TOPIC 1 ASSESSED HOMEWORK MARK SCHEME

1. (i) $\frac{10x + 11y}{x + y} = 10.8$

OR ratio 10:11 = 1:4 **OR** 20:80 etc

Allow idea that there are 5 × 0.2 divisions between 10 and 11.

1

abundance of ^{10}B is 20(%)

OR

$\frac{10x}{100} + \frac{11(100-x)}{100} = 10.8$

$\therefore 10x + 1100 - 11x = 1080$

$x = 1100 - 1080 = 20\%$

Correct answer scores M1 and M2.

1

(ii) Same number of electrons (in outer shell or orbital)

Ignore electrons determine chemical properties.

Same electronic configuration / arrangement

Ignore protons unless wrong.

1

[3]

2. (a) (Total number of) protons and neutrons (in nucleus of atom)

(number of) nucleons

1

(b) Zn^{-}

Do not allow Zn^{1-} or Zn^{+1} or ZN

Ignore numbers

1

(c) m / z

Allow mass / charge

1

(relative) abundance / (relative) intensity

QoL

Allow M1 + M2 in any order

1

$$\frac{206 + 207 + (208 \times 2)}{4} = \frac{(829)}{4}$$

(d) (i)

M1 = topline 1

M2 = ÷ 4 1

= 207.3

Only
207.3 = 3 marks 1

(ii) Lead / Pb

Not PB 1

(iii) Same number of electrons (in outer shell) / same electronic configuration

Ignore electrons determine chemical properties
Ignore reference to p and n if correct
Penalise if incorrect 1

[9]

3. (a) $\frac{\text{Average/mean mass of (1) atom(s) (of an element)}}{\text{1/12 mass of one atom of } ^{12}C}$ 1

If moles and atoms mixes Max = 1 1

OR

$\frac{\text{(Average) mass of one mole of atoms}}{\text{1/12 mass of one mole of } ^{12}C}$

OR

$\frac{\text{(Weighted) average mass of all the isotopes}}{\text{1/12 mass of one atom of } ^{12}C}$

OR

Average mass of an atom/isotope compared to C-12 on a scale in which an atom of C-12 has a mass of 12

This expression = 2 marks

(b) d block

Allow 3d/D
Other numbers lose M1
Ignore transition metals

1

[Ar] $3d^2 4s^2$

1

Can be written in full
Allow subscripts
$3d^2$ and $4s^2$ can be in either order

27

1

(c)
$$\frac{(90 \times 9) + (91 \times 2) + (92 \times 3) + (94 \times 3)}{17}$$

(= 1550)

1

(or Σ their abundances)

If one graph reading error lose M1 and allow consequential M2 and M3.
If 2 GR errors penalise M1 and M2 but allow consequential M3
If not 17 or Σ their abundances lose M2 and M3

1

= 91.2

91.2 = 3 marks provided working shown.

1

Zr/Zirconium

M4 -allow nearest consequential element from M3
accept Zr in any circumstance

1

(d) High voltage supply

1

Removes electron(s) (to form ions)

1

Z^+ = <u>90</u> has shortest TOF

If not 90 lose M3 and M4
If charge is wrong on 90 isotope lose M3 only
Accept any symbol in place of Z

1

since lowest mass/lowest m/z

Allow lightest

1

(e) (ions hit detector and) cause current/(ions) accept electrons/cause electron flow

QWC

1

bigger current = more of that isotope/current proportional to abundance

Implication that current depends on the number of ions

1

[15]

4. (a) 37

These answers only.
Allow answers in words.

1

48

Ignore any sum(s) shown to work out the answers.

1

(b) Dissolved in volatile solvent/passed through hollow needle

1

Subjected to high voltage

1

(c) (i) s / block s / group s

Only

1

(ii) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^1$

Allow $3d^{10}$ before $4s^2$
Allow in any order.

1

(d) $\dfrac{(85 \times 2.5) + 87 \times 1}{3.5}$

M1 is for top line

1

1

= 85.6

Only

1

OR

$\dfrac{(58 \times 5) + 87 \times 2}{7}$

M1 ^{85}Rb 71.4% and ^{87}Rb 28.6%
M2 divide by 100

1

1

85.6

5

M3 = 85.6

1

(e) Detector

Mark independently
Allow detection (plate).

1

Current / digital pulses / electrical signal related to abundance

Not electrical charge.

