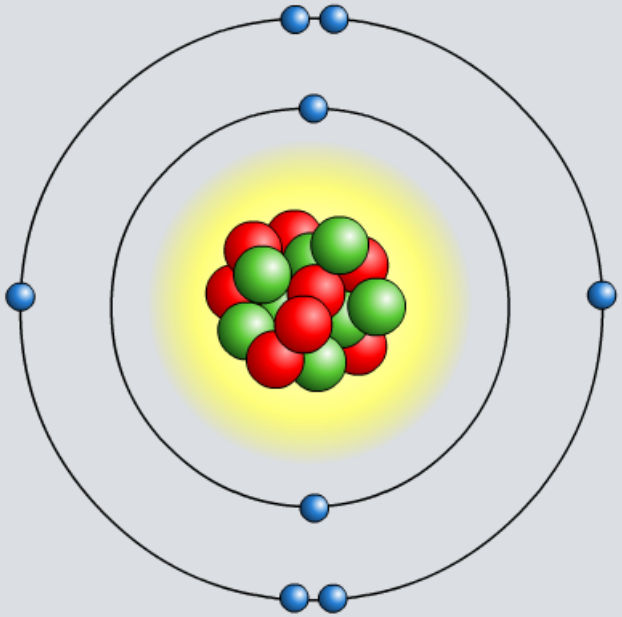
Ionization Energy



What is ionization energy?

Ionization is a process in which atoms lose or gain electrons and become ions.

The first ionization (I_1) energy of an element is the energy required to *remove* one electron from a gaseous atom.

$$M_{(g)} \rightarrow M^+_{(g)} + e^-_{(g)}$$

The **second ionization (I_2) energy** involves the removal of a second electron:

$$M^+_{(g)} \rightarrow M^{2+}_{(g)} + e^-_{(g)}$$

Looking at trends in ionization energies can reveal useful evidence for the arrangement of electrons in atoms and ions.

