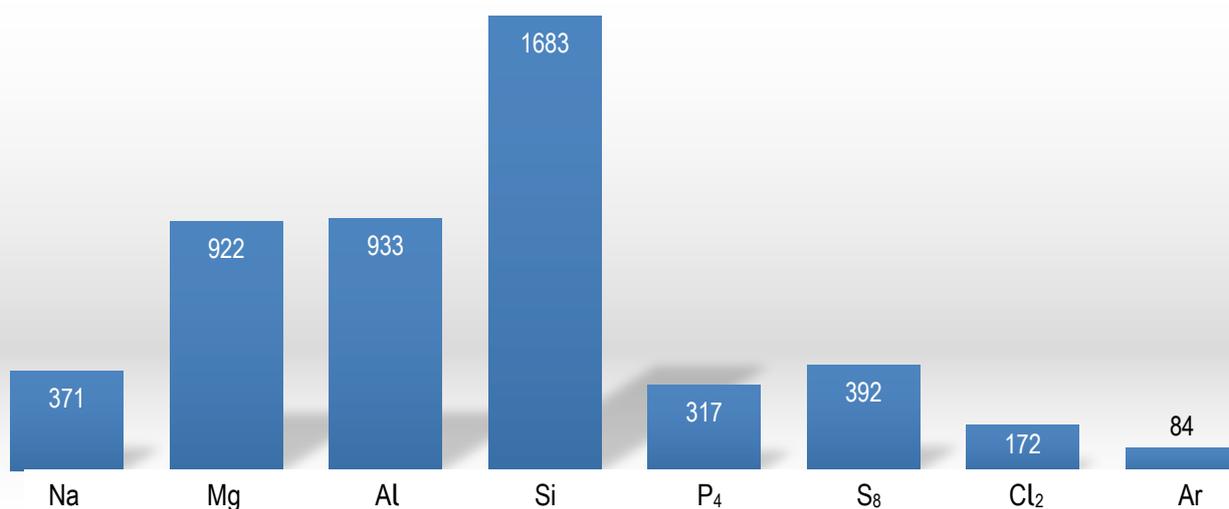




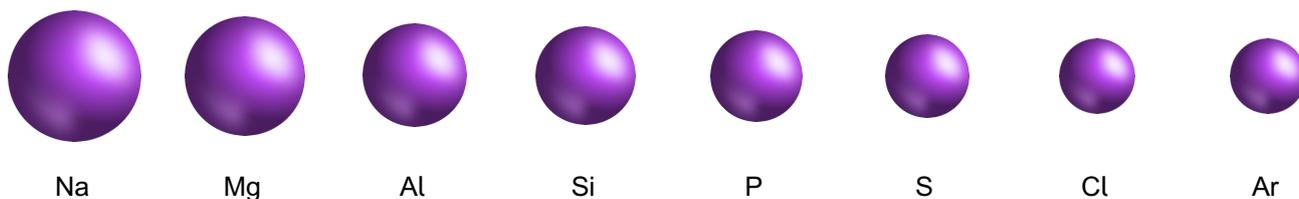
## PERIOD 3 ELEMENTS

### Melting points (K)



	Structure type	Notes
Na Mg Al	metallic	Fairly high as strong attraction between + nuclei of atoms and the cloud of – delocalised outer shell electrons From Na to Al, melting points increase because: <ul style="list-style-type: none"><li>• metallic bonding gets stronger<ul style="list-style-type: none"><li>○ atoms get smaller</li><li>○ more protons in the nuclei</li><li>○ more delocalised outer shell electrons</li></ul></li><li>• so stronger attraction between cloud of delocalised electrons and the nuclei of atoms</li></ul>
Si	giant covalent	Highest melting point as giant covalent – need to break many strong covalent bonds
P <sub>4</sub> S <sub>8</sub> Cl <sub>2</sub>	molecular	Low melting points as non-polar molecules with only weak van der Waals' forces between molecules Melting point: S <sub>8</sub> > P <sub>4</sub> > Cl <sub>2</sub> due to number of electrons in molecules: S <sub>8</sub> > P <sub>4</sub> > Cl <sub>2</sub>
Ar	monatomic	Lowest melting point as monatomic structure. Very weak van der Waals' forces between <u>atoms</u>

