MODERN PERIODIC TABLE

Lecture 6.

Group number	General outer configuration	Examples
Group 1	ns^1	$_{3}Li:2s^1$, $_{11}Na:3s^1$
Group 2	ns^2	$_{4}Be:2s^2$, $_{12}Mg:3s^2$
Group 3	$ns^2\ (n\text{-}1)d^1$	$_{21}Sc:4s^23d^1$, $_{39}Y:5s^24d^1$
Group 13	$ns^2\ np^1$	$_{5}B:2s^22p^1$, $_{13}A1:3s^23p^1$
Group 14	$ns^2\ np^2$	$_{6}C:2s^22p^2$, $_{14}Si:3s^23p^2$
Group 15	$ns^2\ np^3$	$_{7}N:2s^22p^3$, $_{15}P:3s^23p^3$
Group 16	$ns^2\ np^4$	$_{8}O:2s^22p^4$, $_{16}S:3s^23p^4$
Group 17	$ns^2\ np^5$	$_{9}F:2s^22p^5$, $_{17}C1:3s^23p^5$
Group 18	$ns^2\ np^6$	$_{10}Ne:2s^22p^6$, $_{18}Ar:3s^23p^6$

Trends in the periodic table:

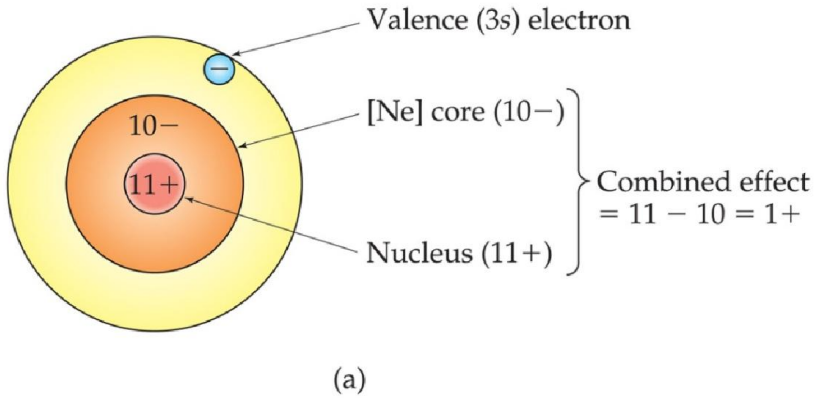




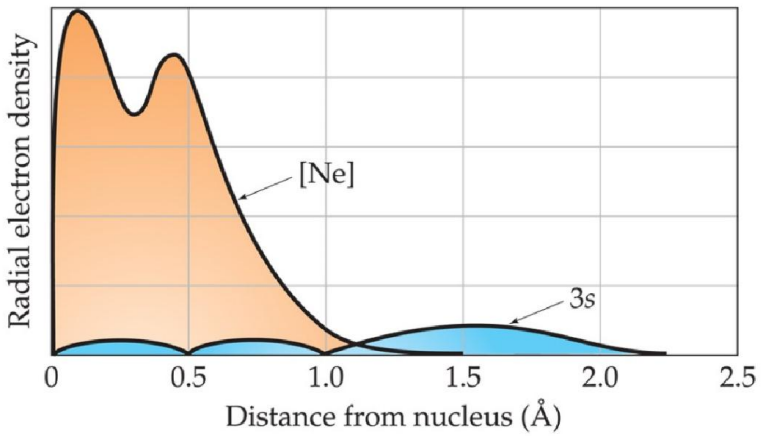
Ionization Energy
Atomic Radius
Electron Affinity
Electronegativity

EFFECTIVE NUCLEAR CHARGE

Na atom.

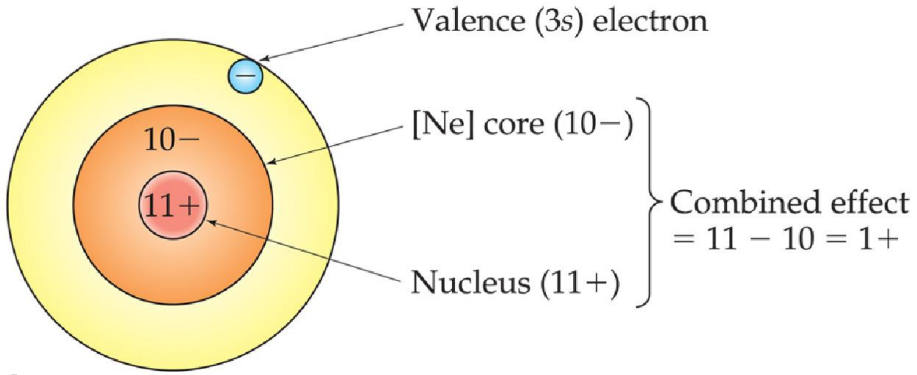


(a)



