

Answer on Question #77906 – Chemistry – Inorganic Chemistry

I have not understood this line from J. D. Lee: 'The ionisation energy for an atom is always positive and for an ion may be negative. (Why negative when heat is supplied?) If IE can be negative, please give me an example of the same. I am quite confused.

Solution:

When talking about atoms we're talking about bound systems. There is a threshold kinetic energy of the electrons above which they are free to escape the effects of the nucleus and below which they produce bound, discrete energy levels. It is just natural to identify the zero of the energy scale with this threshold. That's the reason why the energy levels of atoms/molecules/condensed matter are negative. The electron in the ground state of a hydrogen atom has around -13.6 eV. This means that 13.6 eV is needed to get it out of the confinement by the nucleus and set it free - this is the ionization energy, defined as the energy *absorbed* by an atom to lose an electron and become a positive ion. Thus ionization energy is always positive, since every single electron is bound and thus has negative energy!

What might not be positive is electron affinity. It is a different quantity, defined as the energy released when an atom captures an electron and becomes a negative ion. Some atoms might prefer to gain another electron, they release energy, hence affinity is positive (atoms that have a nearly full shell, especially chlorine, fluorine etc.), but some don't like it, they consume energy, hence their affinity is negative (atoms that already have a full valence shell, especially noble gases).