

Mark schemes

1	(a) Mg ⁽²⁺⁾ or Magnesium <i>Na⁺ CE=0</i>	1
	Because Mg ²⁺ has more protons AND With the <u>same</u> shielding/screening/electron arrangement/number of electrons (or isoelectronic) <i>Allow larger/stronger nuclear charge</i> <i>Ignore atomic radius</i>	1
	(b) Na(g) → Na ⁺ (g) + e ⁻ <i>1 for correct species and gas phase</i> <i>Allow e without charge</i> <i>Allow Na(g) - e⁻ → Na⁺(g)</i> <i>Na(g) + e⁻ → Na⁺(g) + 2e⁻</i>	1
	(c) Mg between 600-800	1
	S between 800-1040 <i>If S not lower than P on graph then M1 only</i> <i>If no plots on graph must state S below P to access M3 & M4</i>	1
	e ⁻ paired in (3)p orbital in S (owtte) <i>Allow (3)p subshell/sublevel provided pair mentioned</i>	1
	Paired e ⁻ repel (so less energy needed to remove)	1
		[7]
2	C	[1]
3	(a) General increase <i>If not increase then CE</i>	1
	Greater nuclear charge / more protons	1
	Same shielding / electrons added to same shell <i>Allow similar</i>	1
	Stronger <u>attraction</u> (from nucleus) for <u>outer electron(s)</u> <i>Allow electron in outer shell</i>	1

- (b) Aluminium / Al (lower than Mg)
CE if not Al or S 1
- (Outer) electron in (3)p orbital / sub-shell (level)
If 2p or 4p orbital lose M2 and M3 1
- (3p) higher in energy
Allow more shielded or weaker nuclear attraction
M3 is dependent on M2 1
- or
- Sulfur / S (lower than P)
 (Outer) electrons in (3)p orbital begin to pair
 Repel
If 2p or 4p orbital lose M2 and M3
Allow 2 electrons in (3)p
M3 is dependent on M2 1
- (c) Sulfur / S
CE if not S 1
- Large jump after 6th or between 6th and 7th
Do not allow M2 if atom/ion is removed 1
- (d) Silicon
CE if not Si 1
- Giant covalent structure / macromolecule 1
- Covalent (bonds)
Giant covalent scores M2 and M3 1
- Many / strong (covalent bonds) or
 (covalent bonds) need lots of energy to break
CE for M2-M4 if molecules / metallic / ionic / IMFs mentioned 1
- [13]

4 A

[1]

5 (a) The number of protons increases (across the period) / nuclear charge increases 1

Therefore, the attraction between the nucleus and electrons increases
Can only score M2 if M1 is correct 1

- (b) S₈ molecules are bigger than P₄ molecules

Allow sulfur molecules have bigger surface area and sulfur molecules have bigger M_r

1

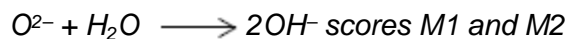
Therefore, van der Waals / dispersion / London forces between molecules are stronger in sulfur

1

- (c) Sodium oxide contains O²⁻ ions

1

These O²⁻ ions react with water forming OH⁻ ions



1

- (d) $\text{P}_4\text{O}_{10} + 12\text{OH}^- \longrightarrow 4\text{PO}_4^{3-} + 6\text{H}_2\text{O}$

1

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6

- (a) Silicon / Si

If not silicon then CE = 0 / 3

1

covalent (bonds)

M3 dependent on correct M2

1

Strong or many of the (covalent) bonds need to be broken / needs a lot of energy to break the (covalent) bonds

Ignore hard to break

1

- (b) Argon / Ar

If not argon then CE = 0 / 3. But if Kr chosen, lose M1 and allow M2+M3

1

Large(st) number of protons / large(st) nuclear charge

Ignore smallest atomic radius

1

Same amount of shielding / same number of shells / same number of energy levels

Allow similar shielding

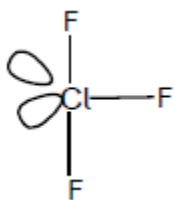
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- (c) Chlorine / Cl

Not Cl₂, Not CL, Not Cl²

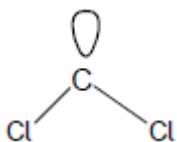
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(d) (i)



Or any structure with 3 bonds and 2 lone pairs
Ignore any angles shown

1



Or a structure with 2 bonds and 1 lone pair

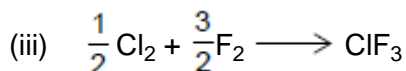
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(ii) Bent / v shape

Ignore non-linear, angular and triangular

Apply list principle

1



No multiples

Ignore state symbols

1

[11]

7

(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

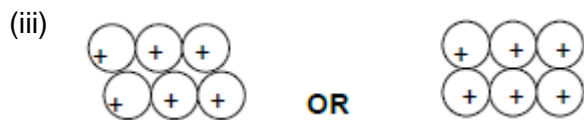
Strong attraction between them or strong metallic bonds

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



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

(ii) $\text{NiCl}_2 \cdot 6\text{H}_2\text{O} + 6 \text{SOCl}_2 \longrightarrow \text{NiCl}_2 + 6 \text{SO}_2 + 12 \text{HCl}$

Allow multiples.

1

$\text{NaOH} / \text{NH}_3 / \text{CaCO}_3 / \text{CaO}$

Allow any name or formula of alkali or base.

Allow water.

1

[9]

8

(a) Carbon / C

If M1 incorrect, CE = 0 / 3

1

Fewest protons / smallest nuclear charge / least attraction between protons (in the nucleus) and electrons / weakest nuclear attraction to electrons

Allow comparative answers.

Allow converse answers for M2

1

Similar shielding

Allow same shielding.

1

(b) Increase

1

Oxygen / O

If not oxygen, then cannot score M2, M3 and M4

1

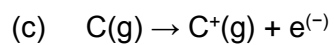
Paired electrons in a (2)p orbital

If paired electrons in incorrect p orbital, lose M3 but can award M4

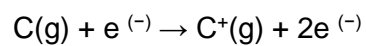
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(Paired electrons in a p orbital) repel

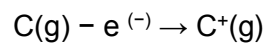
1



OR



OR



Ignore state symbols for electron.

1

(d) (More energy to) remove an electron from a (more) positive ion / cation

Allow electron closer to the nucleus in the positive ion.

1

(e) Lithium / lithium / Li

If formula given, upper and lower case letters must be as shown.

1

[10]