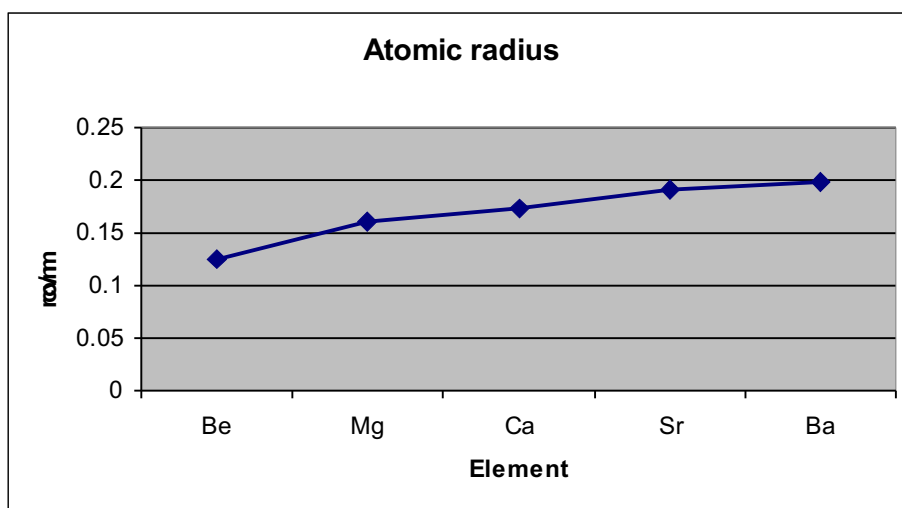


Group 2 trends

- The group 2 elements are called the alkaline earth metals. The physical properties and chemical reactivity depend upon the electronic structure of the elements.

Atomic radius – the distance between nucleus and the outer shell (measured in units nm)



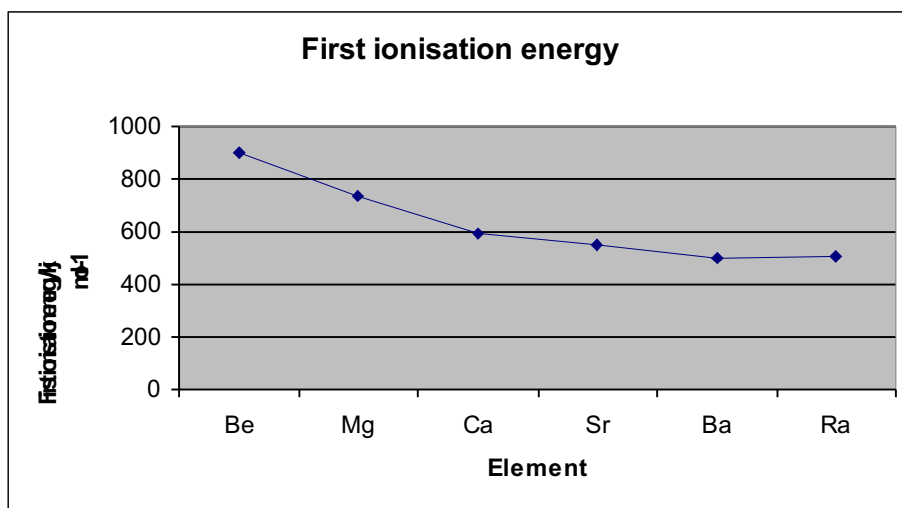
Trend – atomic radius increases down the group

Explanation

There are more filled energy levels between the nucleus and the outer electrons therefore the outer electrons are more shielded from the attraction of the nucleus so the electrons in the outer energy levels are further from the nucleus and the atomic radius increases.

As the number of protons in the nucleus increases going down Group 2, you might expect the atomic radius to decrease because the nuclear charge increases. This does not happen, because although the electrons in the inner energy levels become closer to the nucleus, the factors described above have a greater influence on the atomic radius overall.

First ionisation energy – the amount of energy required (KJmol^{-1}) to remove an electron from a gaseous atom



Trend – as you can see, the first ionisation energy decreases going down the group.

