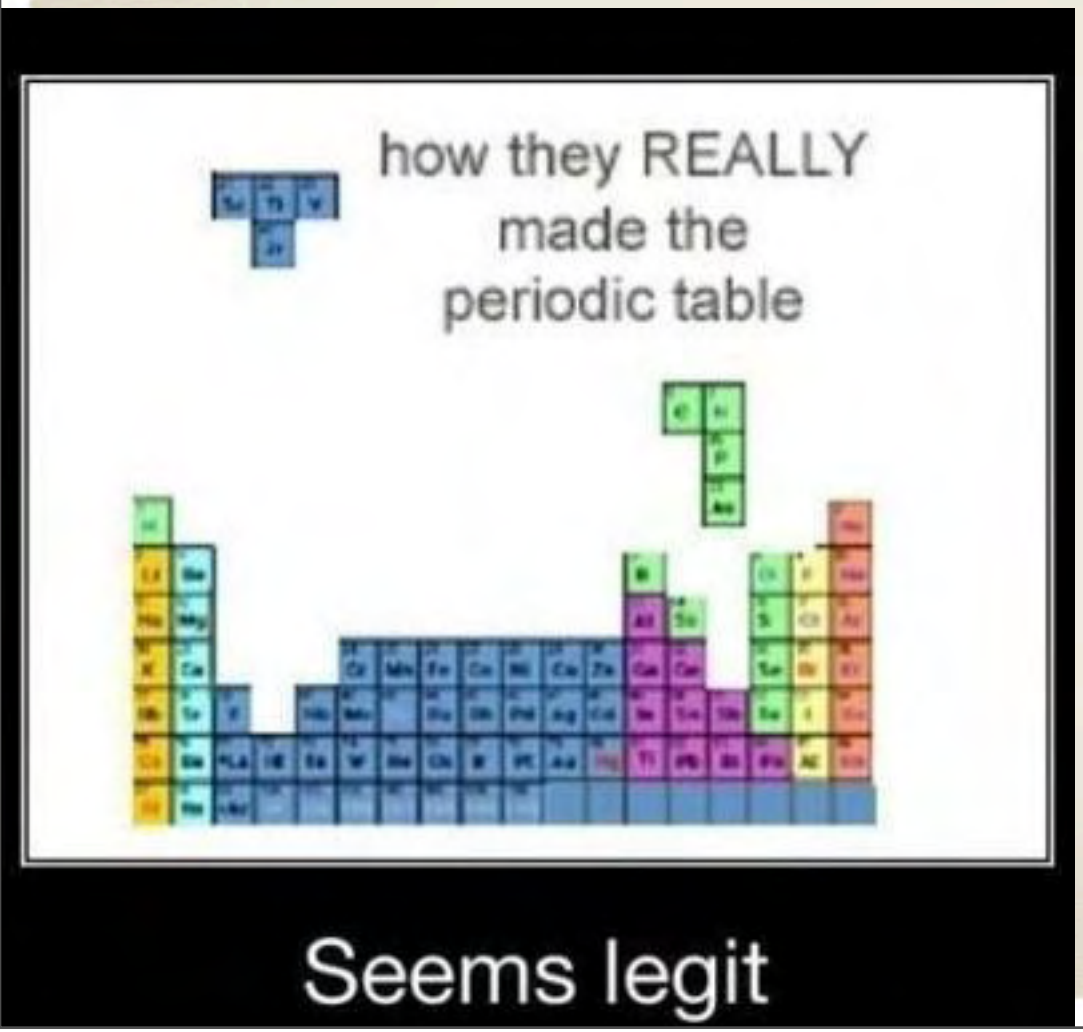
Periodicity



Physical and Chemical Properties

Melting Points

Reactivity

Trends so far...

- So far we have looked at Atomic Radius, Ionic Radius, Ionization Energy and Electronegativity trends
- Today we will add Melting Point to that list!
- But first...a POP QUIZ!

Which has the larger atomic radius?

Li or K

Ca or Ni

Ga or B

O or C

Cl or Br

Be or Ba

Si or S

Arrange the following elements in order of increasing electronegativity

a. gallium, aluminum, indium
b. calcium, selenium, arsenic
c. oxygen, fluorine, sulfur
d. phosphorus, oxygen, germanium

Choose the element with the greatest first ionization energy:

Carbon or aluminum
Calcium or strontium
Helium or lithium
Chlorine or argon
Chlorine or fluorine
Sulfur or chlorine

Melting Points

melting point the temperature at which a compound changes from a solid to a liquid

