

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<sup>+</sup>* 1

Electron (removed) from the 2<sup>nd</sup> 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  $^{85}\text{Rb}$  71.4% and  $^{87}\text{Rb}$  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)**  $N^{3-} / N^{-3}$

1

(b) F<sup>-</sup> fluoride

*Ignore fluorine/F  
Penalise FI*

1

(c)  $Li_3N / NLi_3$

1

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

*M1 for correct fractions*

1

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

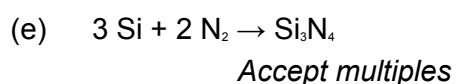
1.5      1      or      3 : 2  
*M2 for correct ratio*

1



*If Ca<sub>3</sub>N<sub>2</sub> shown and with no working award 3 marks*  
*If Ca<sub>3</sub>N<sub>2</sub> obtained by using atomic numbers then lose M1*

1

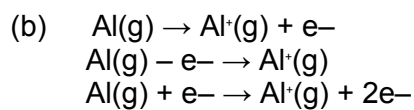


1

[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<sup>-</sup> but penalise state symbol mark if other state symbols on e<sup>-</sup>*

2

(c) 2<sup>nd</sup>/second/2/II  
*Only*

1

(d) Paired electrons in (3)p orbital  
*Penalise wrong number*

*If paired electrons repel allow M2*

1

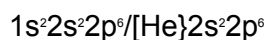
repel

1

(e) Neon/Ne

*No consequential marking from wrong element*

1



*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*

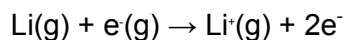
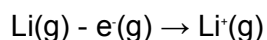
1

As group is descended more shielding

1

[11]

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



*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]