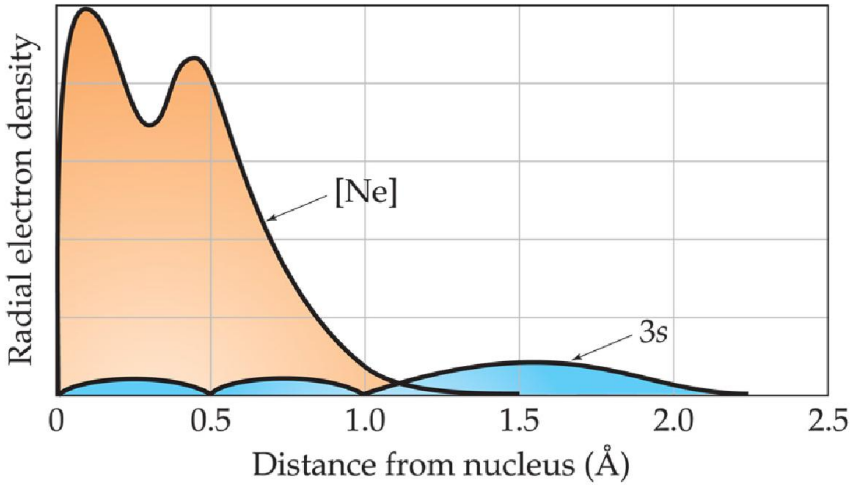
- In a many-electron atom, electrons are both attracted to the nucleus and repelled by other electrons.
- The nuclear charge that an electron “feels” depends on both factors.
- It’s called Effective nuclear charge.
- electrons in lower energy levels “shield” outer electrons from positive charge of nucleus.

EFFECTIVE NUCLEAR CHARGE



Na

(a)



- The effective nuclear charge, Z_{eff}, is:

$Z_{eff} = Z - \sigma$

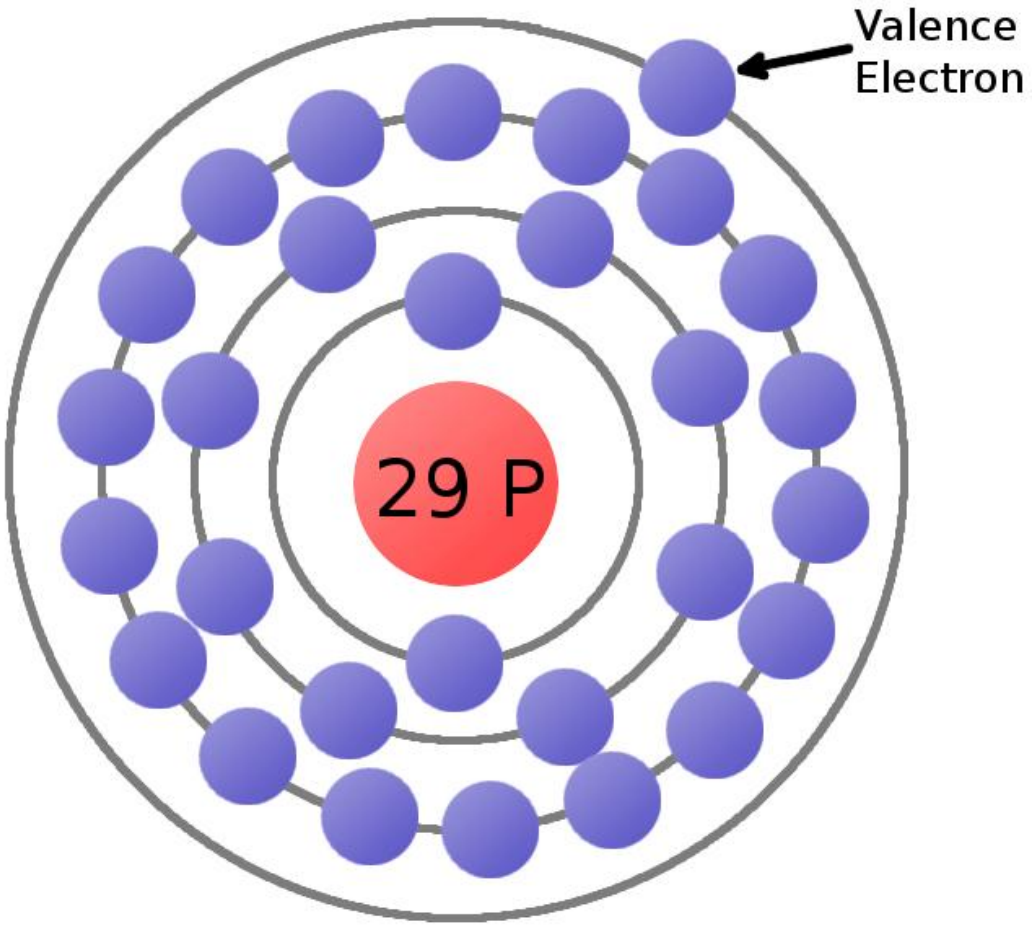
Where:

