



# Higher Chemistry: Unit 1 - Chemical Changes and Structure

## Part A - Periodicity and Bonding

### SUMMARY, QUIZ and HOMEWORK 1

#### WELL DONE!

By now you should have completed the following lessons:

1. Bonding and structure in the first 20 elements
2. Covalent Radius
3. Ionisation Energy
4. Electronegativity

Now it's time for a summary of what you have learned so far and to check your understanding.

#### Success Criteria

You will have been successful in this lesson if you:

1. Read the summaries below (there is no need to copy/print these)
2. Watch the link provided
3. Complete the summary quiz (on MS forms)
4. Completed Homework 1 (answers will be given next week)

MS Teams will be monitored throughout the week by a chemistry teacher. If you need help or clarification with either the task or the content of the lesson, just ask.

#### Links to Prior Knowledge

You may wish to revise the following to help you understand this summary:

- Higher Chemistry - Lessons 1 - 4

*You will need a data booklet for this lesson. Download or print a copy of the Higher Chemistry Data Booklet from MS Teams or from the SQA website - [https://www.sqa.org.uk/sqa/files\\_ccc/ChemistryDataBooklet\\_NewH\\_AH-Sep2016.pdf](https://www.sqa.org.uk/sqa/files_ccc/ChemistryDataBooklet_NewH_AH-Sep2016.pdf)*

## SUMMARY

### The First 20 Elements - Bonding and Structure

The first 20 elements of the periodic table can be divided into 5 groups based on their bonding and structure, as shown below.

				2			1
H -259 -253 gas							He -270 -269 gas
Li 180 1340 solid	Be 1280 2500 solid	B 2030 3700 solid	C 3500 3900 solid	N -210 -196 gas	O -219 -183 gas	F -220 -188 gas	Ne -249 -246 gas
Na 98 883 solid	Mg 650 1110 solid	Al 660 2400 solid	Si 1410 2500 solid	P 44 280 solid	S 119 445 solid	Cl -101 -34 gas	Ar -189 -186 gas
K 63 760 solid	Ca 850 1440 solid						
5		4		3			

Key

symbol

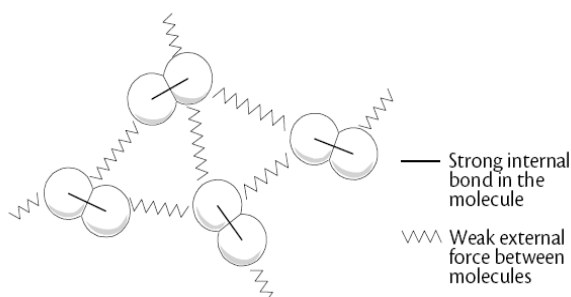
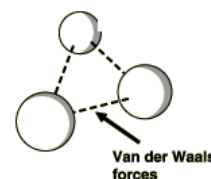
m.pt. (°C)

b.pt. (°C)

state

#### 1. Monatomic Gases

These are the Noble gases, Helium, Neon and Argon. They are completely unreactive and exist as single atoms held together only by weak Van der Waals forces.

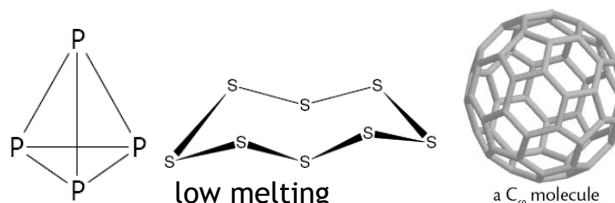


#### 2. Covalent Molecular Gases

Hydrogen, Nitrogen, Oxygen, Fluorine and Chlorine all exist as diatomic molecules ( $H_2$ ,  $N_2$  etc) and are all gases at room temperature. Atoms are held to each other by strong covalent bonds, but molecules held together by weak intermolecular forces.

#### 3. Covalent Molecular Solids

Phosphorous, sulfur and carbon (fullerene) exist as molecules but larger than diatomic:  $P_4$ ,  $S_8$  and  $C_{60}$ . All are solid at room temperatures, but will still have relatively low melting points.



#### 4. Covalent Networks (revision from Nat 5)

#### 5. Metals (revision from Nat 5)

## Patterns in the Periodic Table: Periodicity

### 1. Covalent Radius (Atomic Size)

Covalent radius decreases along the period because:

Nuclear charge increases, pulling the electrons closer to the nucleus.