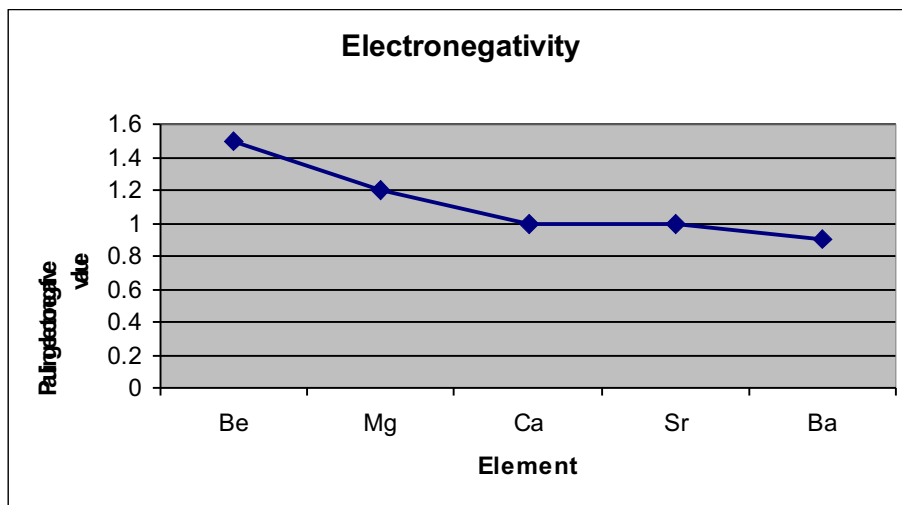
Explanation

There are more filled energy levels between the nucleus and the outer electron; these shield the outer electron from the attraction of the nucleus.

The radius of the atom increases, so the distance between the nucleus and the outer electron increases therefore the force of attraction between the nucleus and outer electron is reduced so less energy is needed to remove the outer electron.

As the number of protons in the nucleus increases going down Group 2, you might expect the first ionisation energy to increase because the nuclear charge increases. This does not happen, because the factors described above have a greater influence on the value of the first ionisation energy.

Electronegativity – the power of an atom to attract electrons in a covalent bond



Trend – as you can see, the electronegativity value decreases going down the group.

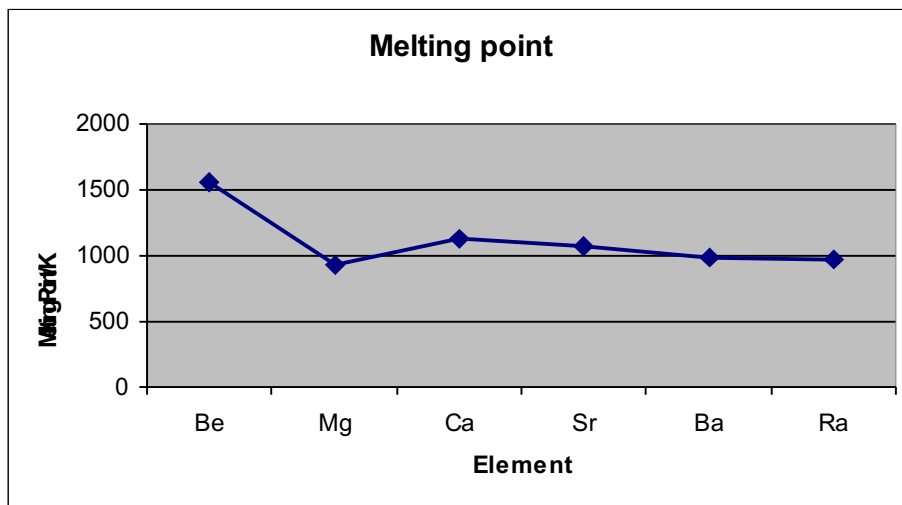
Explanation

The atomic radius increases therefore the outer electrons are more shielded from the attraction of the nucleus so the bonding electrons are less strongly attracted to the nucleus.

As the number of protons in the nucleus increases going down Group 2, you might expect the electronegativity to increase because the nuclear charge increases. This does not happen, because the factors described above have a greater influence on the electronegativity.

Note that the compounds formed by Group 2 elements are essentially ionic. However, beryllium compounds tend to be atypical, and show some covalent character. This is because the Be^{2+} ion is relatively very small. As a result, it has a high surface charge density, which allows it to polarise anions very strongly.

Melting point – the temperature (Kelvin) when a substance changes state from a solid to a liquid



Trend – as you can see, in general the melting point decreases going down the group, the melting point for magnesium is anomalously low.

