

# Successive Ionization Energies of the Elements

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Generally the  $n-1$ st ionization energy is larger than the  $n$ th ionization energy. The next ionization energy (the  $n-1$ st) involves removing an electron from an orbital closer to the nucleus. Electrons in the closer orbital experience greater forces of electrostatic attraction, and thus, require more energy to be removed.

Large jumps in the successive ionization energies occur when passing noble gas configurations. For example, as can be seen in the bottom row in the table at the right, the first two ionization energies of calcium (stripping the two 4s electrons from a calcium atom) are much smaller than the third, which requires stripping off a 3p electron from the very stable argon configuration of  $\text{Ca}^{2+}$ .

The first 10 ionization energies for elements 1-20 are given in the following table:

Number	Symbol	Name	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	8 <sup>th</sup>	9 <sup>th</sup>	10 <sup>th</sup>
1	H	<a href="#">hydrogen</a>	1312									
2	He	<a href="#">helium</a>	2372	5251								
3	Li	<a href="#">lithium</a>	520	7298	11815							
4	Be	<a href="#">beryllium</a>	900	1757	14,849	21,007						
5	B	<a href="#">boron</a>	801	2427	3660	25,026	32,827					
6	C	<a href="#">carbon</a>	1087	2353	4621	6223	37,831	47,277				
7	N	<a href="#">nitrogen</a>	1402	2856	4578	7475	9445	53,267	64,360			
8	O	<a href="#">oxygen</a>	1314	3388	5301	7469	10,990	13,327	71,330	84,078		
9	F	<a href="#">fluorine</a>	1681	3374	6050	8408	11,023	15,164	17,868	92,038	106,434	
10	Ne	<a href="#">neon</a>	2081	3952	6122	9371	12,177	15,238	19,999	23,070	115,380	131,432
11	Na	<a href="#">sodium</a>	496	4562	6910	9543	13,354	16,613	20,117	25,496	28,932	141,362
12	Mg	<a href="#">magnesium</a>	738	1451	7733	10,543	13,630	18,020	21,711	25,661	31,653	35,458
13	Al	<a href="#">aluminium</a>	578	1817	2745	11,577	14,842	18,379	23,326	27,465	31,853	38,473
14	Si	<a href="#">silicon</a>	787	1577	3232	4356	16,091	19,805	23,780	29,287	33,878	38,726
15	P	<a href="#">phosphorus</a>	1012	1907	2914	4964	6274	21,267	25,431	29,872	35,905	40,950
16	S	<a href="#">sulfur</a>	1000	2252	3357	4556	7004	8496	27,107	31,719	36,621	43,177
17	Cl	<a href="#">chlorine</a>	1251	2298	3822	5159	6542	9362	11,018	33,604	38,600	43,961
18	Ar	<a href="#">argon</a>	1521	2666	3931	5771	7238	8781	11,995	13,842	40,760	46,186
19	K	<a href="#">potassium</a>	419	3052	4420	5877	7975	9590	11,343	14,944	16,964	48,610
20	Ca	<a href="#">calcium</a>	590	1145	4912	6491	8153	10,496	12,270	14,206	18,191	20,385

The above data is available at: [http://en.wikipedia.org/wiki/Ionization\\_energies\\_of\\_the\\_elements\\_\(data\\_page\)](http://en.wikipedia.org/wiki/Ionization_energies_of_the_elements_(data_page)) ABOVE UNITS: kJ/mol