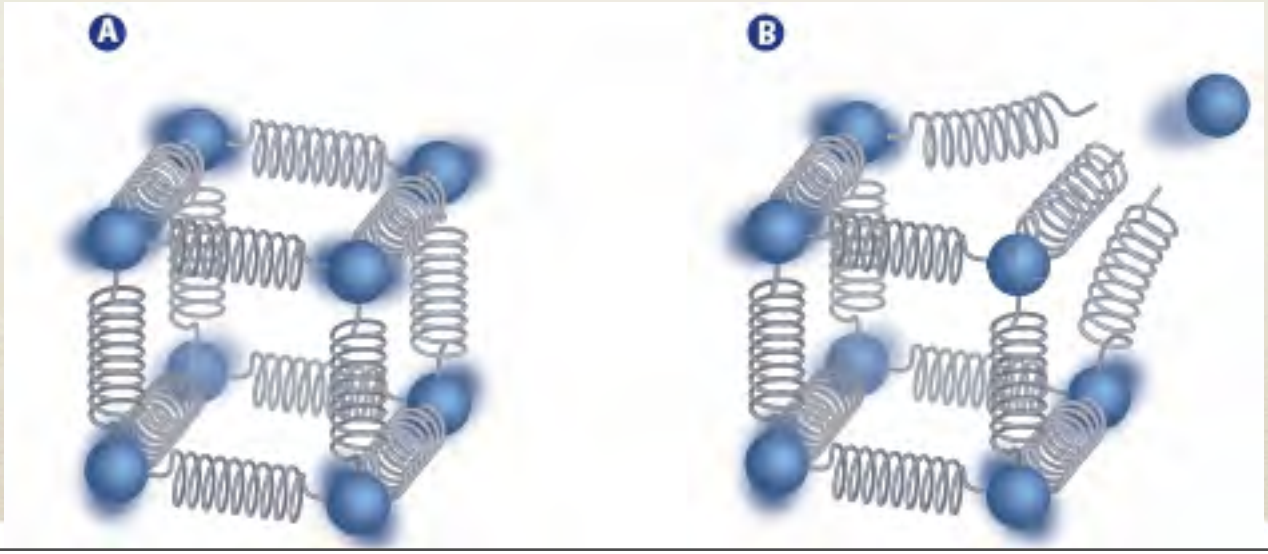
- Melting point pattern across a period is not uniform
- When a substance **melts**, some of the **attractive forces** holding the particles together are **broken** so that the particles can move freely around each other but are still close together.
- The stronger these forces are, the more energy is needed to overcome them and the higher the melting temperature.

Melting Points

- Melting points are affected by impurities, weakened structures result in lower melting points
- Melting points depend on
  - Structure of element
  - Type of attractive forces between atoms

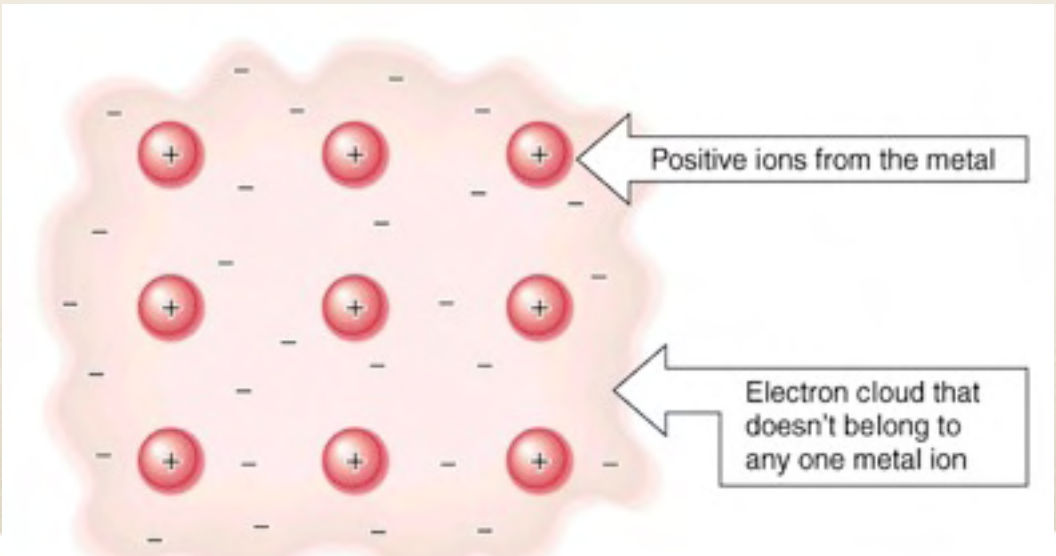
Intermolecular Forces

- The stronger the forces BETWEEN two molecules (called intermolecular forces, shown here by springs) the HIGHER the melting point
- It takes more energy to separate molecules (or melt them)
- The forces between metals and non-metals are different, so we have to study them separately