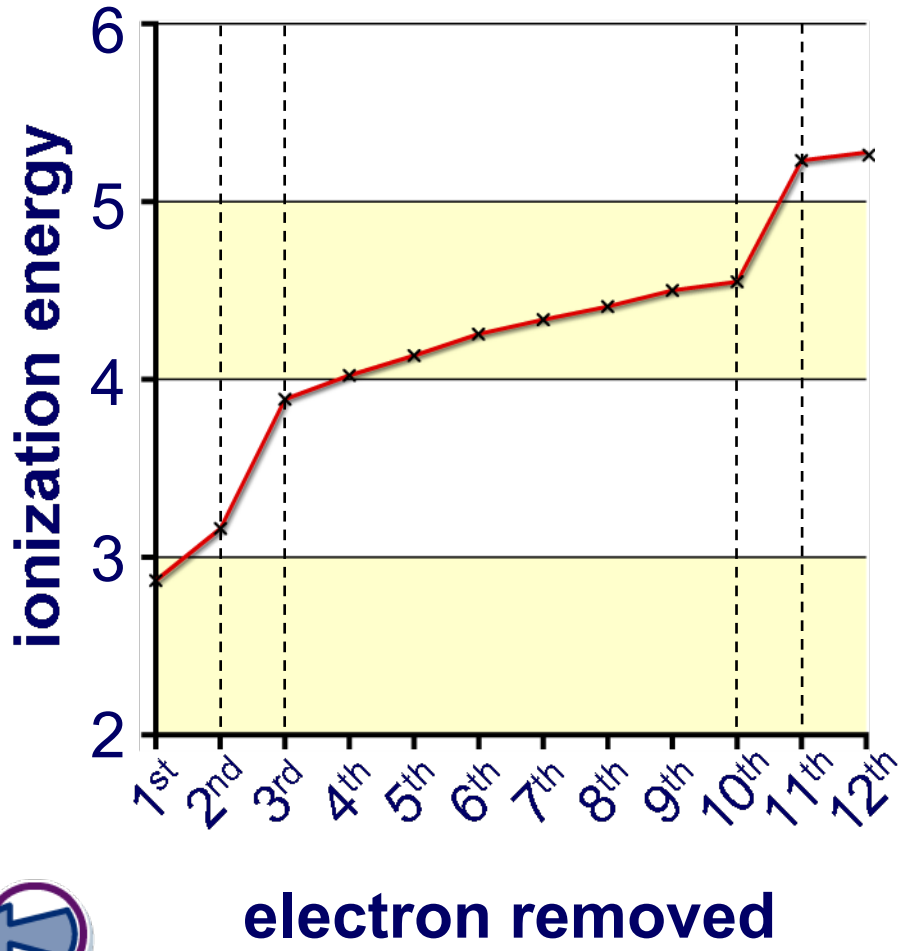
Definitions of ionization energy

Match the equation to the correct description

$M^{3+}_{(g)} \rightarrow M^{4+}_{(g)} + e^-_{(g)}$	second ionization energy
$M_{(g)} \rightarrow M^+_{(g)} + e^-_{(g)}$	fourth ionization energy
$M^{2+}_{(g)} \rightarrow M^{3+}_{(g)} + e^-_{(g)}$	first ionization energy
$M^+_{(g)} \rightarrow M^{2+}_{(g)} + e^-_{(g)}$	third ionization energy

Evidence for energy levels

Plotting the **successive ionization energies** of magnesium clearly shows the existence of different energy levels, and the number of electrons at each level.

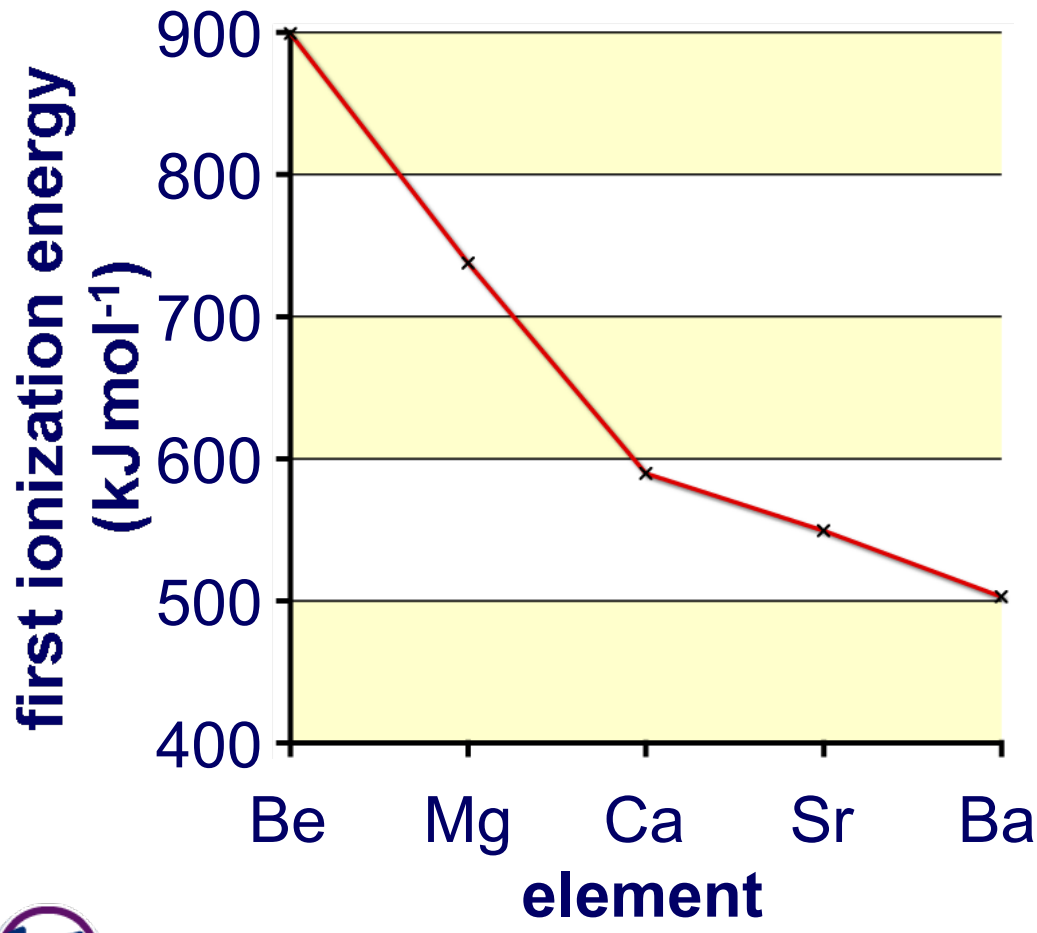


Successive ionization energies increase as more electrons are removed.

Large jumps in the ionization energy reveal where electrons are being removed from the next principal energy level, such as between the 2nd and 3rd, and 10th and 11th ionization energies for magnesium.

