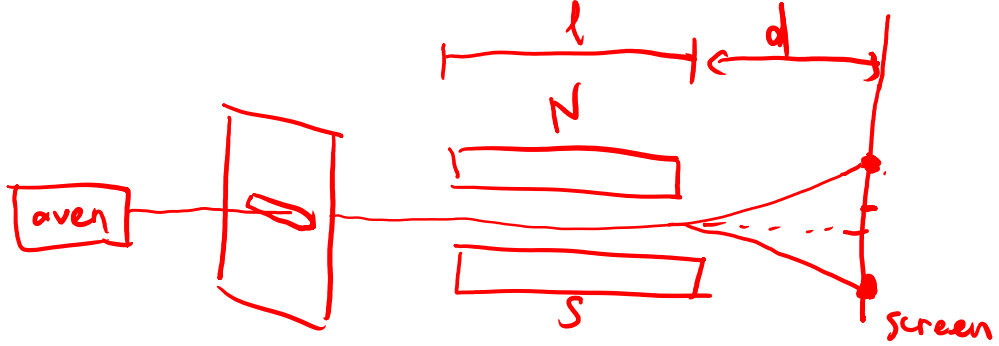
Announcements



- Practice exam 2 will be given out today. 6 questions for 2 hour. Practice before Monday.
- Review session on April 3, Monday.
- Homework 8 is due TODAY.
- Homework 9 is due on April 3, Monday.
- Exam 2 is on April 5, next Wednesday. DRC test accommodation request.

l: $F = ma$, t_1 Δs_1

d: v: exit v $t_2 = \frac{d}{v}$, Δs_2

$2(\Delta s_1 + \Delta s_2)$

Last time

- Periodic table (Pauli exclusion principle)

Today’s class

- Electron screening
- A closer look at the periodic table - properties of elements

in-class quiz (5 min)

Consider the four 2*p* electrons in oxygen (Z=8). If the total m_s has its largest possible value, what is the largest possible value of the total m_l?

A. 3

B. 2

C. 1

D. 0

E. -1

in-class quiz (5 min)

Consider the four 2*p* electrons in oxygen (Z=8). If the total m_s has its largest possible value, what is the largest possible value of the total m_l?

$m_s = 3 \times \frac{1}{2} + 1 \times (-\frac{1}{2}) = 1$

$m_l = 2 \times 1 + 1 \times 0 + 1 \times (-1) = 1$

A. 3

B. 2

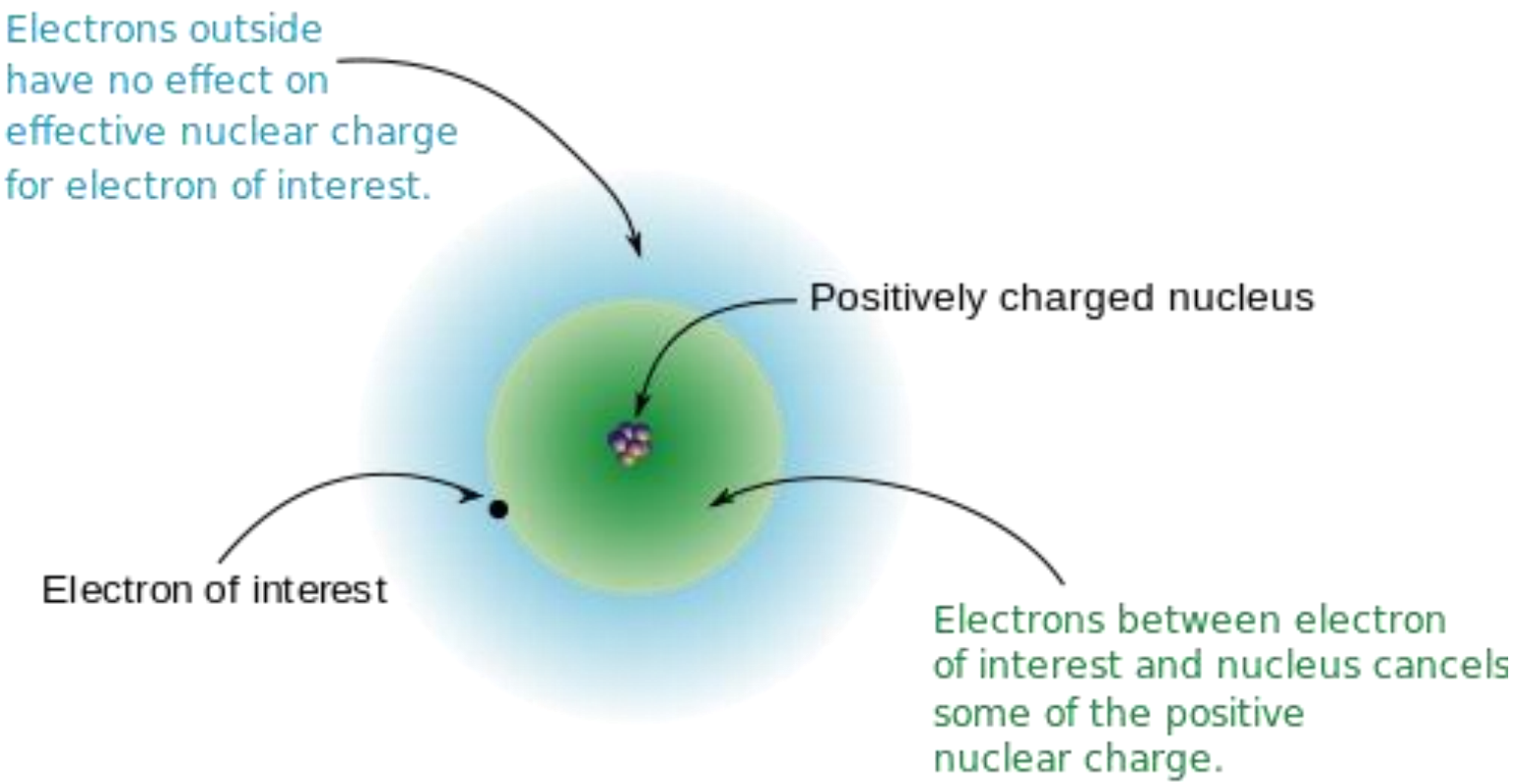
2p m_l $\underline{\uparrow\downarrow}$ 1 $\underline{\uparrow}$ 0 $\underline{\uparrow}$ -1

