtte]

1

chlorine reacts with (the) iodide [owtte]

*allow chlorine reacts with both*

**or**

*chlorine has more reactions for **2 marks***

**or**

*bromine reacts with one **and** iodine does not react at all for **2 marks***

1

[8]

46

(a) kills bacteria / sterilises (water)

*allow kills microorganisms / microbes / germs*

*allow 'makes (water) safe (to drink)' **or** disinfectant*

*ignore cleans water **or** removes impurities / bacteria*

1

(b) goes colourless / decolourised (from red / red-brown / brown / yellow / orange)

*allow colour disappears*

*ignore 'goes clear' **or** discoloured*

*do **not** accept incorrect initial colour*

*do **not** accept precipitate*

1

(c) (i)  $\text{Br}_2$  **and**  $2\text{Cl}^-$

*allow multiples / fractions if whole equation balanced*

1

(ii) changes to red / red-brown / brown / yellow / orange

*do **not** accept effervescence / fizzing / precipitate / gas given off*

*ignore vapour / temperature changes / ignore initial colour*

1

(d) (i) 7 outer electrons **or**

same number of outer electrons

*allow last / final shell for outer*

*allow energy level / orbit / ring for shell*

*allow 'need to gain  $1 e^-$  to have a full outer shell'*

*ignore 'similar number of outer electrons'*

1

(ii) bromine / it (atom) is bigger **or**  
*must be a comparison*

outer electrons (level / shell) further from nucleus **or** more shells  
*do **not** accept more outer shells*  
*ignore more electrons*

forces / attractions are weaker **or** more shielding **or** attracts less  
*do **not** accept magnetic / gravitational / intermolecular forces*  
*allow 'electron(s) attracted less easily'*

electron(s) gained less easily  
*"outer / last / final" must be mentioned once, otherwise max 2 marks.*  
*accept converse for chlorine throughout where clearly stated*

3

(e) (i) white precipitate **or** white solid  
*ignore names of chemicals*

1

(ii) cream precipitate **or** cream solid  
*allow pale yellow / off-white precipitate / solid*  
*ignore names of chemicals*

1

**[10]****47**

(a) potassium / it is an alkali metal **or** it is in group 1 **or** it is reactive  
*it = potassium*  
*allow argon is a noble gas / unreactive / group 0*  
*ignore references to atomic structure*  
*ignore references to correct physical properties*

1

(b) group 4 / they are metals and non-metals  
*accept element missing or gap left*  
*ignore differences in properties*

1

(c) it / they fitted at the beginning / end of the table  
*ignore left gaps / spaces*

1

**[3]**

<b>48</b>	(a) (i) B	1	
	(ii) A	1	
	(iii) E	1	
	(iv) D	1	
	(b) (i) Mendeleev and Newlands	1	
	(ii) atomic weight	1	
	(iii) chemical reactions	1	
	(iv) electrons	1	<b>[8]</b>

<b>49</b>	(a) (i) undiscovered elements owtte	1	
	(ii) they would be in the wrong group / have the wrong / different properties / don't fit the pattern owtte <i>allow atomic weights may have been wrong</i>	1	
	(b) (i) any <b>three</b> from:		
	• elements arranged in proton / atomic number order <i>ignore mass number / atomic weight / neutrons throughout</i>		
	• group: elements in the same group / column have same number of outer electrons owtte		
	• group: number of shells increase down group		
	• period: elements in the same period / row have the same number of shells / energy levels		
	• period: number of protons / electrons increase across period		
	• atomic number: link of atomic number to number of protons		
• atomic number gives number of electrons	3		

(ii) it would mean splitting a proton / electron

**or**

implication of splitting proton / electron

1

(c) *must be a comparison*

(outer) electron closer (to nucleus)

*accept fewer (electron) shells / energy levels*

*fluorine is the smaller/est*

1

stronger/est attraction (to nucleus) owtte

*do **not** allow magnetic / intermolecular forces*

**or**

less screening (by inner electrons)

1

electron gained more easily

*need some indication of outer electron shell somewhere in explanation otherwise max of 2 marks*

1

[9]

50

(a) (i) floated / (moved on) surface

*accept does not sink*

*ignore it melted*

1

(ii) melted / molten

*ignore heat is given off*

1

(iii) hydrogen

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

1

(b) (i) potassium / rubidium / caesium / francium

*accept: K / Rb / Cs / Fr*

1

(ii) they are metals

1

they form ions with a 1+ charge

1

- (c) (i) atomic weight 1
- (ii) similar 1
- (iii) groups 1
- (d) left gaps owtte 1
- [10]**

51

- (a) acts as barrier between sodium and air / oxygen / water (vapour)  
*accept because they are reactive*  
*ignore oil will not react* 1
- (b)  $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$   
*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]**

**52**

- (a) B

1

- (b) eg link between Li, Na, K, (Rb, Cs)

**or** Mg, Ca, (Sr, Ba)

**or** F, Cl, Br, I

*allow any **two** elements in the same group (in both Newland's **and** the modern periodic table)*

1

linked appropriate comment about that link eg similar physical / chemical properties **or** similar specific reactions **or** same number of outer electrons

*if no elements identified, allow **1** mark for a general comment about elements **in the same column** having similar properties*

*"every eighth element has similar properties" = **1** mark*

1

(c) any **two** from:

- no gaps for undiscovered elements **or** elements still being discovered
- some boxes have 2 elements
- metals and non-metals in same column / mixed up / some elements in the same column had different properties
- pattern for first 16 or so elements only
- any sensible suggestion about misplaced elements eg copper in group 1 metals

2

(d) alkanes are not elements **or** alkanes are compounds

*ignore molecule / molecular*

1

[6]

53

(a) tungsten

1

has the high(est) melting point

*accept that metals other than tungsten  
are likely to melt*

1

(b) argon

1

is an unreactive gas

*accept that gases other than argon are reactive  
accept that argon is a noble gas or in Group 0*

1

[4]

<b>54</b>	(a) D	1
	(b) B	1
	(c) F	1
	(d) G	1
	(e) H	1
		<b>[5]</b>

- 55** (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 <u>hydroxide</u>   | 1 |
| hydrogen   | 1 |
| (c) more violent / reactive  |   |
| <i>accept a description of the reaction which indicates greater violence</i> | 1 |

(d) (i) decreases

1

and then slows down **or** levels off

1

(ii) 26(°C)

1

[9]

56

- (a) comment + relevant example gets **1 + 1** marks  
third marking point can be **either** a comment **or** an example unrelated to first comment i.e. 3 comments would be max **2** marks

max 3

(could be many answers)

*ignore references to music*

e.g. many elements in the groups have very dissimilar properties e.g. Cu + K  
(= 2 marks)

two elements in one place on the table e.g. Ce or La  
(= 2 marks)

no clear division between metals and non-metals **or** metals and non-metals jumbled / mixed up (could give example from table)

Newlands didn't allow spaces for new elements

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

elements with dissimilar properties are separated **or** grouped elements with similar properties

gaps left for elements to be added when discovered

relative atomic mass order not followed in all cases (so that elements go in groups with other similar elements) **or** Mendeleev in proton number order

groups related to electronic structure **or**  
group number equals number of outer electrons

new groups created **or** iron, cobalt nickel  
in a group **or** eight groups instead of seven

correct elements in periods 2 and 3

reactivity trends in groups **or** reactivity trends across periods

separates metals and non-metals

2

[5]