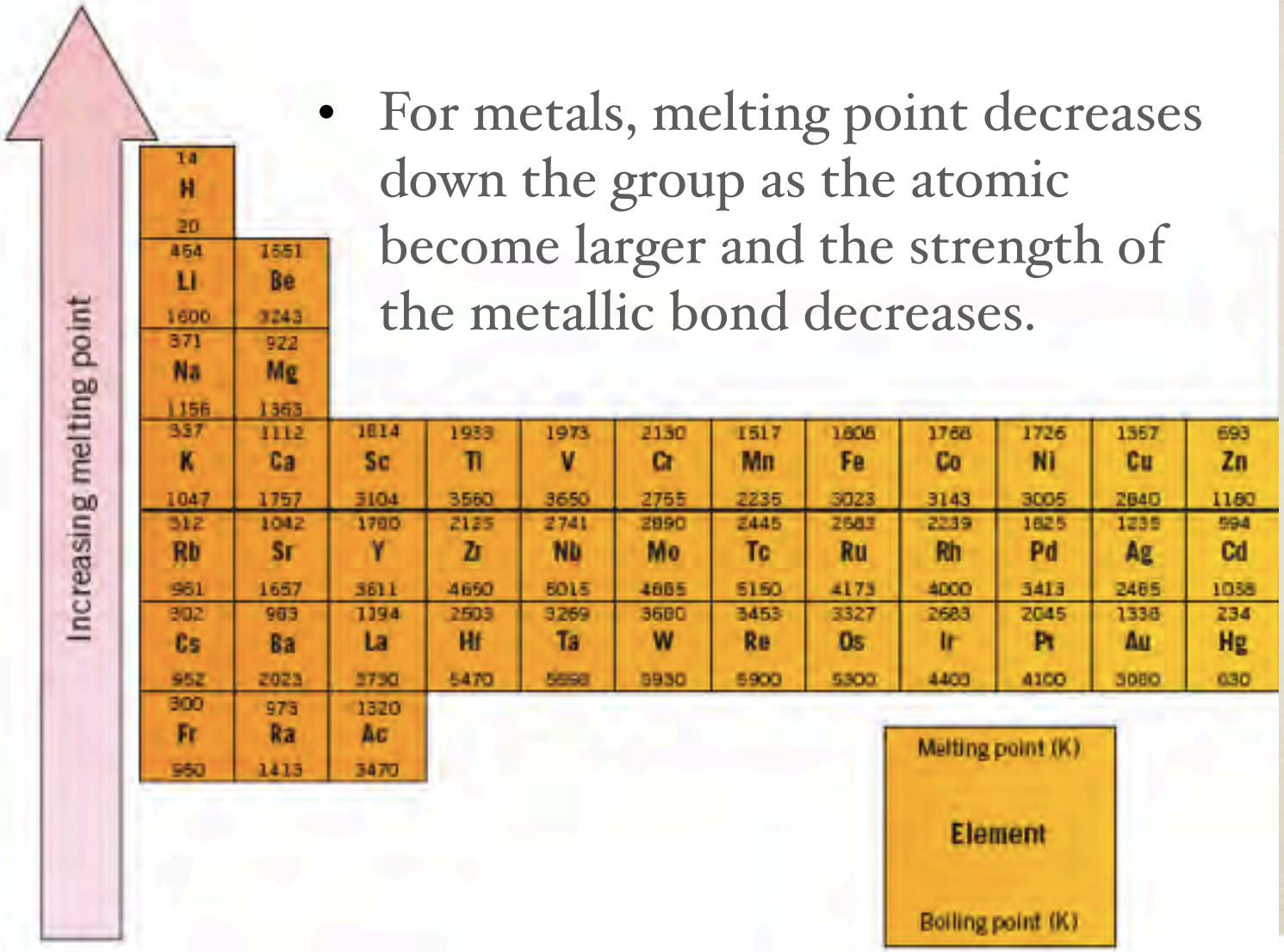
Metals

- The valence electrons in metals become detached from the individual atoms so that metals consist of a close packed lattice of positive ions in a **sea of <u>delocalised</u> electrons**
- As you go down a group, the size of the atom increases, but the number of valence electrons remains the same. This results in a weaker metallic bond
- As you go across a period, the number of valence electrons increases, resulting in stronger metallic bonding.