C. 1

D. 0

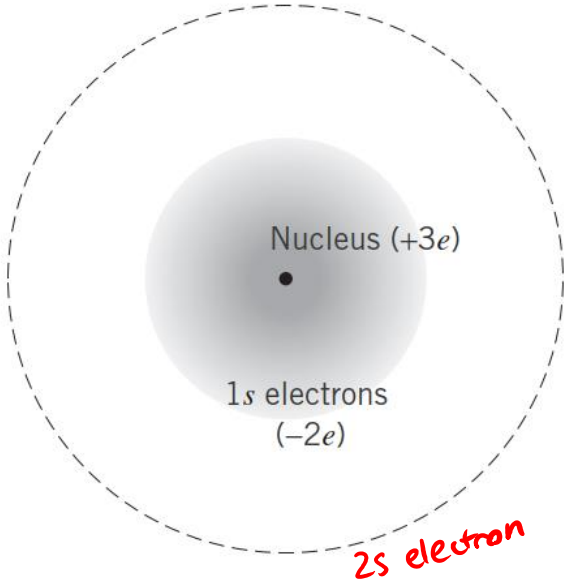
E. -1

Electron screen model



Effective nuclear charge

Li atom $Z = 3$ $1s^2 2s^1$

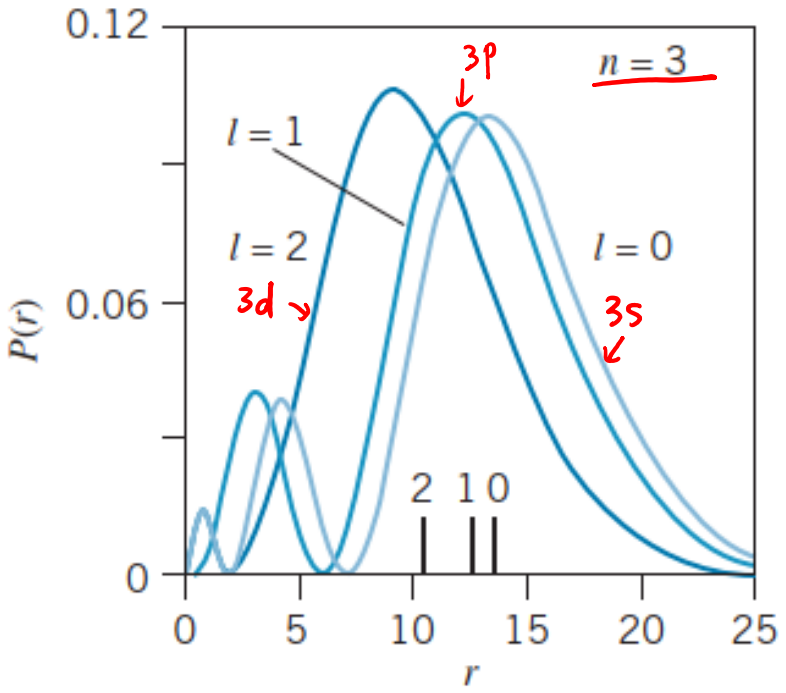


$Z_{eff} = 1 = 3 - 2$

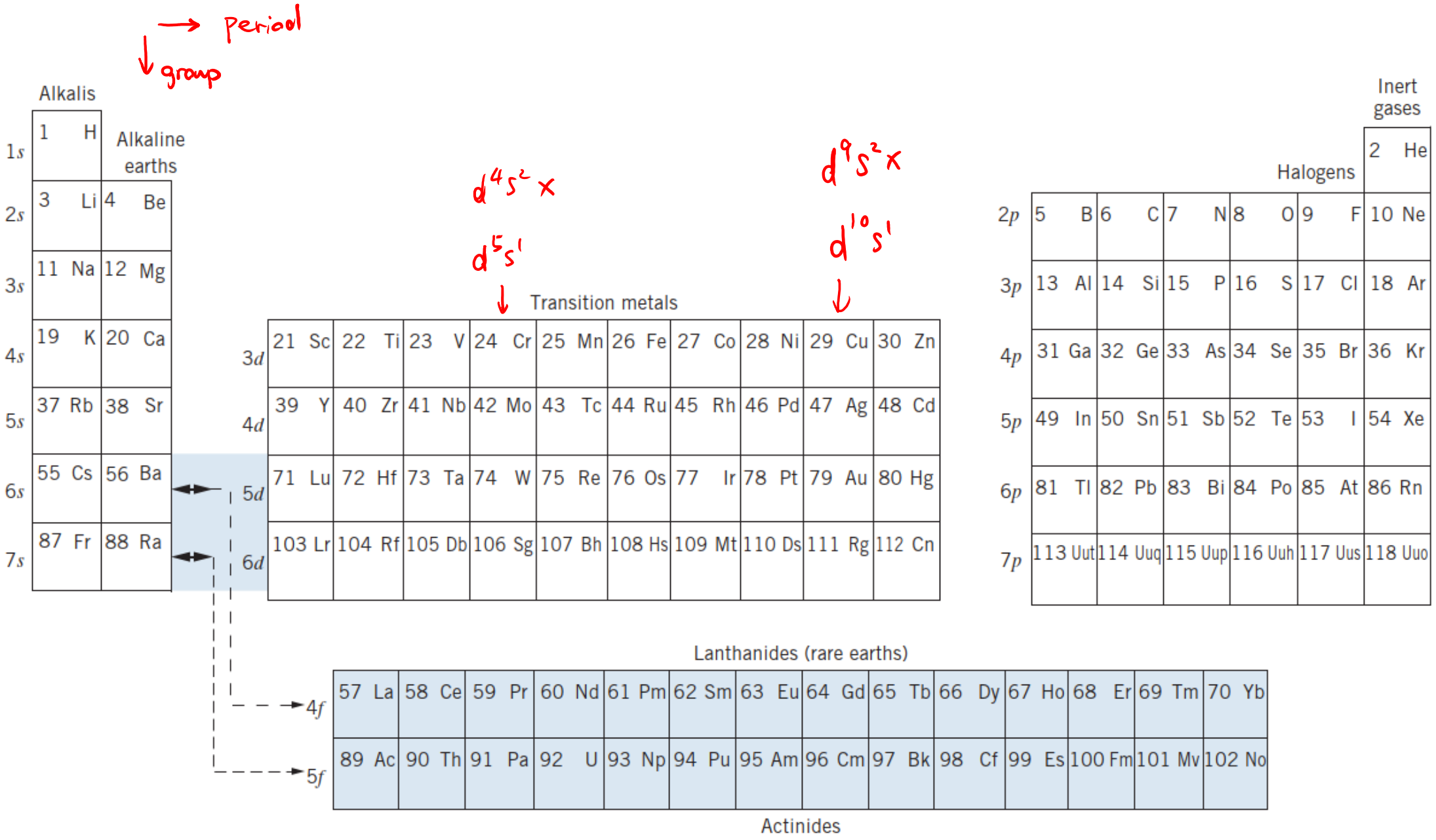
$$E_n = (-13.6\,\text{eV})\frac{Z_{\text{eff}}^2}{n^2}$$