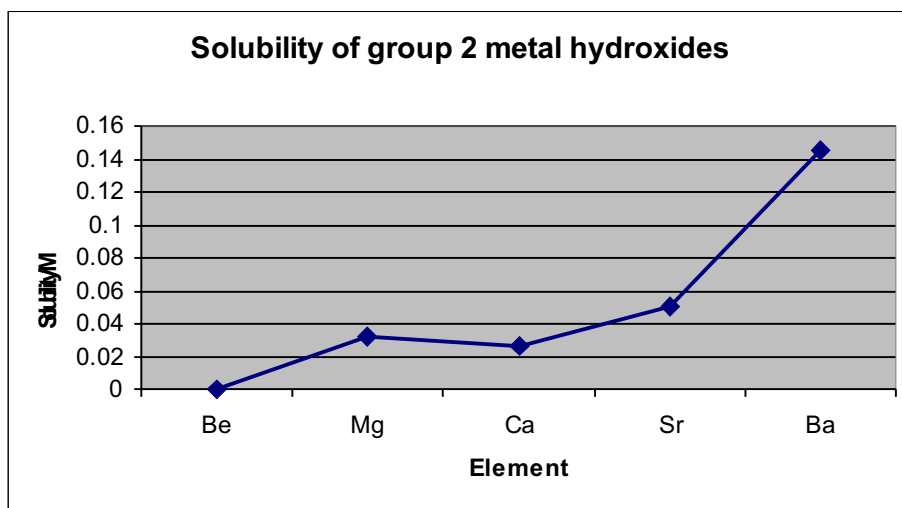
Explanation

The number of delocalised electrons remains the same and the charge on each metal cation stays the same at $2+$, but the ionic radius increases so the attraction between the delocalised electrons and the metal cations decreases.

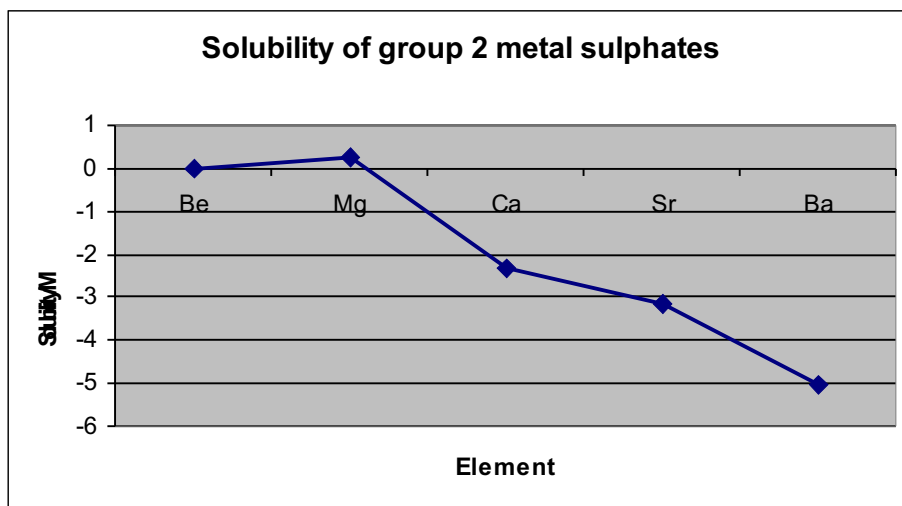
This is because beryllium and magnesium have different metallic structures from the other elements in the group:

- beryllium and magnesium have a hexagonal close-packed structure;
- calcium and strontium have a face-centred cubic structure; and
- barium has a body-centred cubic structure.

Solubility – the maximum amount of a substance that can be dissolved in water



Trend – the solubility in water increases down the group



Trend – the solubility in water decreases down the group

Data sources:

- aqa AS Chemistry book
- <http://www.chemguide.co.uk>
- <http://www.creative-chemistry.org.uk>

The **economic** importance of the **GROUP 2** metals

Beryllium- is found in the semi-precious gem beryl. Beryllium is the atypical element of group 2. It can react with acids AND alkalis and It is highly polarising as it has a high charge-to-size ratio

Magnesium- helps plants to grow by involvement with chlorophyll and the energy collected is used in photosynthesis

Calcium- is found in milk and bones and is reaaallllllllly good 4 U! (I think)

Strontium- Strontium 90, a radioisotope of Strontium (Sr), can be very dangerous, but it can also be used to treat skin cancer!

Strontium, along with aluminium and zinc are used in alloys to make strong and lightweight bicycle frames

Barium- helps doctors in medicine by blocking x-rays and allowing the digestive system to show up

Radium- Radium had been used to make self-luminous paints for watches, aircraft instrument dials and other instrumentation, but has largely been replaced by **cobalt-60**, a less dangerous radioactive source. A mixture of radium and **beryllium** will emit **neutrons** and is used as a neutron source. Radium is used to produce **radon**, a radioactive gas used to treat some types of cancer.

A single gram of radium-226 will produce 0.0001 millilitres of radon a day. Radium is about one million times more active than uranium. The lab notebooks used by the Curies are too highly contaminated to be safely handled today.