Auf-bau exceptions

$_{24}Cr$ $[Ar]4s^2 3d^4$ ✗ $[Ar]4s^1 3d^5$ ✓

$_{29}Cu$ $[Ar]4s^2 3d^9$ ✗ $[Ar]4s^1 3d^{10}$ ✓

$_{47}Ag$ $[Kr]5s^2 4d^9$ ✗ $[Kr]5s^1 4d^{10}$

Valence e⁻s + groups!

e⁻s in outer shell (largest n)

1 valence e⁻

gp IA

H		$1s^1$
Li	$1s^2$	$2s^1$
Na	$1s^2 2s^2 2p^6$	$3s^1$

group # = # valence e⁻s

ns^1

gp 7A

F	$1s^2$	$2s^2 2p^5$	— 7 valence e⁻s
Cl	$1s^2 2s^2 2p^6$	$3s^2 3p^5$	

$ns^2 np^5$

Transition Metal Electron Configurations

- The electron configurations of the transition elements (*d* block) and inner transition elements (*f* block) exhibit trends that differ somewhat from those of the main-group elements.
- As we move to the right across a row in the *d* block, the d orbitals fill as shown below.

21 Sc $4s^2 3d^1$	22 Ti $4s^2 3d^2$	23 V $4s^2 3d^3$	24 Cr $4s^1 3d^5$	25 Mn $4s^2 3d^5$	26 Fe $4s^2 3d^6$	27 Co $4s^2 3d^7$	28 Ni $4s^2 3d^8$	29 Cu $4s^1 3d^{10}$	30 Zn $4s^2 3d^{10}$
39 Y $5s^2 4d^1$	40 Zr $5s^2 4d^2$	41 Nb $5s^1 4d^4$	42 Mo $5s^1 4d^5$	43 Tc $5s^2 4d^5$	44 Ru $5s^1 4d^7$	45 Rh $5s^1 4d^8$	46 Pd $4d^{10}$	47 Ag $5s^1 4d^{10}$	48 Cd $5s^2 4d^{10}$

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Irregular Electron Configurations (2 of 2)

- Expected
- $Cr = [Ar]4s^2 3d^4$
- $Cu = [Ar]4s^2 3d^9$
- $Mo = [Kr]5s^2 4d^4$
- $Ru = [Kr]5s^2 4d^6$
- $Pd = [Kr]5s^2 4d^8$

- Found experimentally
- $Cr = [Ar]4s^1 3d^5$
- $Cu = [Ar]4s^1 3d^{10}$
- $Mo = [Kr]5s^1 4d^5$
- $Ru = [Kr]5s^1 4d^7$
- $Pd = [Kr]5s^0 4d^{10}$

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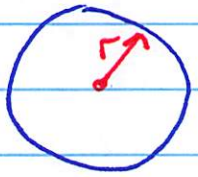
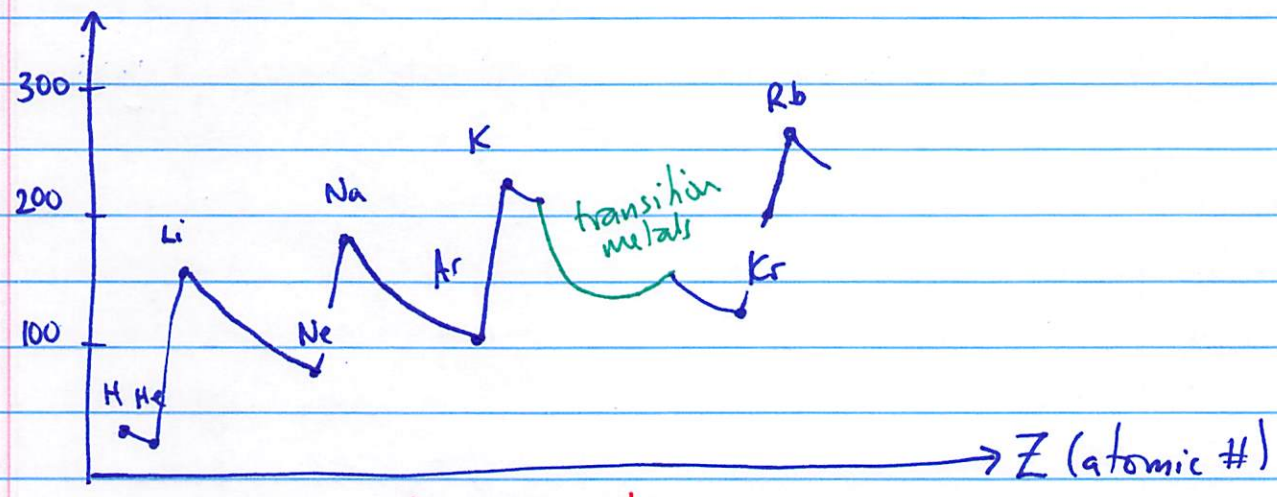
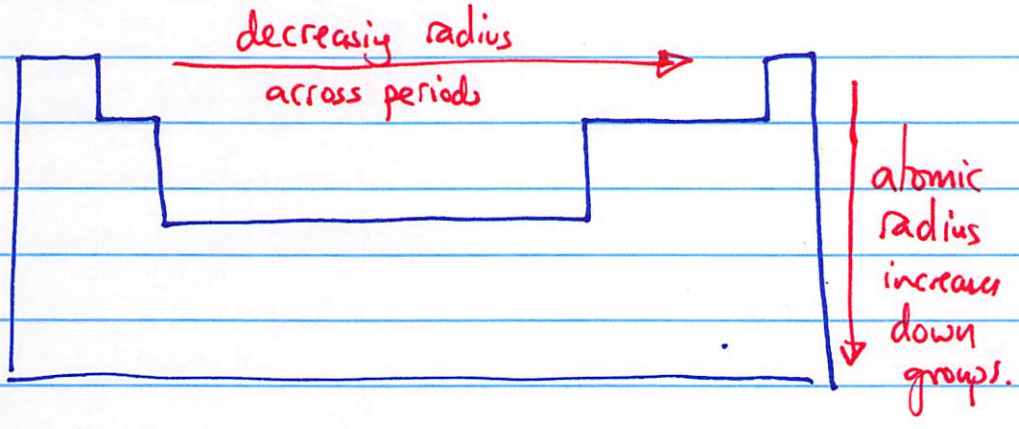
Periodic trends