Covalent radius increases down a group because:

The number of occupied electron shells increases

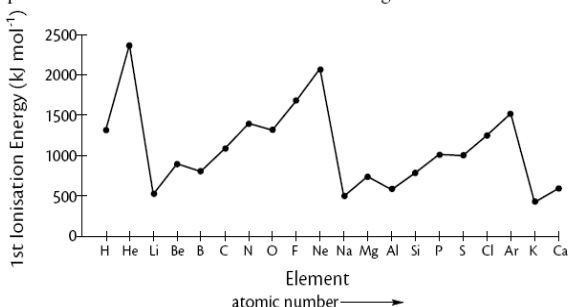
	Electron arrangement	Covalent radius (pm)
Li	2, 1	123
Na	2, 8, 1	157
K	2, 8, 8, 1	203
Rb	2, 8, 18, 8, 1	216
Ca	2, 8, 18, 18, 8, 1	235

### 2. Ionisation Energy

Ionisation energy increases along the period because:

- Nuclear charge increases and atomic size decreases so electrons are held with a greater force.

The graph shows the variation of 1st Ionisation Energies with Atomic Number.



Ionisation energy decreases down a group because:

- Outer electrons are increasingly further away from nuclear attraction
- AND there is a screening effect (or shielding effect) due to electrons on inner shells.

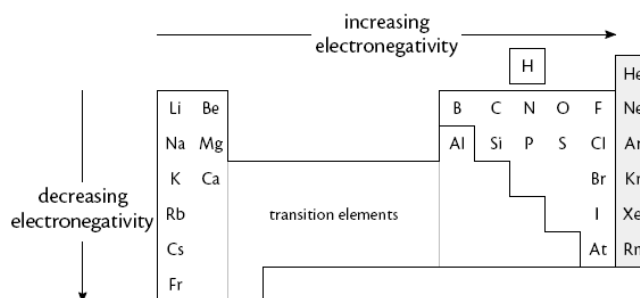
$\text{Na}^+ (\text{g}) \rightarrow \text{Na}^{2+} (\text{g}) + \text{e}^-$  requires much more energy because:

It involves removal of an electron from an electron shell which is closer to the nucleus.

AND the electron is less shielded from the nucleus.

### 3. Electronegativity

Trends for electronegativity are THE SAME AS the trends for ionisation energy.





**WATCH** - YOUTUBE: Professor Dave Explains: <https://youtu.be/hePb00CqvP0>

This is an 8 minute summary of what you've learned so far. Some of the content is above Higher level, so feel free to ignore or skip from 4:35 - 6:18

### Further Reading

To learn more about the first 20 elements. Follow the links below:

**BBC Bitesize:** <https://www.bbc.co.uk/bitesize/guides/zxc99j6/revision/1>

Read pages 1 to 8 and try the test

**Evans2 chem web:** <https://www.evans2chemweb.co.uk/login/index.php#>

Username: snhs      password: giffnock

Select any teacher → revision material → CfE Higher → Periodicity

### Summary Quiz and Homework 1

You should now try the **Summary Quiz:**

(You will need to be signed into GLOW to access this)

[https://forms.office.com/Pages/ResponsePage.aspx?id=oyzTzM4Wj0KVQTctawUZKSkMeY-rsvRNs\\_x4XAdH73JUN01PV1hHOFhIWjRHVFU1UFRIVVo5NUpYRS4u](https://forms.office.com/Pages/ResponsePage.aspx?id=oyzTzM4Wj0KVQTctawUZKSkMeY-rsvRNs_x4XAdH73JUN01PV1hHOFhIWjRHVFU1UFRIVVo5NUpYRS4u)

You should also complete **Homework 1** (below)

*Please Note: The homework is mostly made from higher chemistry past paper questions, so you may find them quite tricky to start and there are even some problem solving questions. Take your time and try to answer all questions as best you can. Next week, we will post the answers and a full explanation of each question.*

