Essential Pre-Uni Chemistry D3.1

A Level

P P P

There are trends evident in atomic and ionic radii. Ionisation energies also show trends. Complete the sentences below with the words 'increase' or 'decrease', to indicate what happens to the radii and ionisation energy of the atoms or ions [(a)–(f)], or to the ionisation energies [(g)–(i)].

Part A Along a period, L-R

Going along a period from left to right, the atomic radii...

- ○ increase
- ○ decrease

Part B Down a group

Going down a group, the atomic radii...

- ○ increase
- ○ decrease

Part C Electrons removed

As successive electrons are removed from the same atom/ion, the radii...

- ○ decrease
- ○ increase

Part D Same charge, down a group

The radii of ions of the same charge, on descending a group...

- increase
- decrease

Part E Adding electrons

As successive electrons are added to one atom to make increasingly negative ions, the radii...

- increase
- decrease

Part F Along period, L-R

Along a period from left to right, the radii of isoelectronic species generally...

- decrease
- increase

Part G Along period, L-R

Along a period from left to right, the first ionisation energies generally...

- increase
- decrease

Part H Down a group

Going down a group, the first ionisation energies...

- increase
- decrease

Part I Ionisation energies

Successive ionisation energies for the same element...

- increase
- decrease

Essential Pre-Uni Chemistry D3.3

A Level

An element has its first to fifth ionisation energies in $\mathrm{kJ\,mol^{-1}}$ listed as: 578, 1817, 2745, 11578, 14831.

Give the group number in the periodic table that corresponds to this element.

- 18
- 17
- 2
- 13
- 1
- 14
- 15
- 16

Essential Pre-Uni Chemistry D3.2

A Level

Part A [Na Mg Al]

Which would have the smallest radius in the set [Na Mg Al]?

- Al
- Mg
- Na

Part B [Na^+ Mg^{2+} Al^{3+}]

Which would have the smallest radius in the set [Na^+ Mg^{2+} Al^{3+}]?

- Na^+
- Mg^{2+}
- Al^{3+}

Part C [B Al Ga In Tl]

Which would have the smallest radius in the set [B Al Ga In Tl]?

- Tl
- B
- Ga
- Al
- In

Part D $\ce{[Si^{4-} P^{3-} S^{2-} Cl^{-}]}$

Which would have the largest radius in the set $[\mathrm{Si}^{4-}\ \mathrm{P}^{3-}\ \mathrm{S}^{2-}\ \mathrm{Cl}^{-}]$?

- Si^{4-}
- Cl^{-}
- S^{2-}
- P^{3-}

Part E $[\mathrm{Ti}^{4+}\ \mathrm{Zr}^{4+}\ \mathrm{Hf}^{4+}\ \mathrm{Rf}^{4+}]$

Which would have the smallest radius in the set $[\mathrm{Ti}^{4+}\ \mathrm{Zr}^{4+}\ \mathrm{Hf}^{4+}\ \mathrm{Rf}^{4+}]$?

- Ti^{4+}
- Zr^{4+}
- Rf^{4+}
- Hf^{4+}

Part F $[\mathrm{Fe}\ \mathrm{Fe}^{2+}\ \mathrm{Fe}^{3+}\ \mathrm{Fe}^{2-}]$

Which would have the largest radius in the set $[\mathrm{Fe}\ \mathrm{Fe}^{2+}\ \mathrm{Fe}^{3+}\ \mathrm{Fe}^{2-}]$?

- Fe^{2-}
- Fe^{2+}
- Fe^{3+}
- Fe

Sizes of atoms and ions

A Level

Part A Sizes of ions

Which of the following sets of diagrams best indicates the relative radii of the atom and most common ion of sodium and chlorine?

