

MARK SCHEME

GCSE

CHEMISTRY

AQA - TRIPLE SCIENCE

C1 - TEST 5

ATOMIC STRUCTURE

Advanced

Mark schemes

- 1.** (a) B 1
- (b) C 1
- (c) A 1
- (d) sum of protons and neutrons
allow number of protons and neutrons 1
- (e) between 69.5 and 70.0 1
- (f) Chadwick provided the evidence to show the existence of neutrons
allow Chadwick discovered neutrons 1
- (this was necessary because) isotopes have the same number of protons
allow (this was necessary because) isotopes have the same atomic number
- or**
- (this was necessary because) isotopes are atoms of the same element
ignore isotopes have the same number of electrons 1
- but with different numbers of neutrons
allow but with different mass (numbers) 1
- [8]**
- 2.** (a) gas
for 1 mark 1
- (b) AlX_3
for 1 mark 1
- (c) 7 / halogens
for 1 mark 1
- [3]**
- 3.** Mendeleev's table
contains only elements
divides metals and non-metals
contains far more elements which were discovered later
groups elements according to chemical properties

puts elements in order of atomic number / atomic mass / table includes these numbers

can use to work out / linked to electronic structures

left gaps for missing elements which had not been discovered

other sensible answers

any two for 1 mark each

[2]

4.

(a) transition / transitional metals / elements / d-block
for one mark

1

(b) coloured
catalyst

(*accept* high melting point)
for 1 mark each

2

[3]

5.

(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]

6.

- (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]

7.

(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]

8.

- (a) conducts electricity

1

density low

1

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

unreactive (with water)

forms compounds with
 covalent bonds

high melting point

2

[4]

9.

- (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]

10.

(a) heat with a water bath

or

heat with an electric heater

or

allow to evaporate / crystallise at room temperature

1

(b) to make sure that all the iodine reacts

allow so can see the reaction is complete

1

(as) excess iodine would remain in solution

1

(so) iodine could not be filtered off

allow (whereas) excess zinc could be filtered off

or

(so) the zinc iodide would not be pure

allow (so) would have to separate iodine from zinc iodide

1