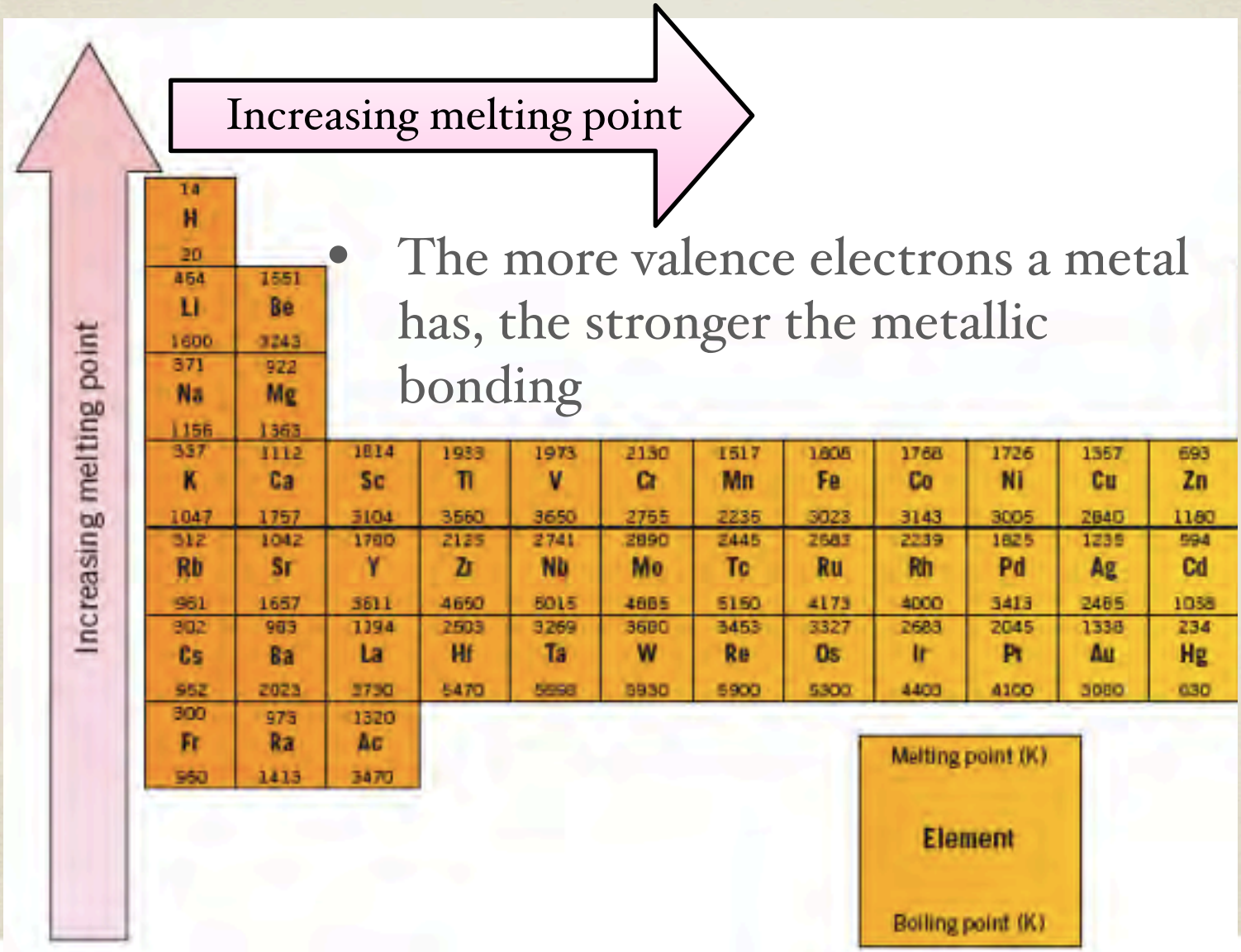


Group Trend for Metals

- For metals, melting point decreases down the group as the atomic become larger and the strength of the metallic bond decreases.



Periodic Trend for Metals



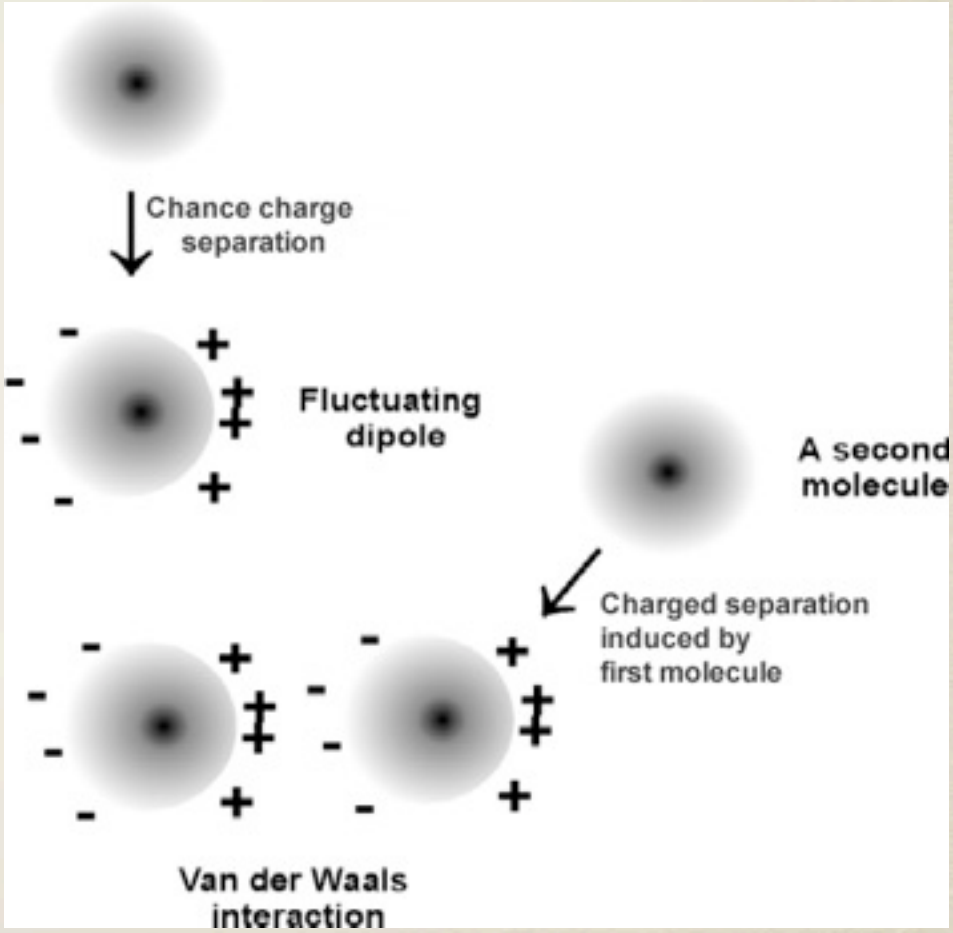
- The more valence electrons a metal has, the stronger the metallic bonding

Non-Metals

- Non-metals tend to exist as diatomic atoms which share electrons perfectly equally (EN =0)
- This is called a non-polar covalent bond
- The only intermolecular force acting is Van der Waal's force