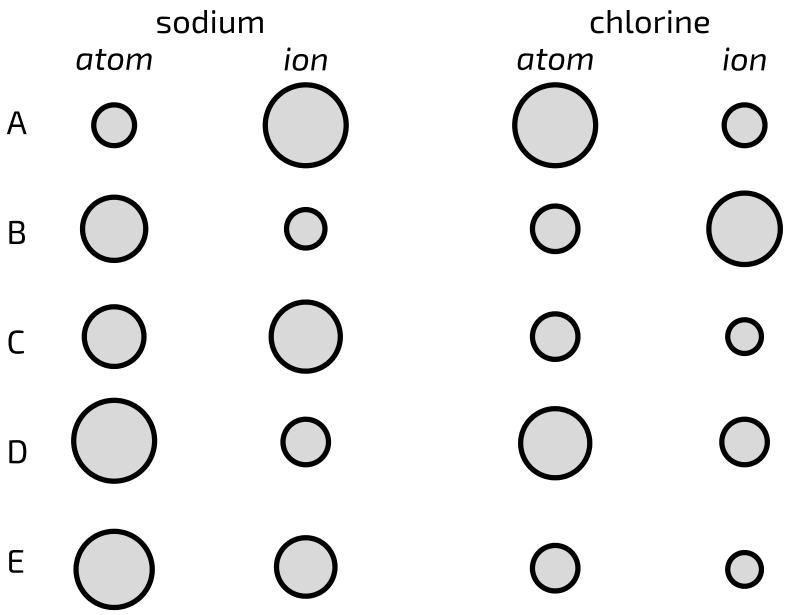

Figure 1: Sizes of Na and Cl atoms and ions

- A
- B
- C
- D

Part B Largest radius

Which species represented by the following formulae has the largest radius?

- P^{3-}
- Cl^{-}
- K^{+}
- Ar

Part A adapted with permission from UCLES, A-Level Chemistry, November 1991, Paper 1, Question 15;
Part B adapted with permission from UCLES, A-Level Chemistry, November 1994, Paper 1, Question 12

Group 2

A Level

P P P

Part A Precipitates

Which pair of $0.1\,\text{mol}\,\text{dm}^{-3}$ aqueous solutions is most likely to give a precipitate when added together?

- NaNO_3 and BaCl_2
- MgSO_4 and SrCl_2
- NH_3 and CaCl_2
- KBr and MgSO_4

Part B Properties of Group 2 elements

Which of the following is a property of the elements in Group 2, magnesium to barium?

- They all form oxides MO
- They all liberate chlorine from concentrated hydrochloric acid
- They all react explosively with cold water liberating hydrogen
- They all have outer electronic structures ns^2sp^2
- They all form covalent chlorides MCl_2

Part A adapted with permission from UCLES, A-Level Chemistry, June 1996, Paper 3, Question 14
Part B adapted with permission from OCSEB, A-Level Chemistry, June 1995, Paper 1, Question 19

Heating calcium hydroxide

A Level

Part A Heating calcium hydroxide

Write the equation for the action of heat on calcium hydroxide, including state symbols, balancing the equation with the lowest possible stoichiometric coefficients.

Part B Decomposition of calcium hydroxide

Which of the following explains why magnesium hydroxide decomposes at a lower temperature than calcium hydroxide?

1. MgO has a larger magnitude lattice energy than CaO.
2. Mg has higher first and second ionisation energies than Ca.
3. $\mathrm{Mg(OH)_2}$ has a larger magnitude lattice energy than $\mathrm{Ca(OH)_2}$.

- **2** and **3** only are correct
- **1** only is correct
- **1, 2** and **3** are correct
- **3** only is correct
- **1** and **2** only are correct

Part A,B adapted with permission from UCLES, A-Level Chemistry, 1989, Paper 2, Question 1;
Part C adapted with permission from UCLES, A-Level Chemistry, 1988, Paper 3, Question 15

Group 2 sulfates

A Level

Part A Sulfuric acid and barium hydroxide

Dilute sulfuric acid was added to aqueous barium hydroxide until the acid was in excess. Which graph shows the variation in the total number of ions in solution?