$$= -13.6\,\text{eV}\,\frac{1^2}{2^2}$$

With penetrating orbits



Electron screen model is most accurate for 3d subshell at n = 3


→ period
↓ group
Alkalis
Alkaline earths
Transition metals
Halogens
Inert gases
d^4s^2 x
d^5s^1
d^9s^2 x
$d^{10}s^1$
1s 1 H
2s 3 Li 4 Be
3s 11 Na 12 Mg
4s 19 K 20 Ca
5s 37 Rb 38 Sr
6s 55 Cs 56 Ba
7s 87 Fr 88 Ra
3d 21 Sc 22 Ti 23 V 24 Cr 25 Mn 26 Fe 27 Co 28 Ni 29 Cu 30 Zn
4d 39 Y 40 Zr 41 Nb 42 Mo 43 Tc 44 Ru 45 Rh 46 Pd 47 Ag 48 Cd
5d 71 Lu 72 Hf 73 Ta 74 W 75 Re 76 Os 77 Ir 78 Pt 79 Au 80 Hg
6d 103 Lr 104 Rf 105 Db 106 Sg 107 Bh 108 Hs 109 Mt 110 Ds 111 Rg 112 Cn
2p 5 B 6 C 7 N 8 O 9 F 2 He 10 Ne
3p 13 Al 14 Si 15 P 16 S 17 Cl 18 Ar
4p 31 Ga 32 Ge 33 As 34 Se 35 Br 36 Kr
5p 49 In 50 Sn 51 Sb 52 Te 53 I 54 Xe
6p 81 Tl 82 Pb 83 Bi 84 Po 85 At 86 Rn
7p 113 Uut 114 Uuq 115 Uup 116 Uuh 117 Uus 118 Uuo
Lanthanides (rare earths)
4f 57 La 58 Ce 59 Pr 60 Nd 61 Pm 62 Sm 63 Eu 64 Gd 65 Tb 66 Dy 67 Ho 68 Er 69 Tm 70 Yb
5f 89 Ac 90 Th 91 Pa 92 U 93 Np 94 Pu 95 Am 96 Cm 97 Bk 98 Cf 99 Es 100 Fm 101 Mv 102 No
Actinides