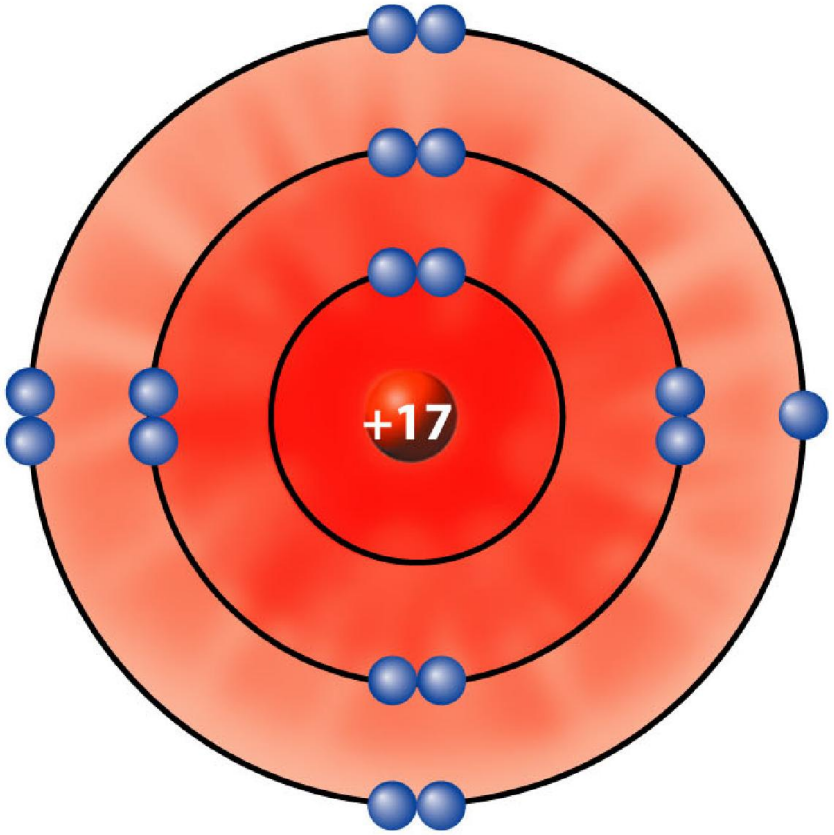
Z = actual nuclear charge

σ = screening constant, usually close to the number of inner (n-1) electrons.

e^- SHIELDING

- As more energy levels are added to atoms, the inner levels of electrons shield the outer electrons from the nucleus' attraction.
- The effective nuclear attraction for these outer electrons is less, and so the outer electrons are less tightly held.
- This makes it easier to remove some of these e- when bonding to other atoms.