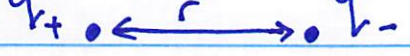
ex: atomic radius







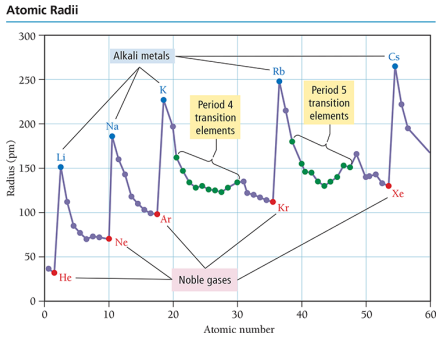
WHY? Coulomb's law:



force of attraction $\propto \frac{q_+ \cdot q_-}{r^2}$

Trend in Atomic Radius: Main Group (2 of 3)

- Atomic radius decreases across period (left to right).
  - Adding electrons to same valence shell
  - Effective nuclear charge increases
  - Valence shell held closer



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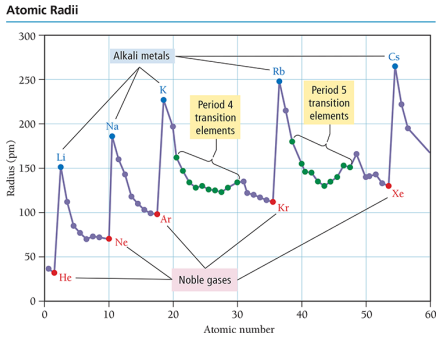
Trend in Atomic Radius: Main Group (3 of 3)

- Atomic radius increases down group.
  - Valence shell farther from nucleus
  - Effective nuclear charge fairly close



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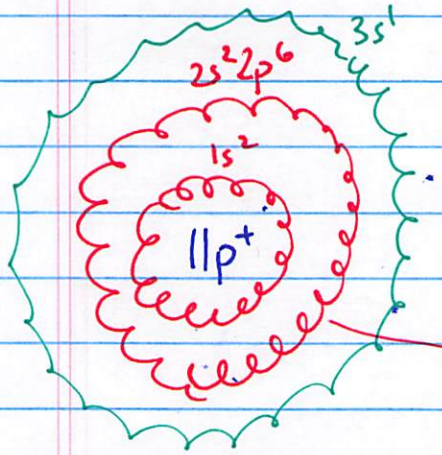
$Z_{eff} = 13 - 10 = (3+)$