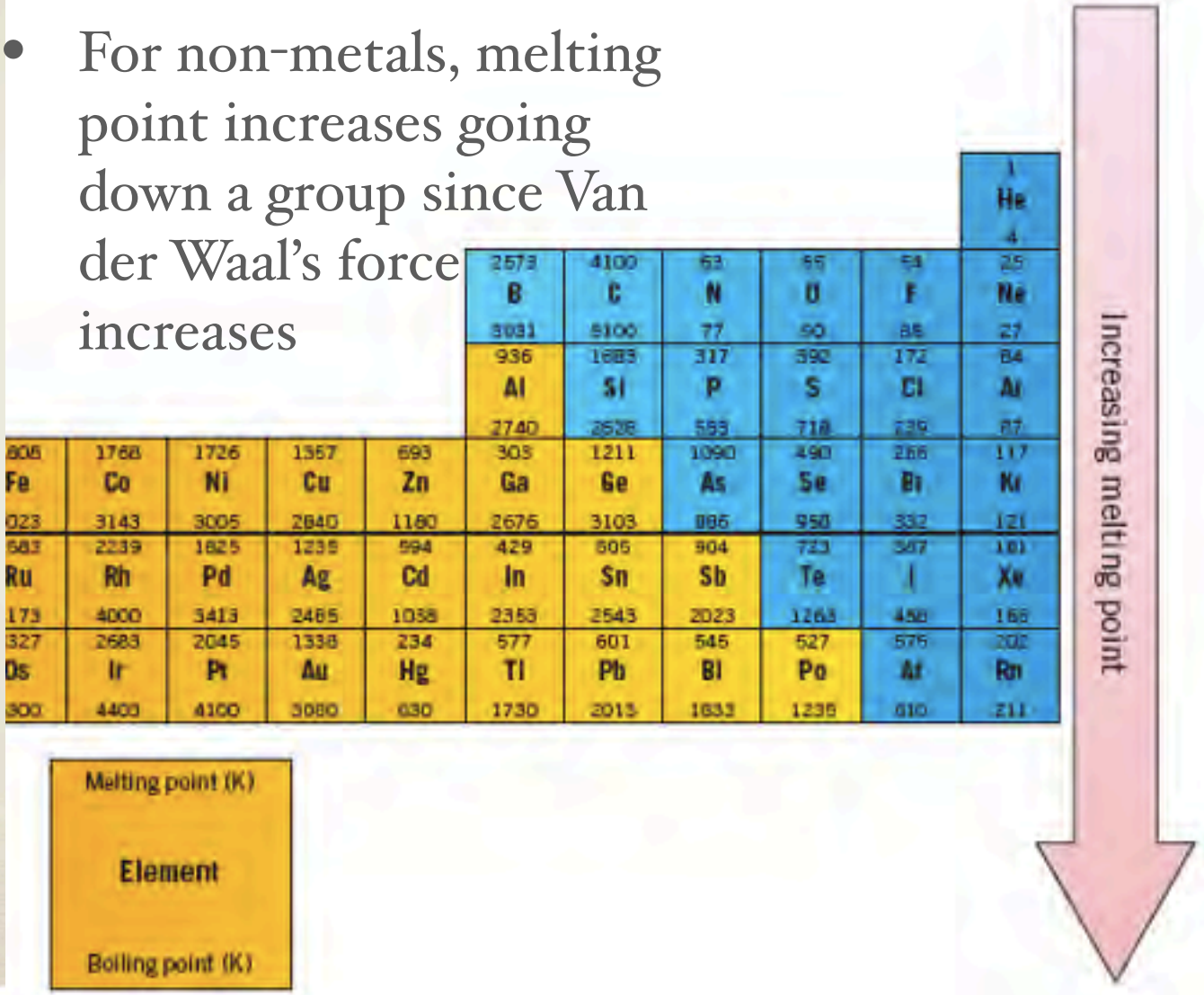
Van der Waals' Forces

- Electrostatic attraction between instantaneous dipoles
- An instantaneous dipole is created by the chance separation of charges on opposite sides of a molecule
- The more electrons, the larger the force

