

Ch. 7.3 Periodic trend in ionic radius

In a row, left \rightarrow right, for cation / anion
atomic & ionic size: decreases

In column, top \rightarrow bottom,
atomic & ionic size: increases

Relative size of ion versus corresponding atom
cation < atom
anion > atom

source: https://china.ips.org/uploads/145_163/Chemistry/Chemistry_Brown_22th.pdf

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Rationale / basis: periodic trend in size of ion similar to atomic size rationale / basis

In a row, left \rightarrow right: ionic size decreases
for cations,
increase $Z \rightarrow$ increase $Z_{\text{eff}} \rightarrow$ increase $F_{\text{attr}} \rightarrow$ decrease ion size
same S (i.e. isoelectronic = same # electrons; recall, $Z_{\text{eff}} = Z - S$)
for anions,
increase $Z \rightarrow$ increase $Z_{\text{eff}} \rightarrow \dots$
same S

In column, top \rightarrow bottom: ionic size increases
get additional shell of electrons \rightarrow increase ion size

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Rationale / basis: relative size of ion versus atom

for atom versus corresponding cation,
remove electron \rightarrow reduce $S \rightarrow$ increase $Z_{\text{eff}} \rightarrow$ increase $F_{\text{attr}} \rightarrow$ decrease ion size
same Z

for atom versus corresponding anion,
add electron \rightarrow raise $S \rightarrow$ decrease $Z_{\text{eff}} \rightarrow$ decrease $F_{\text{attr}} \rightarrow$ increase ion size
same Z
 \rightarrow increase electron – electron repulsion \rightarrow increase ion size

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Isoelectronic species: same number of electrons

—Increasing nuclear charge \rightarrow
 O^{2-} F^- Na^+ Mg^{2+} Al^{3+}
 1.26 Å 1.19 Å 1.16 Å 0.86 Å 0.68 Å

—Decreasing ionic radius \rightarrow

protons: 8 9 11 12 13
electrons: 10 10 10 10 10

That is,
increase $Z \rightarrow$ increase $Z_{\text{eff}} \rightarrow$ increase $F_{\text{attr}} \rightarrow$ decrease ion size
same S

recall: $Z_{\text{eff}} = Z - S$

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Periodic trend in electronegativity (EN)

electronegativity: how much an atom “wants” another atom’s electrons ?

Periodic trend deducible by remembering that F (fluorine) is the most electronegative atom

Electronegativity Values in Paulings

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continue

Based on knowing that F is the most electronegative atom,

Electronegativity Values in Paulings

source: <https://documents.site/genceo-chemistry-matter-and-change.html>

deduce,
In a row, left \rightarrow right: increase in EN ; vice versa

In a column, bottom \rightarrow top: increase in EN ; vice versa

Basis / rationale: too “complicated”

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