Properties of the elements

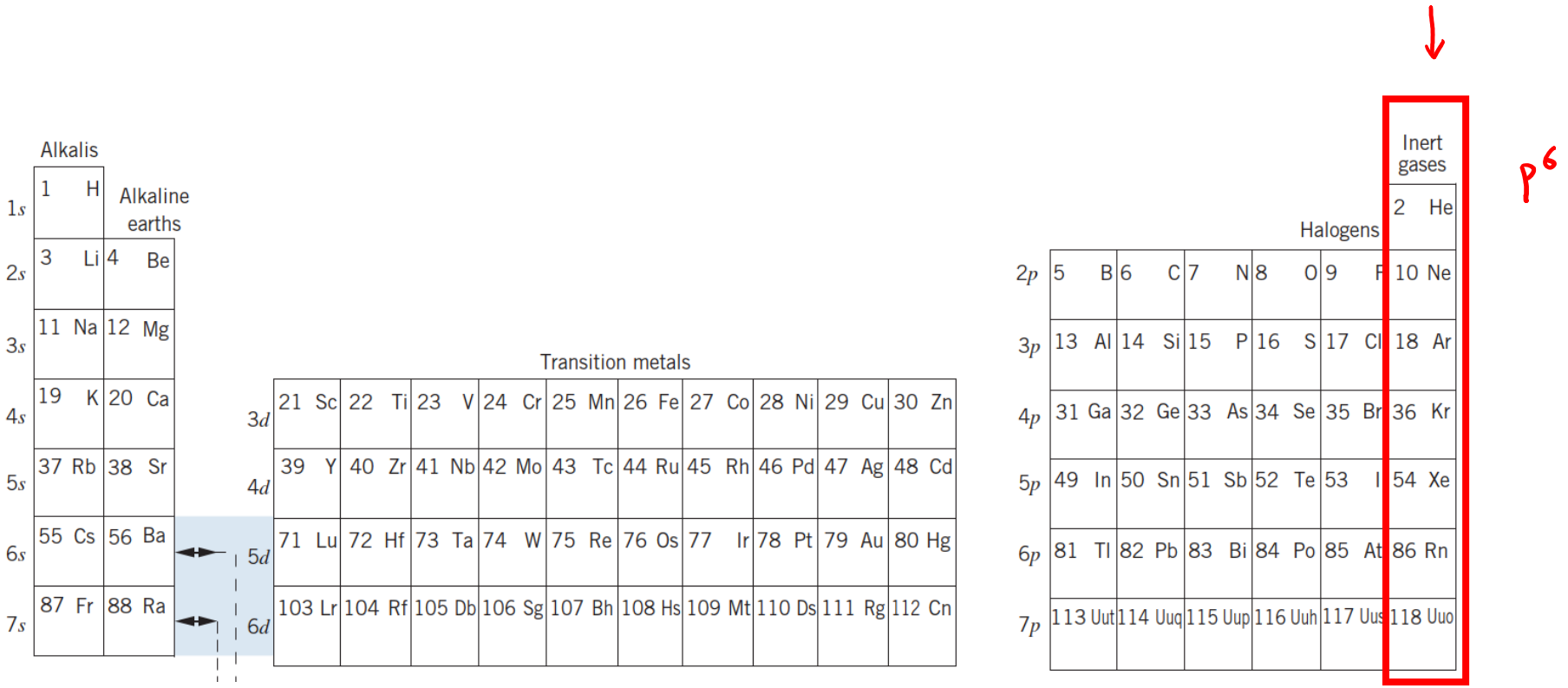
General rules:

Filled subshells are normally very stable configurations.

- an atom with one electron beyond a filled shell
- an atom lacking one electron from a filled shell
- inert gas

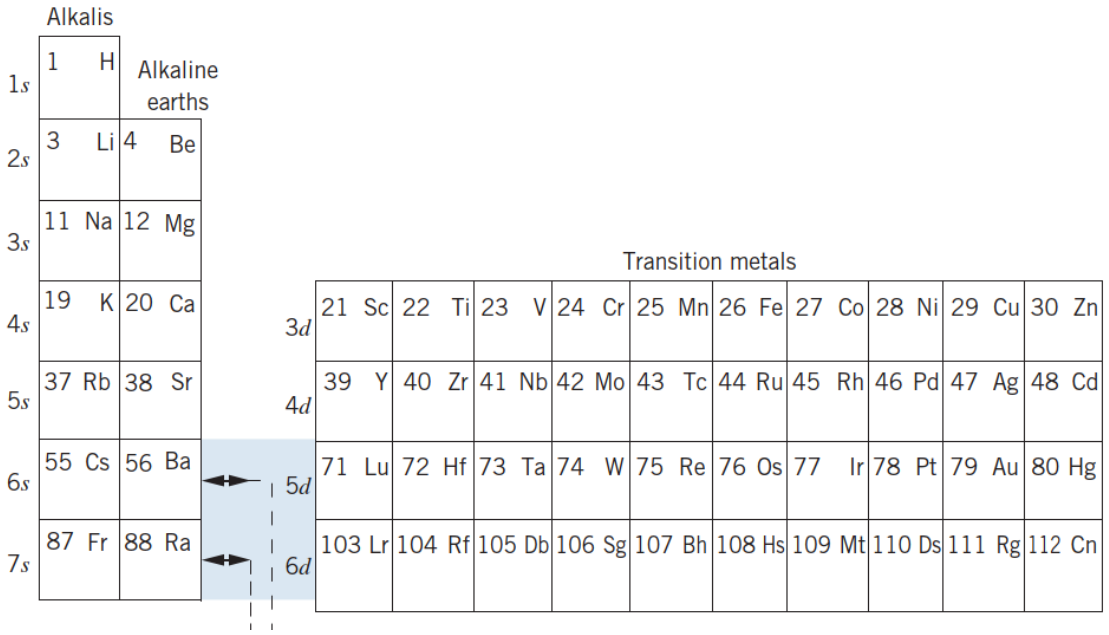
Filled subshells do not normally contribute to the chemical or physical properties of an atom.