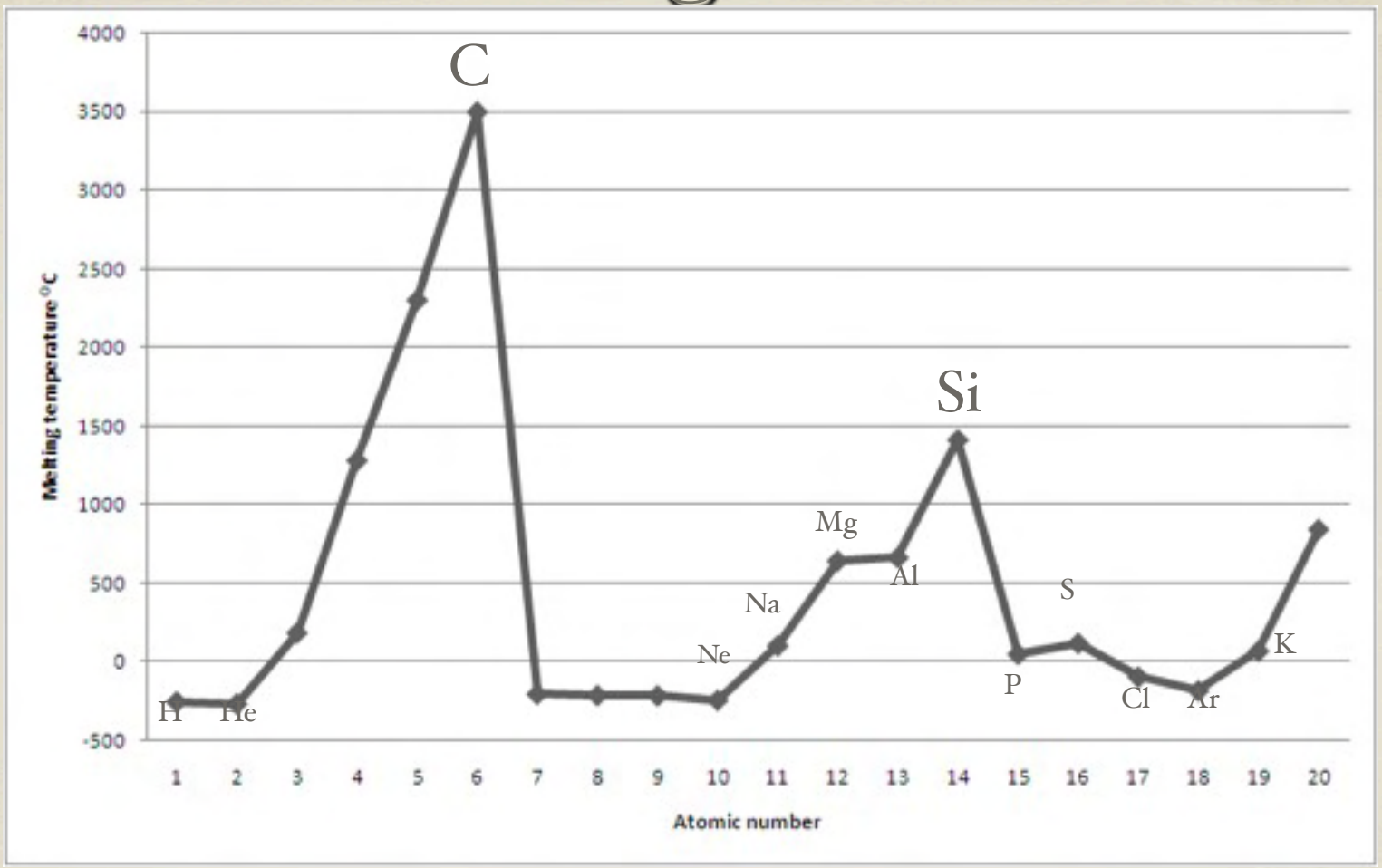


Group Trend for non-metals

- For non-metals, melting point increases going down a group since Van der Waal's force increases



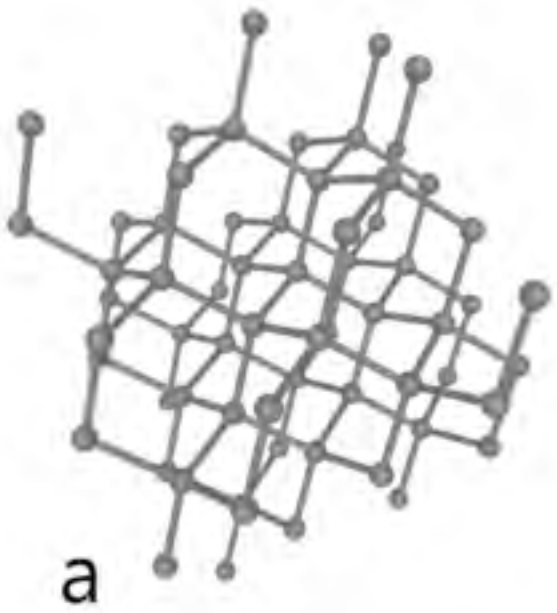
Melting Points