**Homework 1 - Periodicity**

1. Which of the following reactions refers to the second ionisation energy of Magnesium?
- A  $\text{Mg}_{(\text{s})} \rightarrow \text{Mg}^{2+}_{(\text{g})} + 2\text{e}^{-}$   
B  $\text{Mg}_{(\text{g})} \rightarrow \text{Mg}^{2+}_{(\text{g})} + 2\text{e}^{-}$   
C  $\text{Mg}^{2+}_{(\text{g})} \rightarrow \text{Mg}^{+}_{(\text{g})} + \text{e}^{-}$   
D  $\text{Mg}^{+}_{(\text{g})} \rightarrow \text{Mg}^{2+}_{(\text{g})} + \text{e}^{-}$
2. Which of the following atoms has the least attraction for bonding electrons?
- A Carbon  
B Nitrogen  
C Phosphorus  
D Silicon
3. As the relative atomic mass in the halogens increases...
- A The boiling point increases  
B The density decreases  
C The first ionisation energy increases  
D The atomic size decreases
4. Which of the following equations represents the first ionisation energy of fluorine?
- A  $\text{F}^{-}_{(\text{g})} \rightarrow \text{F}_{(\text{g})} + \text{e}^{-}$   
B  $\text{F}^{-}_{(\text{g})} \rightarrow \frac{1}{2}\text{F}_{2(\text{g})} + \text{e}^{-}$   
C  $\text{F}_{(\text{g})} \rightarrow \text{F}^{+}_{(\text{g})} + \text{e}^{-}$   
D  $\frac{1}{2}\text{F}_{2(\text{g})} \rightarrow \text{F}^{+}_{(\text{g})} + \text{e}^{-}$
5. As the atomic number of the alkali metals increases...
- A The first ionisation energy decreases  
B The atomic size decreases  
C The density decreases  
D The melting point increase
6. Which line in the table is likely to be correct for the element francium?

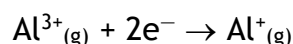
	State at 30° C	First Ionisation Energy / $\text{kJmol}^{-1}$
A	Solid	Less than 376
B	Liquid	Less than 376
C	Solid	Greater than 376
D	Liquid	Greater than 376



7. The table shows the first three ionisation energies of aluminium

Ionisation energy / $\text{kJmol}^{-1}$		
1st	2nd	3rd
578	1817	2745

Using this information, what is the enthalpy change, in  $\text{kJmol}^{-1}$ , for the following reaction?



- A +2167
- B -2167
- C +4562
- D -4562

8. A potassium atom is larger than a sodium atom because potassium has

- A a larger nuclear charge
- B a larger nucleus
- C more occupied energy levels
- D a smaller ionisation energy.

9. Which of the following elements has the greatest attraction for bonding electrons?

- A Lithium
- B Chlorine
- C Sodium
- D Bromine

10. Which type of bonding is never found in elements?

- A metallic
- B covalent
- C ionic
- D monatomic

11. Lithium starts the second period of the Periodic Table.

Li	Be	B	C	N	O	F
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- (a) In general, what is the trend in atomic radius from lithium to fluorine? (1)
- (b) Explain the trend in question (a) (1)

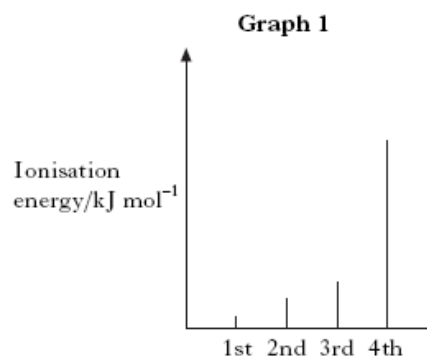


12. Graph 1 shows the first four ionisation energies for aluminium.

(a) Write an equation to represent the fourth ionisation energy of aluminium (1)

(b) Explain fully why is the fourth ionisation energy of aluminium so much higher than the third ionisation energy? (2)

(c) Suggest why the data booklet has no value for the fourth ionisation energy for Lithium. (1)



13. Information about the periodicity can be found in the data booklet, page eleven.

(a) State what is meant by the term *electronegativity*. (1)

(b) Which element has the highest electronegativity listed on page 11 of the data booklet? (1)

(c) Write an equation, with state symbols, for the first ionisation energy for nitrogen. (1)

14. The ability of an atom to form a negative ion is measured by its “Electron Affinity”.

The Electron Affinity is defined as the energy change when one mole of gaseous atoms of an element combines with one mole of electrons to form gaseous negative ions.

Write the equation, showing state symbols, that represents the Electron Affinity of chlorine. (1)

**Total = 20**

Answers will be given next week