

M1.(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

Electron (removed) from the 2nd shell / 2p (orbital)
M2 is dependent on M1
Allow electron from shell 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]

M2. (a) 37

These answers only.

Allow answers in words.

1

48

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

1

(b) (i) Electron gun / high speed/high energy electrons

Not just electrons.

Not highly charged electrons.

1

Knock out electron(s)

Remove an electron.

1

(ii) $\text{Rb(g)} \rightarrow \text{Rb}^{\text{+}}(\text{g}) + \text{e}^{-}$

OR

$\text{Rb(g)} + \text{e}^{-} \rightarrow \text{Rb}^{\text{+}}(\text{g}) + 2\text{e}^{-}$

OR

$\text{Rb(g)} - \text{e}^{-} \rightarrow \text{Rb}^{\text{+}}(\text{g})$

Ignore state symbols for electron.

1

(c) Rb is a bigger (atom) / e further from nucleus / electron lost from a higher energy level / More shielding in Rb / less attraction of nucleus in Rb for outer electron / more shells

*Answer should refer to Rb not Rb molecule
If converse stated it must be obvious it refers to Na
Answer should be comparative.*

1

- (d) (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

- (e) $\frac{(85 \times 2.5) + 87 \times 1}{3.5}$
M1 is for top line

1

1

= 85.6

Only

1

OR

- $\frac{(58 \times 5) + 87 \times 2}{7}$
*M1 ^{85}Rb 71.4% and ^{87}Rb 28.6%
M2 divide by 100*

1

1

85.6

M3 = 85.6

1

- (f) Detector

*Mark independently
Allow detection (plate).*

1

Current / digital pulses / electrical signal related to abundance
Not electrical charge.

1

(g) Smaller

*Chemical error if not smaller, CE = 0/3
If blank mark on.*

1

Bigger nuclear charge / more protons in Sr
Not bigger nucleus.

1

Similar/same shielding

QWC

*(Outer) electron entering same shell/sub shell/orbital/same
number of shells.*

Do not allow incorrect orbital.

1

[16]

M3.(a) $\text{N}^{3-} / \text{N}^{-3}$

1

(b) F⁻ fluoride

*Ignore fluorine/F
Penalise FI*

1

(c) $\text{Li}_3\text{N} / \text{NLi}_3$

1

(d) $\frac{81.1}{40.1} \quad \frac{18.9}{14}$

M1 for correct fractions

1

$$(\approx 2.02 \quad = 1.35)$$

1.5 1 or 3 : 2
M2 for correct ratio

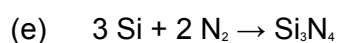
1



If Ca₃N₂ shown and with no working award 3 marks

If Ca₃N₂ obtained by using atomic numbers then lose M1

1



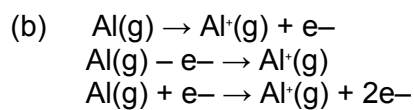
Accept multiples

1

[7]

M4. (a) Cross between the Na cross and the Mg cross

1



One mark for state symbols consequential on getting equation correct.

*Electron does not have to have the – sign on it
Ignore (g) if put as state symbol with e⁻ but penalise state symbol mark if other state symbols on e⁻*

2

(c) 2nd/second/2/II

Only

1

(d) Paired electrons in (3)p orbital

Penalise wrong number

If paired electrons repel allow M2

1

repel

1

(e) Neon/Ne

No consequential marking from wrong element

1

$1s^2 2s^2 2p^6 / [\text{He}] 2s^2 2p^6$

Allow capital s and p

Allow subscript numbers

1

(f) Decreases

CE if wrong

1

Atomic radius increases/electron removed further from nucleus
or nuclear charge/electron in higher energy level/Atoms
get larger/more shells

Accept more repulsion between more electrons for M2

Mark is for distance from nucleus

Must be comparative answers from M2 and M3

CE M2 and M3 if mention molecules

Not more sub-shells

1

As group is descended more shielding

1

[11]

M5. (a) $\text{Li(g)} \rightarrow \text{Li}^{\text{+}}(\text{g}) + \text{e}(\text{g})$

$\text{Li(g)} - \text{e(g)} \rightarrow \text{Li}^{\text{+}}(\text{g})$

$\text{Li(g)} + \text{e(g)} \rightarrow \text{Li}^{\text{+}}(\text{g}) + 2\text{e}^{-}$

One mark for balanced equation with state symbols

Charge and state on electron need not be shown

1

- (b) Increases
If trend wrong then CE = 0/3 for (b). If blank mark on. 1
- Increasing nuclear charge / increasing no of protons
Ignore effective with regard to nuclear charge 1
- Same or similar shielding / same no of shells / electron
 (taken) from same (sub)shell / electron closer to the
 nucleus / smaller atomic radius 1
- (c) Lower
If not lower then CE = 0/3 1
- Paired electrons in a (4) p orbital
If incorrect p orbital then M2 = 0 1
- (Paired electrons) repel
If shared pair of electrons M2 + M3 = 0 1
- (d) Kr is a bigger atom / has more shells / more shielding
 in Kr / electron removed further from nucleus/ electron
 removed from a higher (principal or main) energy level
CE if molecule mentioned
Must be comparative answer
 QWC 1
- (e) 2 / two / II 1
- (f) Arsenic / As 1

[10]