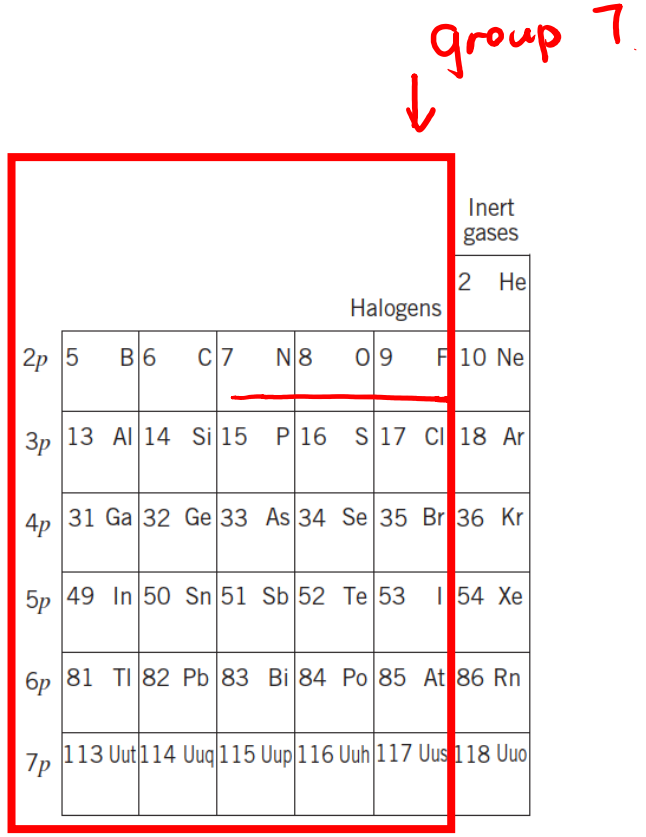
Inert gas



Filled subshells – stable/inert, extremely low boiling points

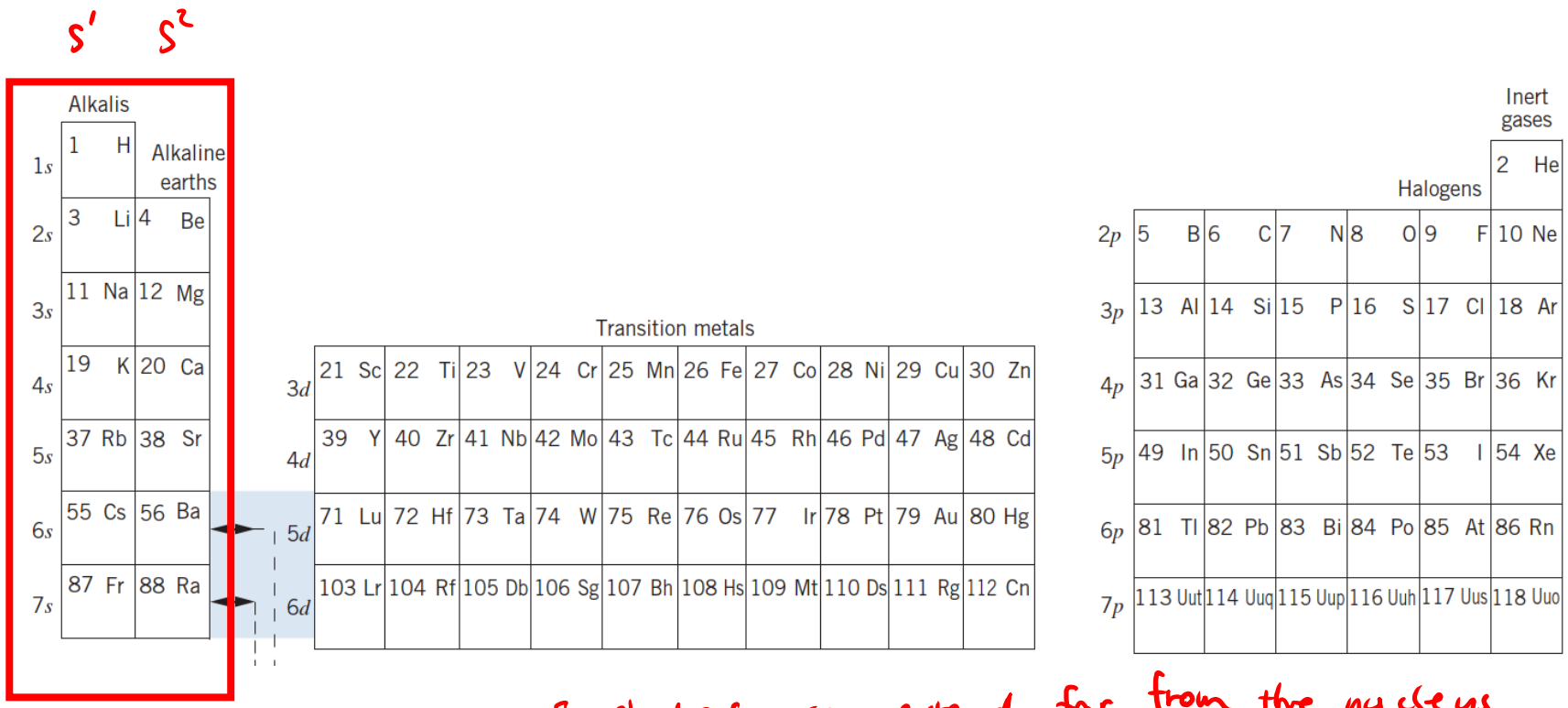
p-subshell elements





np^5 - very reactive reactivity $F_2 > O_2 > N_2$

s-subshell elements



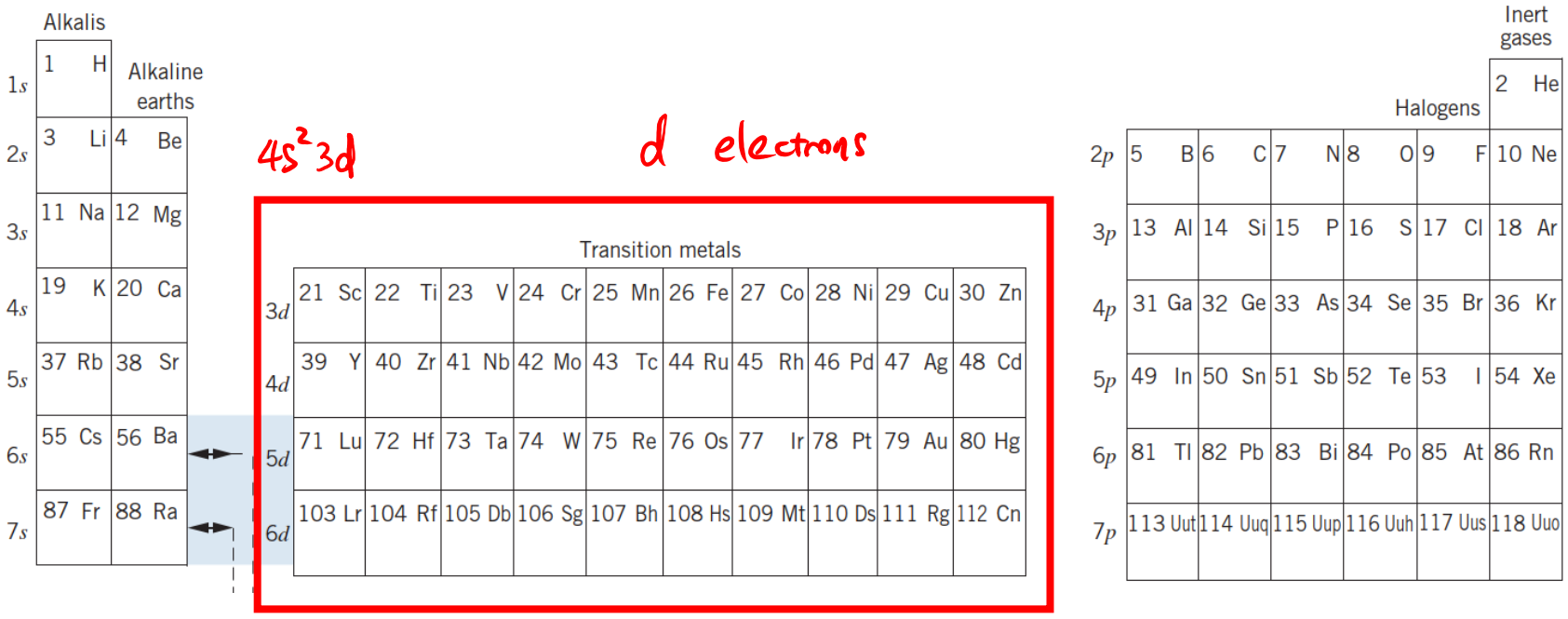
ns^1 & ns^2 – very reactive