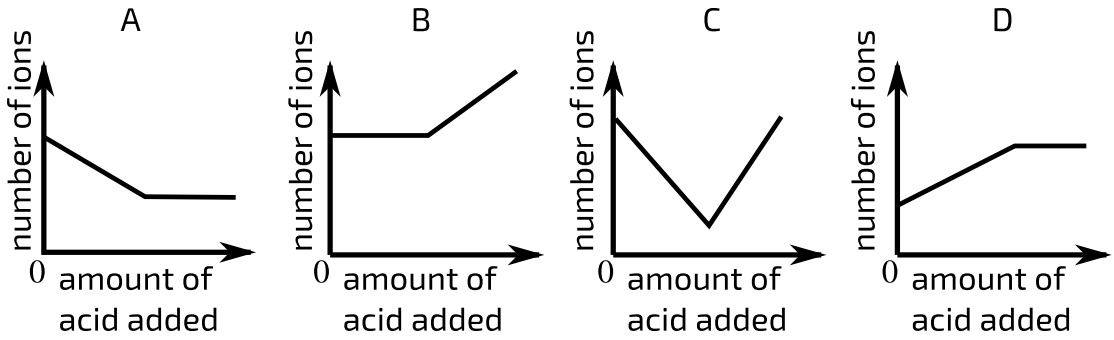

Figure 1: number of ions vs. amount of acid added

- A
- B
- C
- D

Part B Group 2 sulfates

What changes occur in the magnitudes of:

(i) the lattice energy,
(ii) the enthalpy of hydration,
(iii) the solubility of the sulfates,

as Group 2 is descended?

	lattice energy	enthalpy change of hydration	solubility of sulfate
A	decrease	decrease	decrease
B	decrease	increase	decrease
C	increase	decrease	increase
D	increase	decrease	increase

- **A**
- **B**
- **C**
- **D**

Part A adapted with permission from UCLES, A-Level Chemistry, June 1994, Paper 4, Question 16;
Part B adapted with permission from UCLES, A-Level Chemistry, June 1995, Paper 4, Question 13

Groups and electronegativity

A Level

Part A Electronegativity

In the periodic table, the electronegativity of the elements in:

1. Period 3 increases from sodium to chlorine.
2. Group 2 increases from barium to beryllium.
3. Group 7 increases from iodine to fluorine.

- **1, 2** and **3** are correct
- **1** and **2** only are correct
- **2** and **3** only are correct
- **1** only is correct
- **3** only is correct

Part B Groups

Which of the following statements describing the characteristics of elements within any one group of the Periodic Table are correct?

1. The elements are either all metals or non-metals.
2. The melting points of the elements increase with increasing proton (atomic) number.
3. The first ionisation energies of the elements generally decrease with increasing proton (atomic) number.

- **1, 2** and **3** are correct
- **1** and **2** only are correct
- **2** and **3** only are correct
- **1** only is correct
- **3** only is correct

Part A adapted with permission from UCLES, A-Level Chemistry, June 1991, Paper 1, Question 35;
Part B adapted with permission from UCLES, A-Level Chemistry, November 1993, Paper 4, Question 34

Periodic Trends

A Level

Part A Melting points of third row elements

Which graph best shows the variation of melting point of the third row elements?