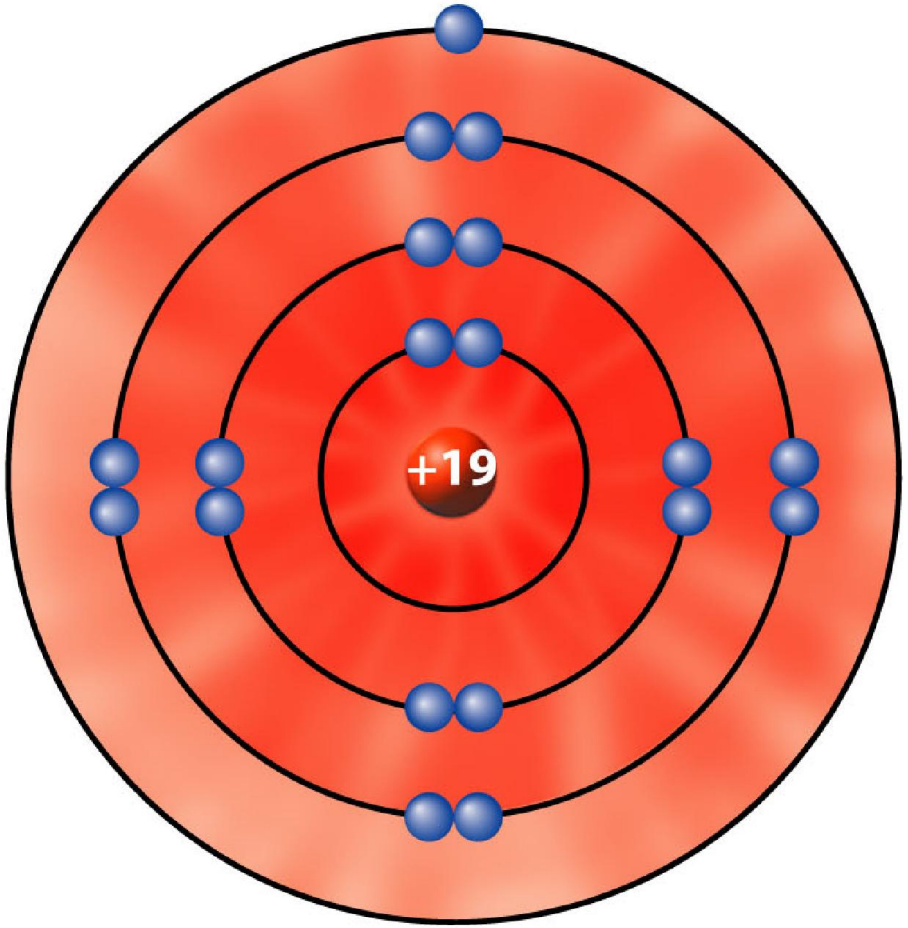




Chlorine

+17 Actual nuclear charge
−10 Inner shell electrons

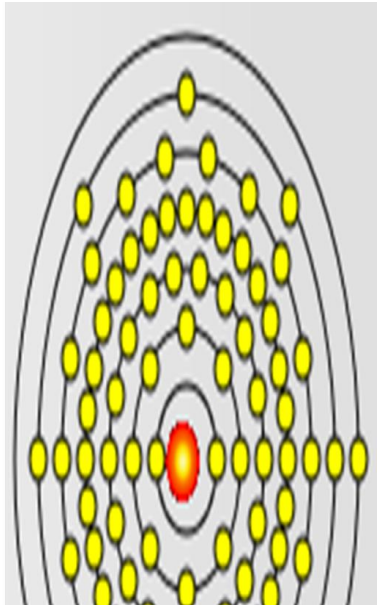
+7 Effective nuclear charge



Potassium

+19 Actual nuclear charge
−18 Inner shell electrons

+1 Effective nuclear charge



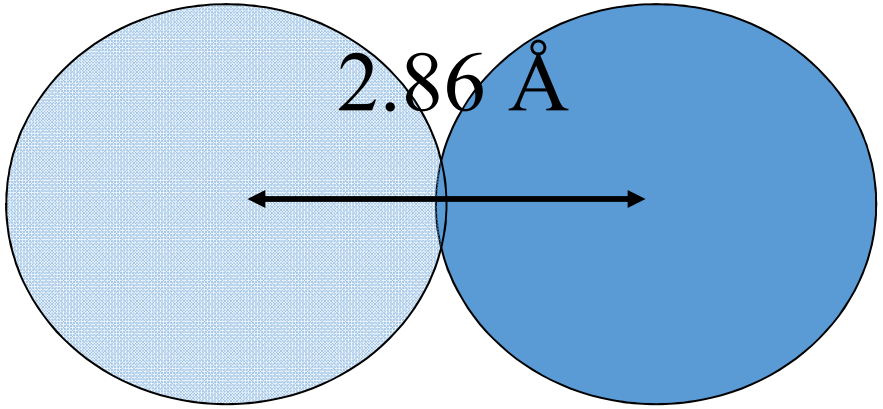
Look at all the shielding Francium's one valance electron has. It barely feels the proton pull from the nucleus. No wonder it will lose it’s one electron the easiest. No wonder it’s the most reactive metal

