

chalcogens, halogens and noble gases: three families that go from reactive to unreactive across one row



Three Families, One Row Apart

Group 16: chalcogens

O, S, Se, Te, Po; $ns2np4$; ore-forming elements

Group 17: halogens

F, Cl, Br, I, At; $ns2np5$; the most reactive nonmetals

Group 18: noble gases

He, Ne, Ar, Kr, Xe, Rn; $ns2np6$; chemically near-inert

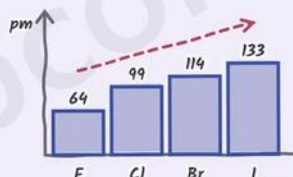
Trends Down Each Group

- atomic and ionic radii INCREASE down all three groups, adding a new shell each time
- ionisation enthalpy DECREASES down each group
- halogens have the smallest radii in their period (one electron short of a noble gas)
- noble gases carry the HIGHEST ionisation enthalpy in every period
- electronegativity DECREASES down groups 16 and 17; F is the most electronegative element of all
- electron gain enthalpy becomes LESS negative down groups 16 and 17
- EXCEPT: O, F are less negative than S, Cl (crowded small 2p subshell, repulsion)

group 16, in the p-block's far right



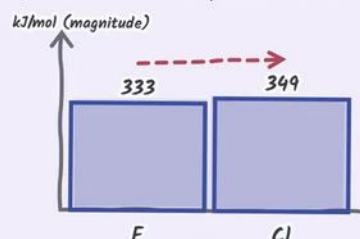
the p-block's far right: the banded column is group 16, and the two columns to its right are 17 and 18. The arrow marks the down-the-group direction



covalent atomic radius of the halogens, pm: growing down the group as each adds a shell

Q. Explain why fluorine has a LESS negative electron gain enthalpy than chlorine, even though F is more electronegative.

- electron gain enthalpy and electronegativity are NOT the same property
- one adds an electron to a free atom, the other pulls density in a bond
- fluorine's 2p subshell is small and dense with electron pairs; the incoming electron feels strong repulsion there
- chlorine's 3p subshell is larger and roomier, so its incoming electron is accepted with less repulsion



electron gain enthalpy magnitude, F vs Cl: both NEGATIVE values, Cl's is MORE negative despite F being more electronegative

Answer

F: -333 kJ/mol, Cl: -349 kJ/mol; the anomaly is size-driven repulsion, not electronegativity