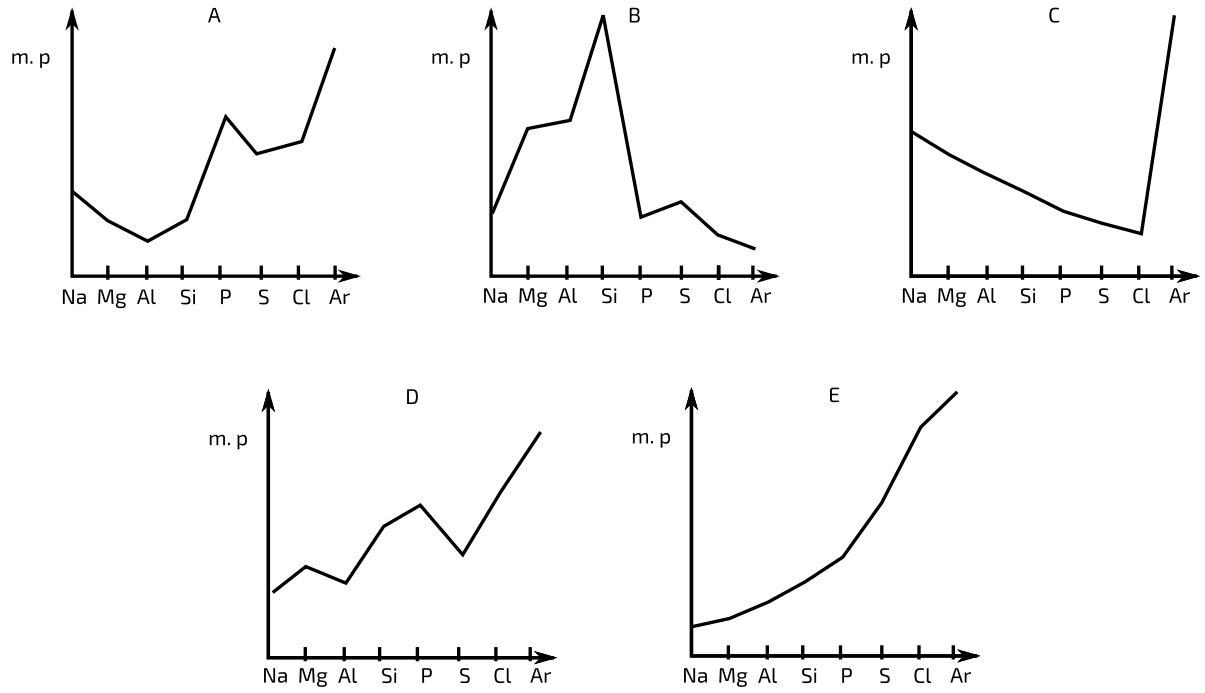

Figure 1: Melting points across 3rd period

- A
- B
- C
- D

Part B Trends in halogens

Which graph correctly describes a trend found in the halogen group?

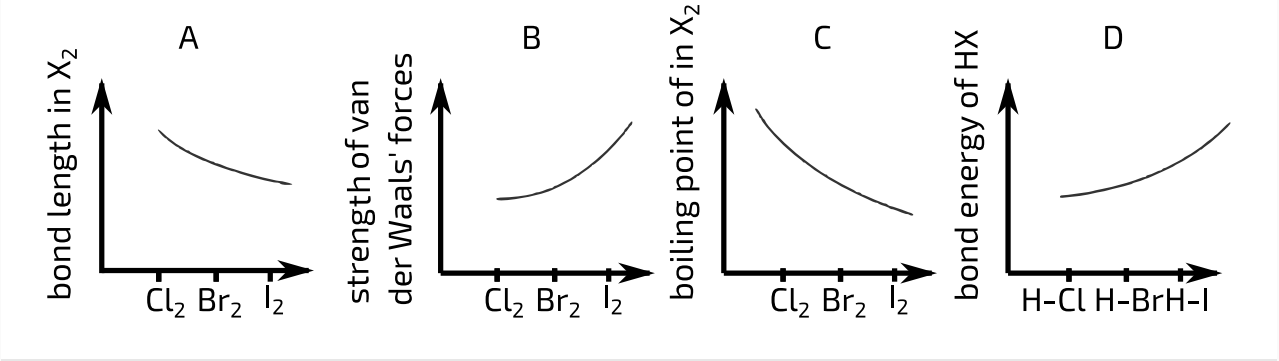

Figure 2: Trends in the halogen group

- A
- B
- C
- D

Part A adapted with permission from UCLES, A-Level Chemistry, June 1991, Paper 1, Question 17;
Part B adapted with permission from UCLES, A-Level Chemistry, June 1995, Paper 4, Question 15

Silver ions

A Level

P P P

An aqueous solution containing Br^- ions is treated with $\mathrm{AgNO_3\,(aq)}$, giving a precipitate **P** which is then tested for its solubility in concentrated $\mathrm{NH_3\,(aq)}$.

What is the colour of **P** and its solubility in $\mathrm{NH_3\,(aq)}$?

	colour of P	**solubility in** $\mathrm{NH_3\,(aq)}$
A	white	insoluble
B	white	slightly soluble
C	cream	slightly soluble
D	yellow	insoluble

- ○ **A**
- ○ **B**
- ○ **C**
- ○ **D**

Adapted with permission from UCLES, A-Level Chemistry, June 1996, Paper 3, Question 17