

# MARK SCHEME

# GCSE

## CHEMISTRY

## AQA - COMBINED SCIENCE

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### C1 - TEST 5

ATOMIC STRUCTURE AND THE PERIODIC TABLE

Advanced

## Mark schemes

- 1.** (a) react with oxygen / oxidise / burn in oxygen / burning / combustion **or** tungsten to tungsten oxide **or** makes an oxide  
*key idea is oxidation*  
*ignore breaking ignore fire / flames / exothermic*  
*ignore react with air* 1
- (b) it is (very) unreactive / not reactive / inert / does not react with tungsten **or** it is a noble gas **or** it is in group 0 or 8 or 18  
*do **not** accept unreactive / inert metal **or** argon is not very reactive* 1
- full outer shell (of electrons) / 8 electrons in outer shell 1
- does not need to gain / lose / swap / transfer / share electrons **or** does not need to form bonds  
*does not bond ionically / covalently* 1
- [4]**
- 2.** (a) group seven/7VII  
*accept halogens* 1
- (b) (i) in light **bulbs**/lasers  
*accept any other specified use as an inert atmosphere e.g. (argon)*  
*welding, storing explosives, fluorescent lights* 1
- (ii) 2.8.8/has a full/8 in/outer shell 1
- electrons  
*accept does not need to share/gain/lose electrons* 1
- (c) (i) any one from:  
disinfectant  
bleaching agent  
sterilising water/kills bacteria  
manufacture of HCl  
water treatment 1

**not:** cleaning/in pools  
 purification of water  
 kills germs  
 warfare  
 antiseptic

- (ii) inner shells 2,8 1
- outer shell 7 1
- (iii) fluorine:  
*accept the converse reasons for chlorine*
- gains **one**/an electron easier/is more  
 strongly attracted  
*not more strongly held* 1
- less shielding of nucleus by inner electron shells 1
- less distance from (attraction of)  
 nucleus/less shells 1

[10]

3.

- (a) did not appear because they had not been discovered **or** they are unreactive **or** they did not form compounds 1
- (b) arranged in order of atomic / proton number 1
- elements in the same group have the same number of electrons in the outer shell 1
- (c) chlorine>bromine>iodine
- table shows that chlorine displaces bromine and iodine 1
- and bromine displaces iodine 1
- (d)  $\text{Cl}_2(\text{aq}) + 2 \text{Br}^-(\text{aq}) \rightarrow \text{Br}_2(\text{aq}) + 2 \text{Cl}^-(\text{aq})$
- correct formulae* 1
- correct balancing* 1
- correct state symbol* 1

(e) the further down the group, the halogen becomes less reactive because outer electrons are further from the nucleus

1

so less attractive force on an incoming electron

1

[10]

4.

(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]

<b>5.</b>	<p>(a) if placed consecutively, then elements would be in wrong group / have wrong properties <i>allow some elements didn't fit pattern</i></p> <p style="text-align: right;">1</p> <p>left gaps</p> <p style="text-align: right;">1</p> <p>(b) (elements placed in) atomic / proton number order</p> <p style="text-align: right;">1</p> <p>(elements in ) same group have same number of <u>outer</u> electrons</p> <p style="text-align: right;">1</p> <p>any <b>one</b> from:</p> <ul style="list-style-type: none"> <li>• number of protons = number of electrons</li> <li>• reactions/(chemical) properties depend on the (outer) electrons</li> <li>• number of shells gives the period</li> </ul> <p style="text-align: right;">1</p> <p style="text-align: center;"><i>allow number of shells increases down the group</i></p> <p>(c) (i) (transition elements usually) have same / similar number of outer / 4th shell electrons</p> <p style="text-align: right;">1</p> <p style="text-align: center;"><i>allow 2 electrons in outer shell</i></p> <p>(because) inner (3rd ) shell / energy level is being filled</p> <p style="text-align: right;">1</p> <p style="text-align: center;"><i>ignore shells overlap</i></p> <p>(ii) <u>2<sup>nd</sup> shell</u> / energy level can (only) have maximum of 8 electrons</p> <p style="text-align: right;">1</p> <p style="text-align: center;"><i>accept no d-orbitals</i></p> <p><b>or</b></p> <p><u>2<sup>nd</sup> shell</u> / energy level cannot have 18 electrons</p> <p style="text-align: right;">1</p>
<b>[8]</b>	
<b>6.</b>	<p>(a) left gaps</p> <p style="text-align: right;">1</p> <p>if placed consecutively, then elements would be in wrong group / have wrong properties / owtte</p> <p style="text-align: right;">1</p> <p style="text-align: center;"><i>allow some elements didn't fit pattern</i></p> <p>(b) (elements placed in) atomic / proton number order</p> <p style="text-align: right;">1</p> <p>(elements in) same group have same number of <u>outer</u> electrons</p> <p style="text-align: right;">1</p>

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]**

**7.**

- (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]

8.

(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]**