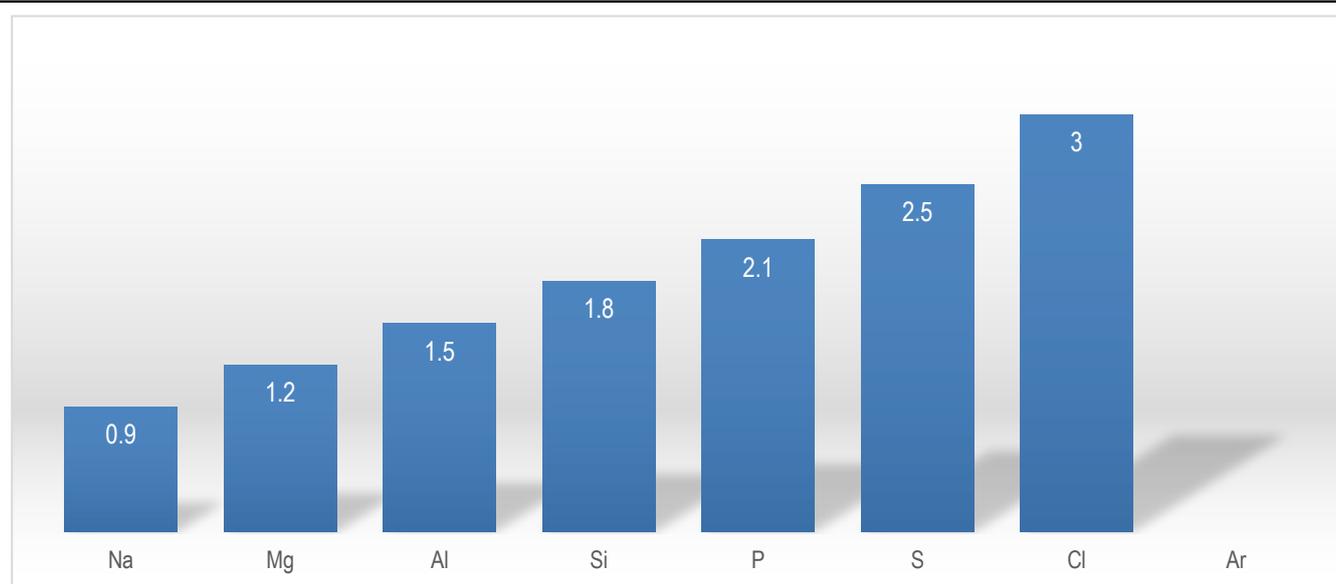
## Atomic radius



Across the period atoms get smaller as

- electrons in same main shell (shell 3)
- with the same amount of shielding
- but more protons in the nucleus
- and so the electrons are pulled in closer to the nucleus