More evidence for energy levels

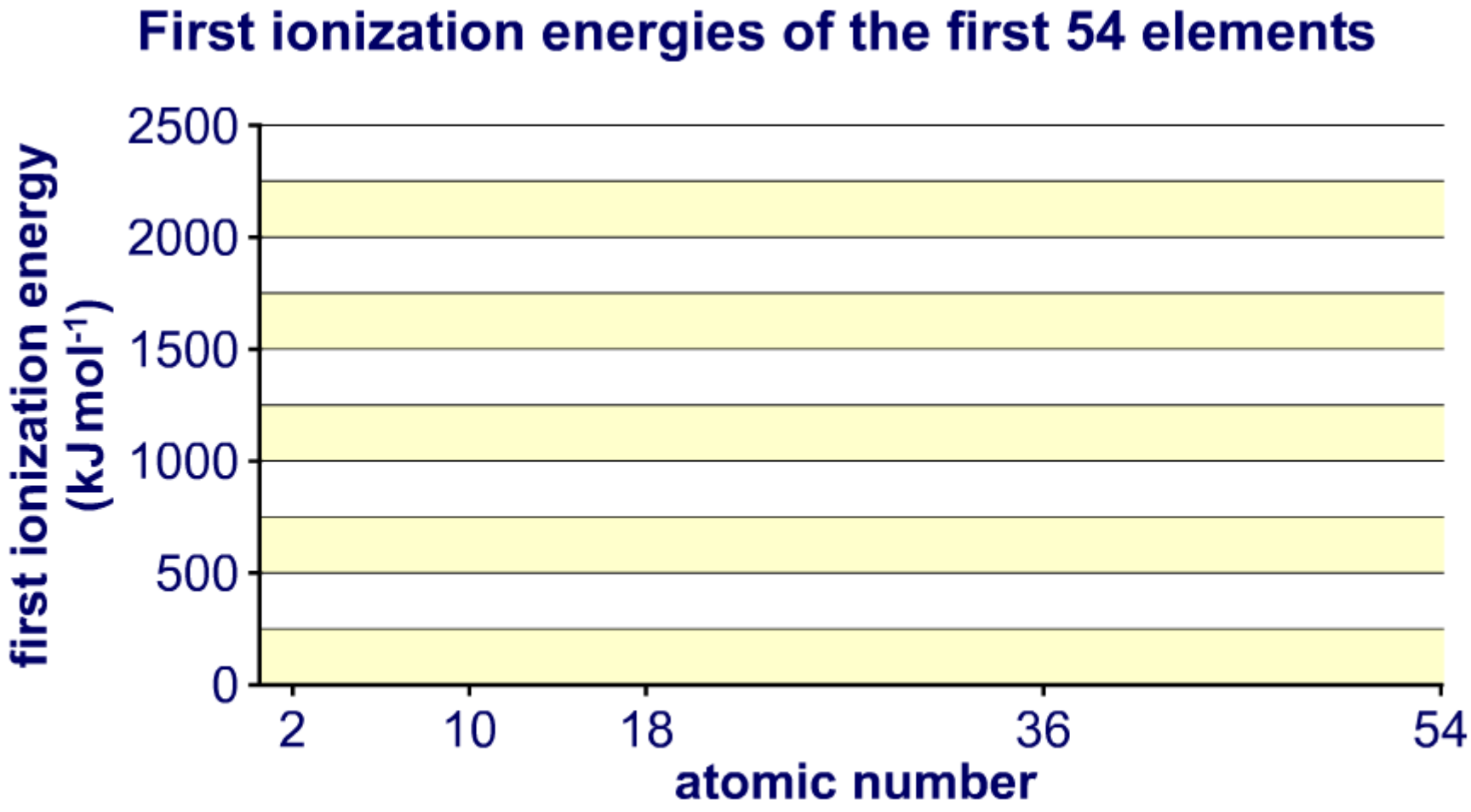
The first ionization energies of group 2 elements also show evidence for the existence of different principal energy levels.



Even though the nuclear charge increases down the group, the first ionization energy decreases.

This means that electrons are being removed from successively higher energy levels, which lie further from the nucleus and are less attracted to the nucleus.

Trends in first ionization energies



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Energy levels

What are the missing words about energy levels?

1. Evidence for the existence of different energy levels comes from studying trends in the [A] of elements.

2. The principal energy levels are labeled with numbers called principal [B] numbers, with level one being the [C] in energy.

3. The principal energy levels are the same as the [D], which are sometimes used in