ns^2 has filled subshell. Why reactive?

s electrons can extend far from the nucleus where s electrons are screened by Z-2 electrons. Therefore, s e⁻s are not tightly bound.

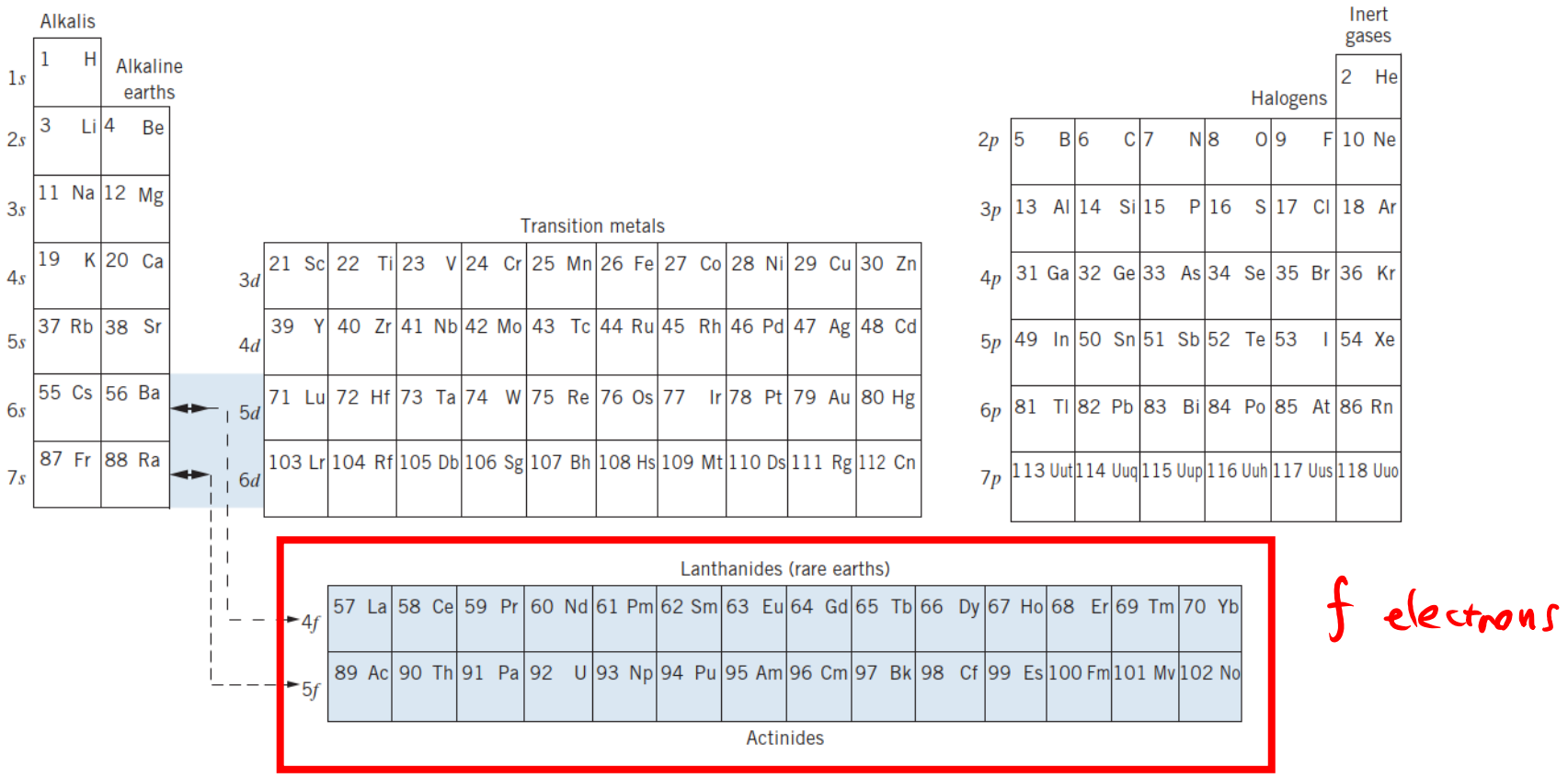
→ large radii, small ionization energies

Transition metals



Chemical properties determined by the outer electrons.
Similar within a period.