## Electronegativity

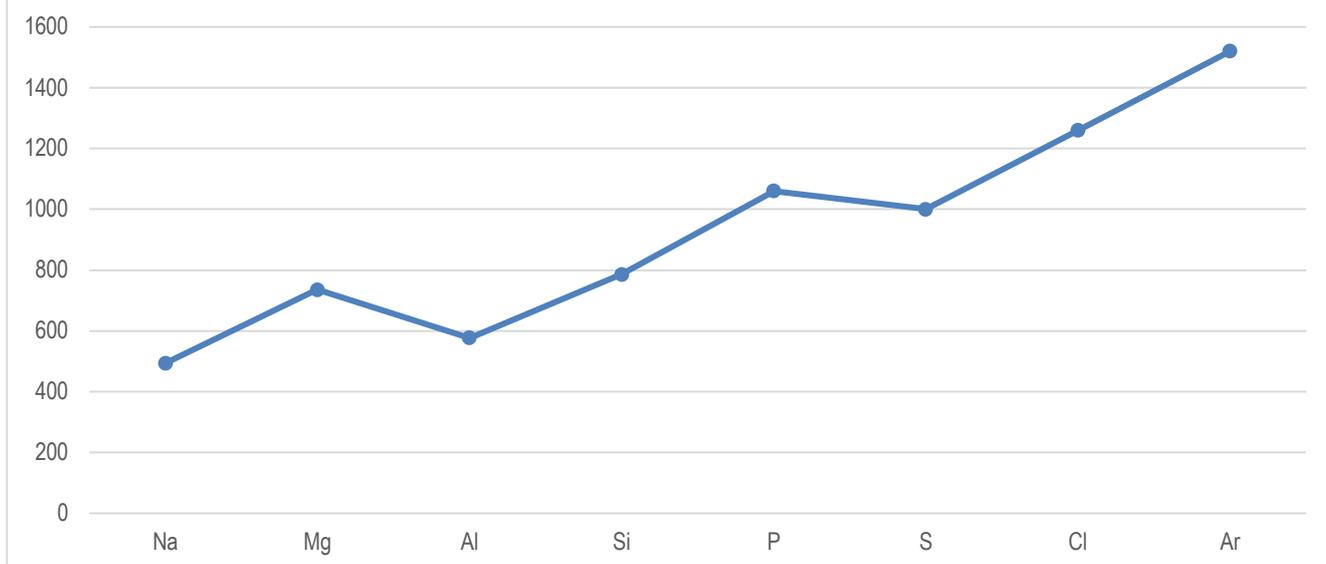


Across the period electronegativity increases as

- smaller atomic radius
- more protons
- stronger attraction between nucleus and the pair of electrons in covalent bond

Note – no value for Ar as it has never formed a covalent bond

## Ionisation energy



### General trend

- smaller atomic radius
- more protons
- stronger attraction between nucleus and outer electron

### Dip from Group 2 to 3 (Mg to Al)

- Mg loses electron from 3s orbital
- Al loses electron from 3p orbital
- 3p is higher energy than 3s

### Dip from Group 5 to 6 (P to S)

- P loses electron from an orbital containing one electron
- S loses electron from an orbital containing two electrons
- greater electron-electron repulsion in S

## Reaction with water

Na	$2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$ <ul style="list-style-type: none"><li>• floats</li><li>• moves around</li><li>• melts</li><li>• fizzes</li></ul>
Mg	$\text{Mg} + \text{H}_2\text{O} \rightarrow \text{MgO} + \text{H}_2$ <ul style="list-style-type: none"><li>• reacts with steam (not with cold water)</li><li>• burns with bright white flame</li><li>• forms white solid</li></ul>
Cl <sub>2</sub>	$\text{Cl}_2 + \text{H}_2\text{O} \rightleftharpoons \text{HCl} + \text{HOCl}$ <ul style="list-style-type: none"><li>• disproportionation reaction: Cl (0) to Cl (-1) and Cl (+1)</li><li>• if indicator added, will initially go colour for acid (due to HCl and HOCl) but then bleach due to OCl<sup>-</sup> ions</li><li>• in bright light, reacts further: <math>\text{Cl}_2 + \text{H}_2\text{O} \rightarrow 2\text{HCl} + \frac{1}{2}\text{O}_2</math></li></ul>

## Reaction with oxygen

Na	$4\text{Na} + \frac{1}{2}\text{O}_2 \rightarrow 2\text{Na}_2\text{O}$ <ul style="list-style-type: none"><li>• burns with yellow-orange flame</li><li>• produces white solid</li></ul>
Mg	$2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ <ul style="list-style-type: none"><li>• burns with bright white flame</li><li>• produces white solid</li></ul>
Al	$4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$ <ul style="list-style-type: none"><li>• hard for foil to burn, but powder burns more readily</li><li>• burns with white flame</li><li>• produces white solid</li></ul>
Si	$\text{Si} + \text{O}_2 \rightarrow \text{SiO}_2$ <ul style="list-style-type: none"><li>• powder will burn</li><li>• burns with white flame</li><li>• produces white solid</li></ul>
P <sub>4</sub>	$\text{P}_4 + 5\text{O}_2 \rightarrow \text{P}_4\text{O}_{10}$ <ul style="list-style-type: none"><li>• ignites very easily</li><li>• burns with bright white flame</li><li>• produces white smoke</li></ul>
S <sub>8</sub>	$\text{S} + \text{O}_2 \rightarrow \text{SO}_2$ <ul style="list-style-type: none"><li>• burns with blue flame</li><li>• produces choking, toxic gas</li><li>• forms SO<sub>2</sub> rather than SO<sub>3</sub></li></ul>