

Ch. 7.3 Periodic trend in ionic radius

Group 1A	Group 2A	Group 3A	Group 6A	Group 7A
Li ⁺ 0.90	Be ²⁺ 0.59	B ³⁺ 0.41	O ²⁻ 1.26	F ⁻ 1.19
Li 1.34	Be 0.90	B 0.82	O 0.73	F 0.71
Na ⁺ 1.02	Mg ²⁺ 0.66	Al ³⁺ 0.68	S ²⁻ 1.70	Cl ⁻ 1.67
Na 1.54	Mg 1.30	Al 1.18	S 1.02	Cl 0.99
K ⁺ 1.32	Ca ²⁺ 1.14	Ga ³⁺ 0.76	Se ²⁻ 1.84	Br ⁻ 1.82
K 1.96	Ca 1.24	Ga 1.26	Se 1.16	Br 1.14
Rb ⁺ 1.66	Sr ²⁺ 1.33	In ³⁺ 0.94	Te ²⁻ 2.07	I ⁻ 2.06
Rb 2.11	Sr 1.92	In 1.44	Te 1.35	I 1.33

● cation ● anion ● neutral atom

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

In column, top → bottom,
atomic & ionic size: increases

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

source: https://sites.lps.org/sputnam/LHS_IB/IBChemistry/Chemistry_Brown_12th.pdf



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Rationale / basis: periodic trend in size of ion

similar to atomic size rationale / basis

In a row, left → 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 → bottom: ionic size increases

get additional shell of electrons → increase ion size



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Rationale / basis: relative size of ion versus atom

for atom versus corresponding cation,

remove electron → reduce $S \rightarrow$ increase $Z_{\text{eff}} \rightarrow$ increase $F_{\text{attr}} \rightarrow$ decrease ion size
same Z

for atom versus corresponding anion,

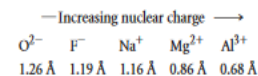
add electron → raise $S \rightarrow$ decrease $Z_{\text{eff}} \rightarrow$ decrease $F_{\text{attr}} \rightarrow$ increase ion size
same Z

or increase electron – electron repulsion → increase ion size



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Isoelectronic species: same number of electrons



source: https://sites.lps.org/sputnam/LHS_IB/IBChemistry/Chemistry_Brown_12th.pdf

— Decreasing ionic radius →

# 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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