TREND FOR EFFECTIVE NUCLEAR CHARGE

- Across a period, nuclear charge increases by +1, however the valence shell remains the same i.e. the incoming electron is accommodated to the same shell.
- Thus, the EFFECTIVE NUCLEAR CHARGE Z_{eff} increases across a period.

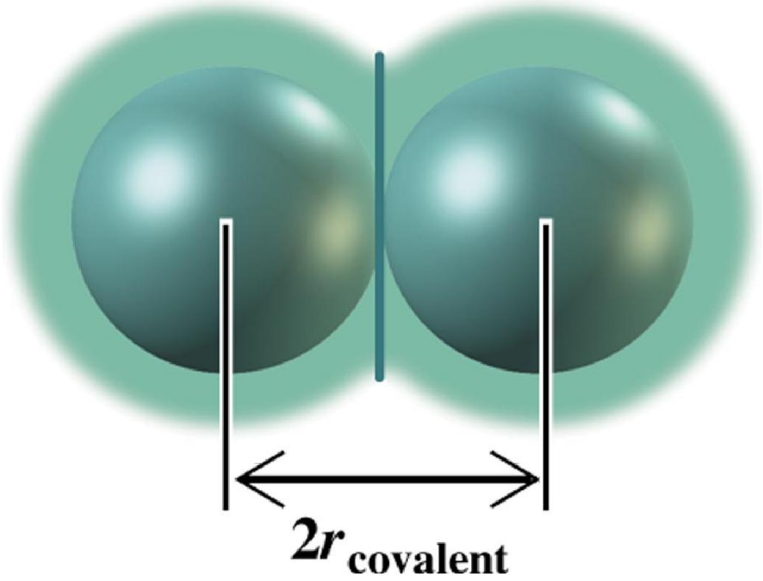
- Down the group, nuclear charge increases, however a new valence shell is added i.e. the incoming electron is accommodated in the next shell.
- Shielding effect exhibited by inner electrons increases as a result.
- Thus, the EFFECTIVE NUCLEAR CHARGE Z_{eff} decreases down the group.

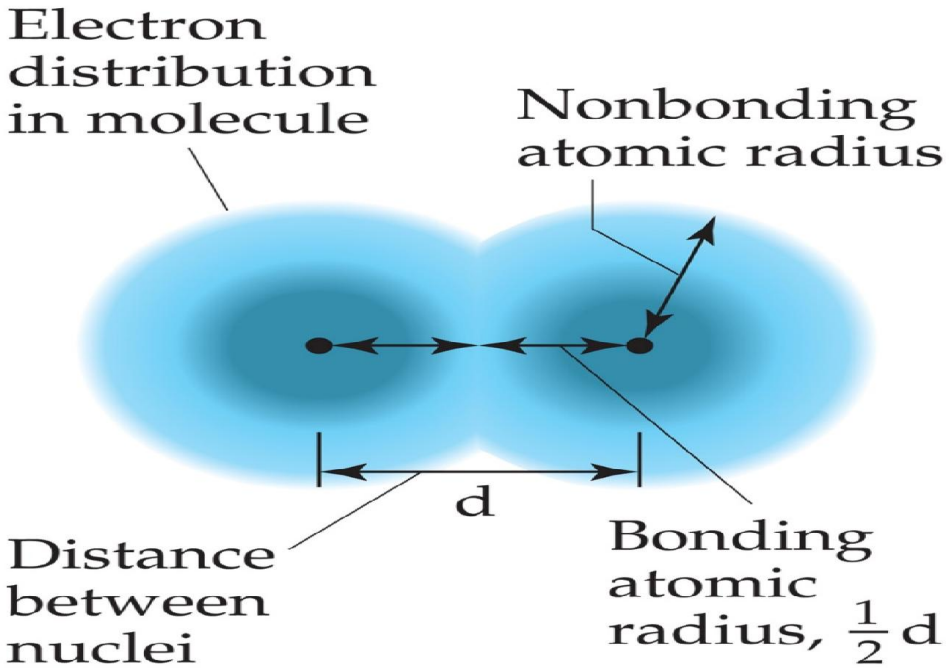
ATOMIC RADIUS



- Radius is the distance from the center of the nucleus to the “edge” of the electron cloud.
- Since a cloud’s edge is difficult to define, scientists use a defined covalent radius, or half the distance between the nuclei of 2 bonded atoms.