Why are Carbon & Silicon so high???

Macrocovalent Compounds

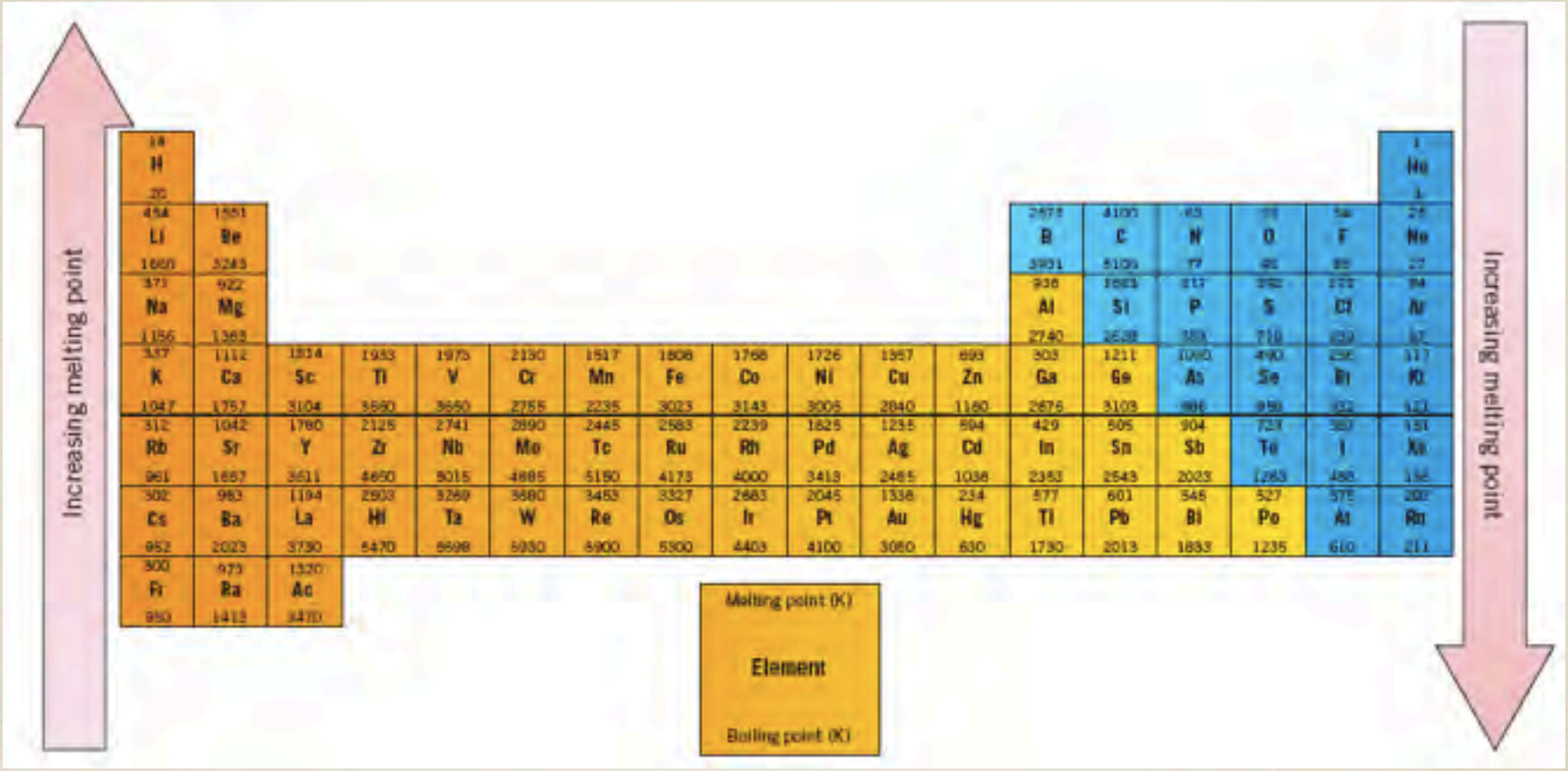
- Silicon and carbon form macromolecular structures
- Contain covalent bonds
- Very strong, difficult to break
- Results in very high melting points