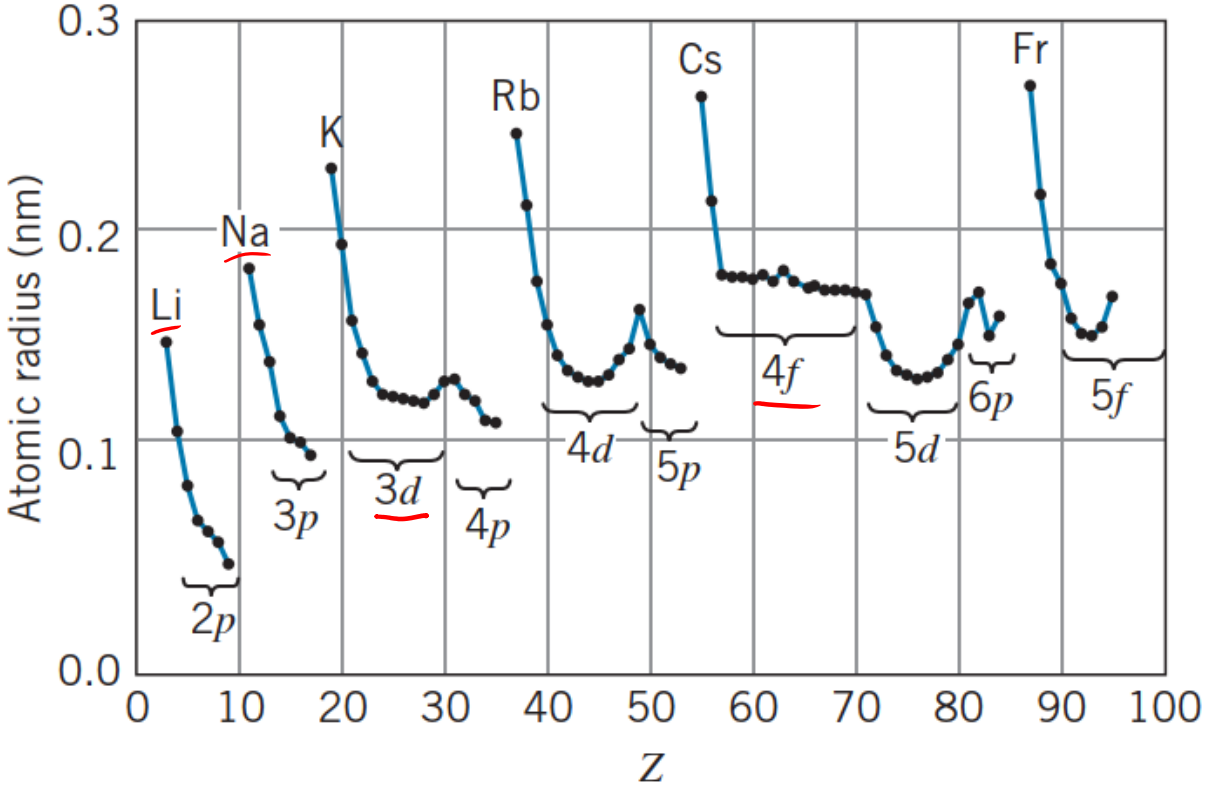
Lanthanides (rare earths) and actinides



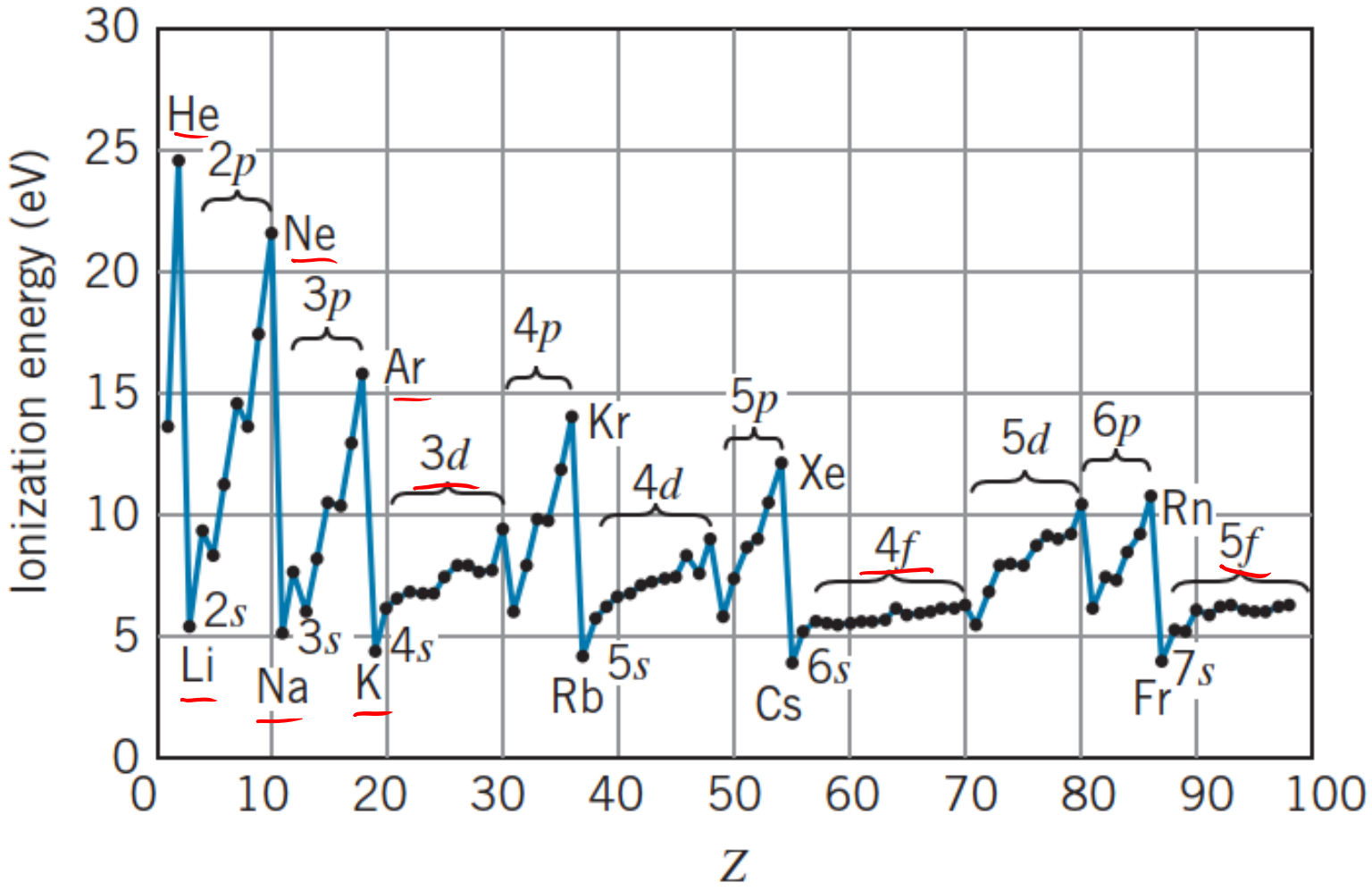
f electrons

Lanthanides – Chemical properties determined by the outer electrons. Similar within a period.