$Z_{eff} = 18 - 10 = (8+)$

$_{11}Na$	$_{13}Al$	$_{18}Ar$
$11p^+$	$13p^+$	$18p^+$
$1s^2 2s^2 2p^6 3s^1$	$1s^2 2s^2 2p^6 3s^2 3p^1$	$1s^2 2s^2 2p^6 3s^2 3p^6$



what outer e⁻s actually/effectively feel

$$Z_{eff} = Z - S$$

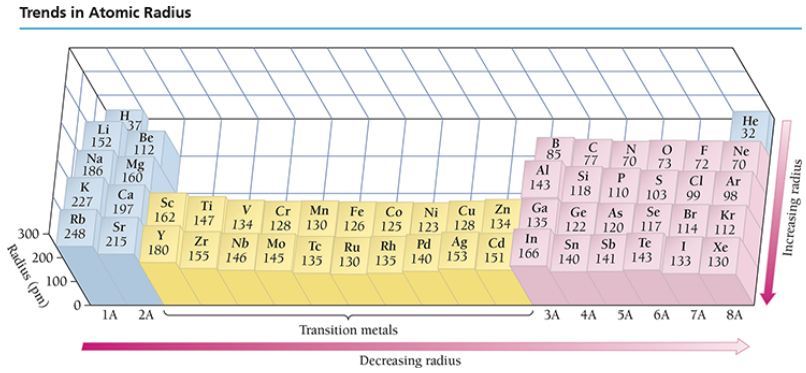
effective nuclear charge — ↳ screening constant. ≈ # core e⁻s

10 e⁻s "screen" 10 of the +ve charges of nucleus.

Na: $Z_{eff} = 11 - 10 = (1+)$

In general, Z_{eff} ↑ across periods, bc we're adding valence e⁻s (not core e⁻s)
↳ don't screen nuclear charge!

Periodic Trends in Atomic Radius



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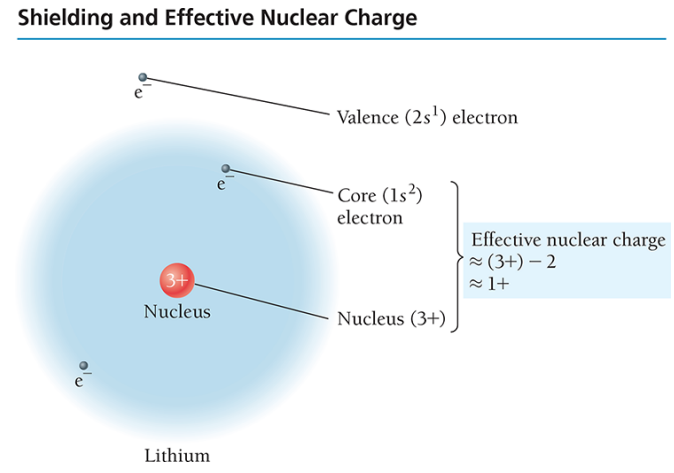
Shielding and Effective Nuclear Charge (2 of 2)



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(bigger) (smaller)

K vs. Na

$Z_{eff} = Z - S$

$= 11 - 10$

$= (1+)$

" Na : $1s^2 2s^2 2p^6 3s^1$

$_{19}K : 1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

$Z_{eff} = Z - S$

$= 19 - 18$

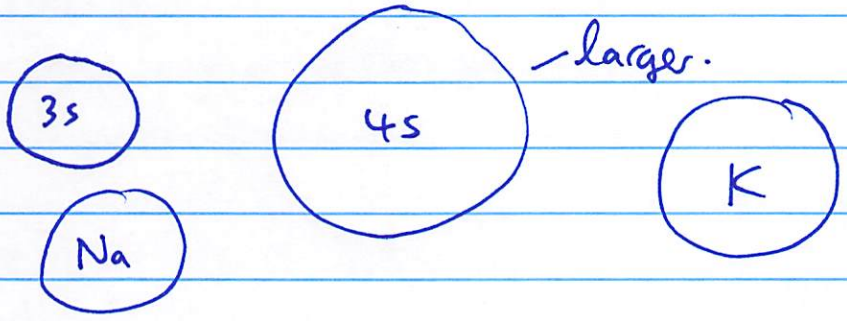
$= (1+)$

$f = \frac{q_+ \cdot q_-}{r^2}$

3s vs 4s

principal QN

dets: size + E



Same Zeff going down groups...
but more shells of e's
... larger.

e^- config of ions

anion / cation

$-$, $+$

add e^-s , remove e^-s

from outer shell (valence).

isoelectronic

same e^- config as

Li^+ $1s^2$ [He] $\quad O^{2-}$ $1s^2 2s^2 2p^6$ [Ne]

$\uparrow -1e^-$

Li $1s^2 2s^1$

$n=2$, valence

$_8O$: $1s^2 2s^2 2p^4$