3rd Period Melting Points

- At the left of the period, elements exhibit **metallic bonding** (Na, Mg, Al), which increases in strength as the number of valence electrons increases.
- Silicon in the middle of the period has a **macromolecular covalent structure** with very strong bonds resulting in a very high melting point.
- Elements in groups 5, 6, and 7 (P_4, S_8, and Cl_2) show simple molecular structures with weak **van der Waals' forces** of attraction between the molecules.
- The noble gases (Ar) exist as **monatomic molecules** (single atoms) with extremely weak forces of attraction between the atoms.

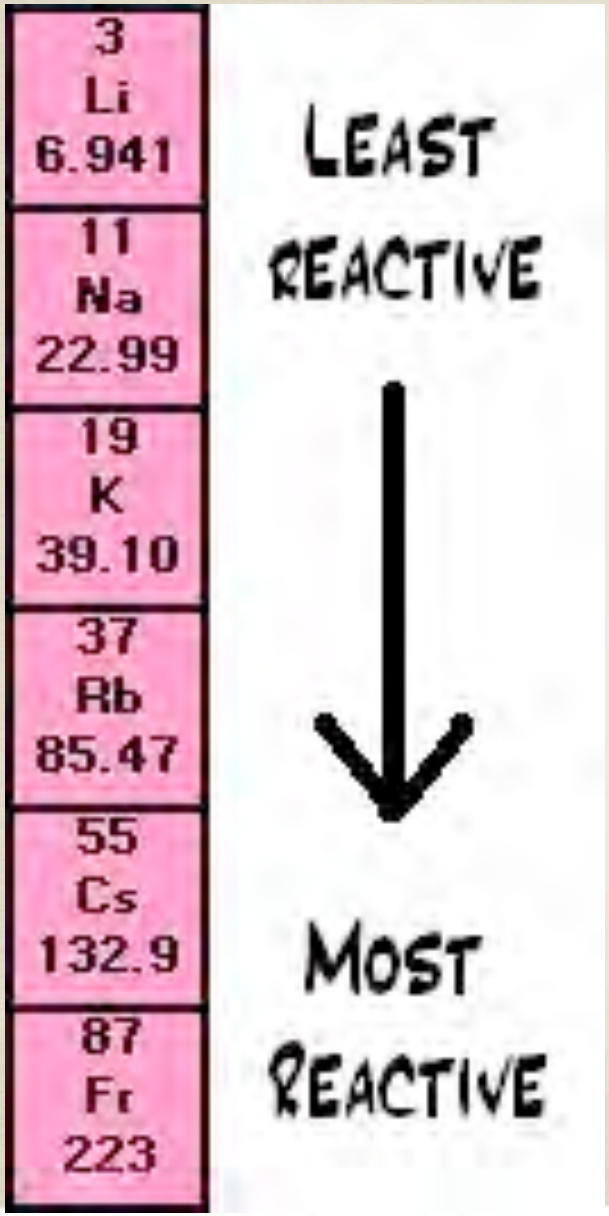
Melting Point Trend

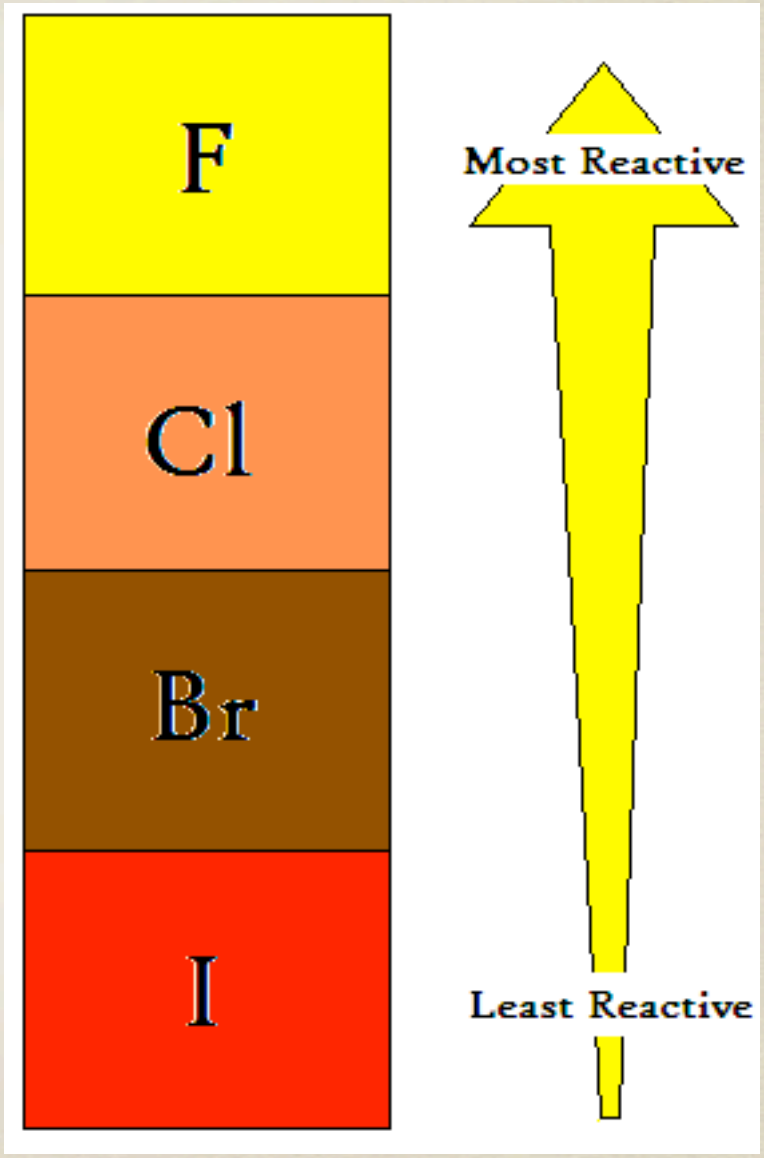


Chemical Properties

- Out of the alkali metals, which metal is most reactive?
- Out of the halogens, which is most reactive?
  - WHY?

Chemical Properties





Reactivity

Group 1 alkali metals

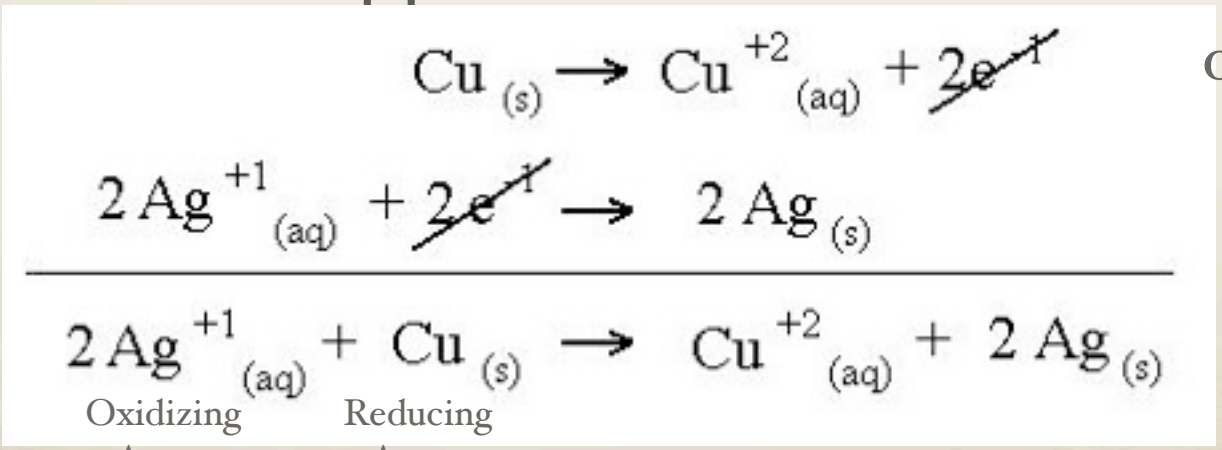
- One valence electron
- Very reactive, stored under liquid paraffin
- React by losing outer electron to form cation
- Reactivity increases down the group because I.E. Decreases
- Reducing Agent

Group 7 halogens

- Seven valence electrons
- Very reactive, fluorine gas can corrode glass
- React by gaining an electron to form anion
- Reactivity decreases down the group as the outer shell is increasingly at higher energy levels and further from the nucleus.
- Oxidizing Agent

LEO the lion says GER

- Redox stands for Reduction and Oxidation
- Reduction is the gain of electrons
- Oxidation is the loss of electrons
- These two processes happen at the same time, and the same number of electrons are transferred in opposite directions



LEO the lion goes GER

- Loss of electrons – Oxidation
- Gain of electrons – Reduction

Brainiac Fun!