Electron Affinity

CHEMISTRY INTERACTIVE TUTOR

Module 3: Periodic Properties

Neutral atoms can also acquire electrons. *The energy change that occurs when an electron is acquired by a neutral atom is called the atom's* **electron affinity.** Most atoms release energy when they acquire an electron.

$$\mathrm{A} + e^- \longrightarrow \mathrm{A}^- + \text{energy}$$

On the other hand, some atoms must be "forced" to gain an electron by the addition of energy.

$$\mathrm{A} + e^- + \text{energy} \longrightarrow \mathrm{A}^-$$

The quantity of energy absorbed would be represented by a positive number, but ions produced in this way are very unstable and hence the electron affinity for them is very difficult to determine. An ion produced in this way will be unstable and will lose the added electron spontaneously.

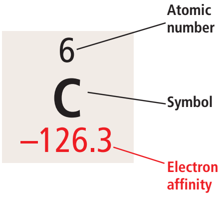
Figure 17 shows the electron affinity in kilojoules per mole for the elements. Positive electron affinities, because they are so difficult to determine with any accuracy, are denoted in **Figure 17** by "(0)." **Figure 18,** on the next page, presents these data graphically.

Period Trends

Among the elements of each period, the halogens (Group 17) gain electrons most readily. This is indicated in **Figure 17** by the large negative values of halogens' electron affinities. The ease with which halogen atoms gain electrons is a major reason for the high reactivities of the Group 17 elements. In general, as electrons add to the same *p* sublevel of atoms with increasing nuclear charge, electron affinities become more negative across each period within the *p* block. An exception to this trend occurs between Groups 14 and 15. Compare the electron affinities of carbon ([He]$2s^22p^2$) and nitrogen ([He]$2s^22p^3$). Adding an electron to a carbon atom gives a half-filled *p* sublevel. This occurs much more easily

FIGURE 17 The values listed in parentheses in this periodic table of electron affinities are approximate. Electron affinity is estimated to be –50 kJ/mol for each of the lanthanides and 0 kJ/mol for each of the actinides.

Periodic Table of Electron Affinities (kJ/mol)



Period	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9	Group 10	Group 11	Group 12	Group 13	Group 14	Group 15	Group 16	Group 17	Group 18
1	1 H −75.4																	2 He (0)
2	3 Li −61.8	4 Be (0)											5 B −27.7	6 C −126.3	7 N (0)	8 O −146.1	9 F −339.9	10 Ne (0)
3	11 Na −54.8	12 Mg (0)											13 Al −44.1	14 Si −138.5	15 P −74.6	16 S −207.7	17 Cl −361.7	18 Ar (0)
4	19 K −50.1	20 Ca (0)	21 Sc −18.8	22 Ti −7.9	23 V −52.5	24 Cr −66.6	25 Mn (0)	26 Fe −16.3	27 Co −66.1	28 Ni −115.6	29 Cu −122.8	30 Zn (0)	31 Ga −30	32 Ge −135	33 As −81	34 Se −202.1	35 Br −336.5	36 Kr (0)
5	37 Rb −48.6	38 Sr (0)	39 Y −30.7	40 Zr −42.6	41 Nb −89.3	42 Mo −74.6	43 Tc −55	44 Ru −105	45 Rh −113.7	46 Pd −55.7	47 Ag −130.2	48 Cd (0)	49 In −30	50 Sn −120	51 Sb −107	52 Te −197.1	53 I −305.9	54 Xe (0)
6	55 Cs −47.2	56 Ba (0)	57 La −50	72 Hf (0)	73 Ta −32.2	74 W −81.5	75 Re −15	76 Os −110	77 Ir −156.5	78 Pt −212.8	79 Au −230.9	80 Hg (0)	81 Tl −20	82 Pb −36	83 Bi −94.6	84 Po −190	85 At −280	86 Rn (0)
7	87 Fr −47.0	88 Ra (0)	89 Ac —	104 Rf —	105 Db —	106 Sg —	107 Bh —	108 Hs —	109 Mt —	110 Ds —	111 Uuu —	112 Uub —	113 Uut —	114 Uuq —	115 Uup —	116	117	118