1

[11]

5. (a) N^{3-} / N^{-3} 1

(b) F^-/ fluoride

Ignore fluorine/F

Penalise Fl 1

[2]

6. H^- = $1s^2$ **or** $1s_2$ 1

[1]

7. (a) $Na(g) \rightarrow Na^+(g) + e^-$

OR $Na(g) + e^- \rightarrow Na^+(g) + 2e^-$

(-) on electron not essential

equation (1)

state symbols (1)

Ignore state symbols on electrons 2

(b) *Trend* : Increases **(1)**

Explanation : Increased nuclear charge or proton number **(1)**

Stronger attraction (between nucleus and (outer) e^-) **(1)**

Trend wrong

Allow M2 only if M3 correct (con) 3

(c) *How values deviate from trend*: (both values) too low **(1)**

Explanation for Al: e^- removed from (3) p **(1)**

e^- or orbital is higher in energy or better shielded than (3)**s**

or p electron is shielded by 3s electrons **(1)**

Allow e^- is further away

Mark independently

Explanation for S: e^- removed from (3)p electron pair **(1)**

repulsion between paired e^- (reduces energy required) **(1)**

Mark separately

If deviation wrong allow M2 and M4

If M3 and / or M5 right (con)

If used 'd' rather than 'p' orbital - lose M2 + M4

but may get M3, M5 (explanation marks) 5

[10]

8. (a) Heat / enthalpy / energy for removal of one electron **(1)**

from a gaseous atom **(1)**
can score in an equation
must have first mark to score the second

2

(b) (i) 2 **(1)**

(ii) Two elements (or Na / Mg) before the drop (in energy) to Al **(1)**

(iii) ionisation energy of Al < that for Mg **(1)**

(iv) fall in energy from P to S **(1)**
or discontinuity in trend

From Al to P there are 3 additional electrons **(1)**
or three elements
For second mark idea of block of 3 elements

5

[7]

9. (a) (i) Higher than P

1

(ii) $1s^2\ 2s^2\ 2p^6\ 3s^1$
Allow any order

1

(iii) $Al^+(g) + e^-_{( )} \longrightarrow Al^{2+}(g) + 2e^-_{( )}$

OR
$Al^+(g) \longrightarrow Al^{2+}(g) + e^-_{( )}$

OR
$Al^+(g) - e^-_{( )} \longrightarrow Al^{2+}(g)$

1

(iv) Electron in Si (removed from) (3)p orbital /

electron (removed)
from higher energy orbital or sub-shell / electron in silicon is more shielded

Accept converse arguments relating to Al
Penalise incorrect p-orbital

1

(b) Sodium / Na

Allow Na^+

1

<u>Electron</u> (removed) from the 2nd shell / 2p (orbital)

M2 is dependent on M1
Allow electron from <u>shell</u> nearer the nucleus (so more attraction)

1

(c) Silicon / Si

Not SI

1

(d) Heat or energy needed to overcome the attraction between the (negative) electron and the (positive) nucleus or protons

Not breaking bonds

QoL

Or words to that effect eg electron promoted to higher energy level (infinity) so energy must be supplied

1

[8]

10. (a) $2s^2 2p^6$;

If ignored the $1s^2$ given and written $1s^2 2s^2 2p^6$ mark as correct
Allow capitals and subscripts

1

(b) (i) $Na^+(g) \rightarrow Na^{2+}(g) + e^{(-)}$;

One mark for equation and one mark for state symbols

$Na^+(g) + e^{(-)} \rightarrow Na^{2+}(g) + 2e^{(-)}$;

M2 dependent on M1
Allow $Na^+(g) - e^{(-)} \rightarrow Na(g)$
Allow $X^+(g) \rightarrow X^{2+}(g) + e$ = 1 mark

2

(ii) $Na^{(2+)}$ requires loss of e^- from a 2(p) orbital or 2nd energy level or 2nd shell <u>and</u> $Mg^{(2+)}$ requires loss of e^- from a 3(s) orbital or 3rd energy level or 3rd shell / $Na^{(2+)}$ loses e from a lower (energy) orbital/ or vice versa;

Not from 3p

1

Less shielding (in Na);

Or vice versa for Mg

1

$e^{(-)}$ closer to nucleus/ more attraction (of electron to nucleus) (in Na);

M3 needs to be comparative

1

(iii) Aluminium /Al;

1

(c) Decreases;

If not decreases CE = 0
If blank, mark on

1

Increasing nuclear charge/ increasing number of protons;

1

Electrons in same shell or level/ same shielding/ similar shielding;

1

[10]

11. D [1]

12. D [1]

13. D [1]

14. A [1]