

M1.(a) (i) d (block) **OR** D (block)

*Ignore transition metals / series.*

*Do not allow any numbers in the answer.*

1

(ii) Contains positive (metal) ions or protons or nuclei and delocalised / mobile / free / sea of electrons

*Ignore atoms.*

1

Strong attraction between them or strong metallic bonds

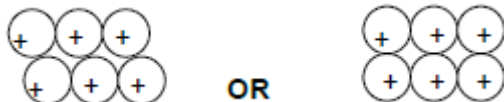
*Allow 'needs a lot of energy to break / overcome' instead of 'strong'.*

*If strong attraction between incorrect particles, then CE = 0 / 2.*

*If molecules / intermolecular forces / covalent bonding / ionic bonding mentioned then CE=0.*

1

(iii)



*M1 is for regular arrangement of atoms / ions (min 6 metal particles).*

*M2 for + sign in each metal atom / ion.*

*Allow 2+ sign.*

2

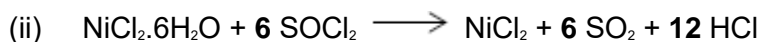
(iv) Layers / planes / sheets of atoms or ions can slide over one another  
*QoL.*

1

(b) (i)  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8 (4s^0)$

*Only.*

1



*Allow multiples.*

1

NaOH / NH<sub>3</sub> / CaCO<sub>3</sub> / CaO

*Allow any name or formula of alkali or base.*

*Allow water.*

1

[9]

**M2.** (a) (i)  $1s^2 2s^2 2p^6 3s^2 3p^1$  (1)

*Allow subscripted electron numbers*

(ii) p (block) (1)

*Allow upper or lower case 's' and 'p' in (a)(i) and (a)(ii)*

2

(b) Lattice of metal / +ve ions/ cations / atoms (1)

*Not +ve nuclei/centres*

*Accept regular array/close packed/tightly packed/uniformly arranged*

(Surrounded by) delocalised electrons (1)

*Note: Description as a 'giant ionic lattice' = CE*

2

(c) Greater nuclear or ionic charge or more protons (1)

Smaller atoms / ions (1)

*Accept greater charge density for either M1 or M2*

More delocalised electrons / e<sup>-</sup> in sea of e<sup>-</sup> / free e<sup>-</sup> (1)

Stronger attraction between ions and delocalised / free electrons etc. (1)

*Max 3*

*Note: 'intermolecular attraction/ forces' or covalent molecules = CE*

*Accept stronger 'electrostatic attraction' if phrase prescribed elsewhere*

*Ignore references to m/z values*

If Mg or Na compared to Al, rather than to each other, then:  
**Max 2**  
 Treat description that is effectively one for Ionisation Energy  
 as a '**contradiction**'

3

(d) (Delocalised) electrons (1)

Move / flow in a given direction (idea of moving non-randomly)  
 or under the influence applied pd QoL mark (1)

Allow 'flow through metal'

Not: 'Carry the charge'; 'along the layers'; 'move through the metal'

2

[9]

**M3.** (a) enthalpy/energy change/required when an electron is removed/  
 knocked out / displaced/ to form a uni-positive ion  
 (ignore 'minimum' energy)

1

from a gaseous atom

(could get M2 from a correct equation here)

(accept 'Enthalpy/energy change for the process...'  
 followed by an appropriate equation, for both marks)  
 (accept molar definitions)

1

(b)  $1s^2 2s^2 2p^6$   
 (accept capitals and subscripts)

1

(c) 's' block  
 (not a specific 's' orbital – e.g. 2s)

1

(d)  $Mg^+(g) \rightarrow Mg^{2+}(g) + e^-$  or  
 $Mg^+(g) + e^- \rightarrow Mg^{2+}(g) + 2e^-$  or  
 $Mg^+(g) - e^- \rightarrow Mg^{2+}(g)$

1

(e) Mg<sup>2+</sup> ion smaller than Ne atom / Mg<sup>2+</sup> e<sup>-</sup> closer to nucleus  
(Not 'atomic' radius fo Mg<sup>2+</sup>)

1

Mg<sup>2+</sup> has more protons than Ne / higher nuclear charge or  
e<sup>-</sup> is removed from a charged Mg<sup>2+</sup> ion / neutral neon atom  
(accept converse arguments)  
(If used 'It' or Mg/magnesium/Mg<sup>3+</sup> etc. & 2 correct reasons,  
allow (1))

1

(f) (i) trend: increases  
(if 'decreases', CE = 0/3)

1

Expl<sup>n</sup>: more protons / increased proton number /  
increased nuclear charge  
(NOT increased atomic number)

1

same shell / same shielding / smaller size

1

(ii) QoL reference to the e<sup>-</sup> pair in the 3p sub-level  
(penalise if wrong shell, e.g. '2p', quoted)

1

repulsion between the e<sup>-</sup> in this e<sup>-</sup> pair  
(if not stated, 'e<sup>-</sup> pair' must be clearly implied)  
(mark M4 and M5 separately)

1

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**M4.** (a) Outer electrons are in p orbitals

1

- (b) decreases 1
- Number of protons increases 1
- Attracting outer electrons in the same shell (or similar shielding) 1
- (c) Sulfur molecules ( $S_8$ ) are larger than phosphorus ( $P_4$ ) 1
- Therefore van der Waals' forces between molecules are stronger 1
- Therefore more energy needed to loosen forces between molecules 1
- (d) Argon particles are single atoms with electrons closer to nucleus 1
- Cannot easily be polarised (or electron cloud not easily distorted) 1

[9]

**M5.** (a) 37

*These answers only.  
Allow answers in words.*

1

48

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

1

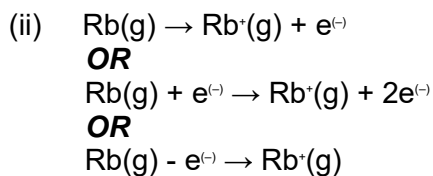
(b) (i) Electron gun / high speed/high energy electrons

*Not just electrons.  
Not highly charged electrons.*

1

Knock out electron(s)  
*Remove an electron.*

1



*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*

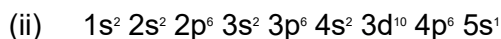
*If converse stated it must be obvious it refers to Na*

*Answer should be comparative.*

1

- (d) (i) s / block s / group s  
*Only*

1



*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**

$(58 \times 5) + 87 \times 2$       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]