Actinides – Radioactive.

Atomic radii

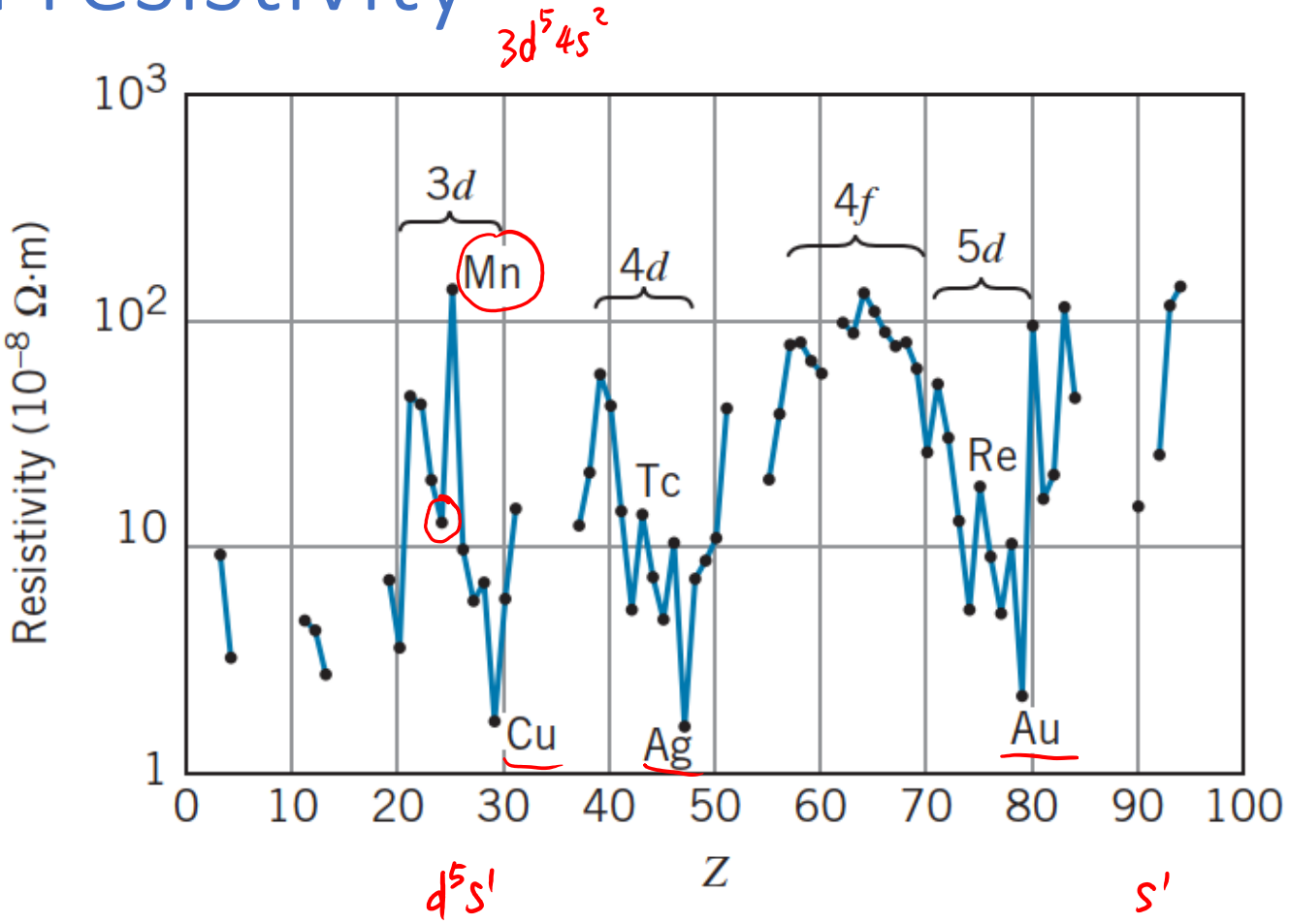


Ionization energy



$$2\frac{Z_{eff}^2}{n^2}$$

Electrical resistivity



Conduct through loosely bound electrons.