- $A_{rad} = \frac{2.86\ Å}{2} = 1.43\ Å$

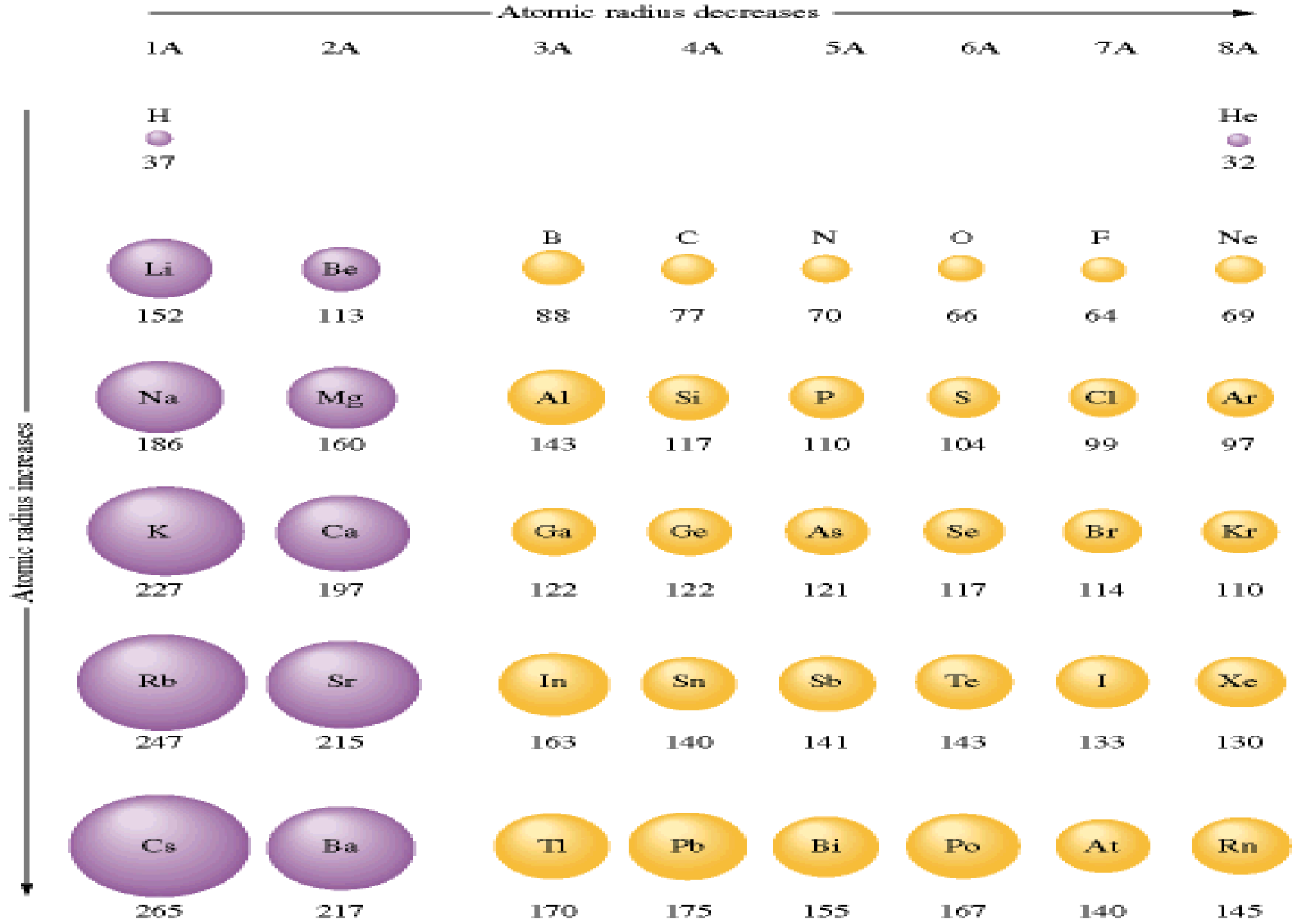


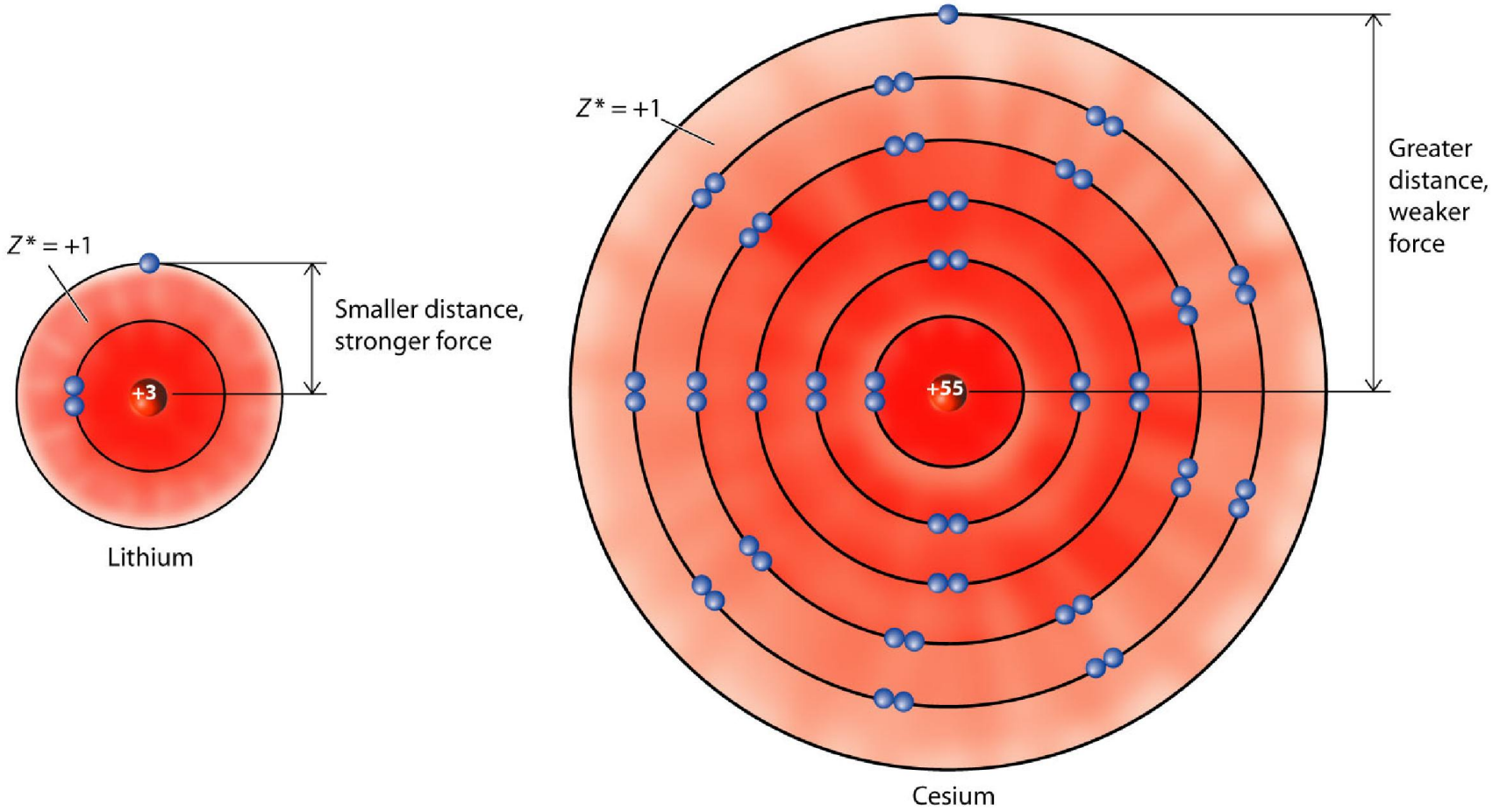


TREND FOR ATOMIC RADIUS

- Across a period, nuclear charge increases by +1, however the valence shell remains the same i.e. the incoming electron is accommodated in the same shell.
- Hence, the EFFECTIVE NUCLEAR CHARGE Z_{eff} increases across a period.
- Due to poor shielding of electrons, Atomic Radius across a period decreases.

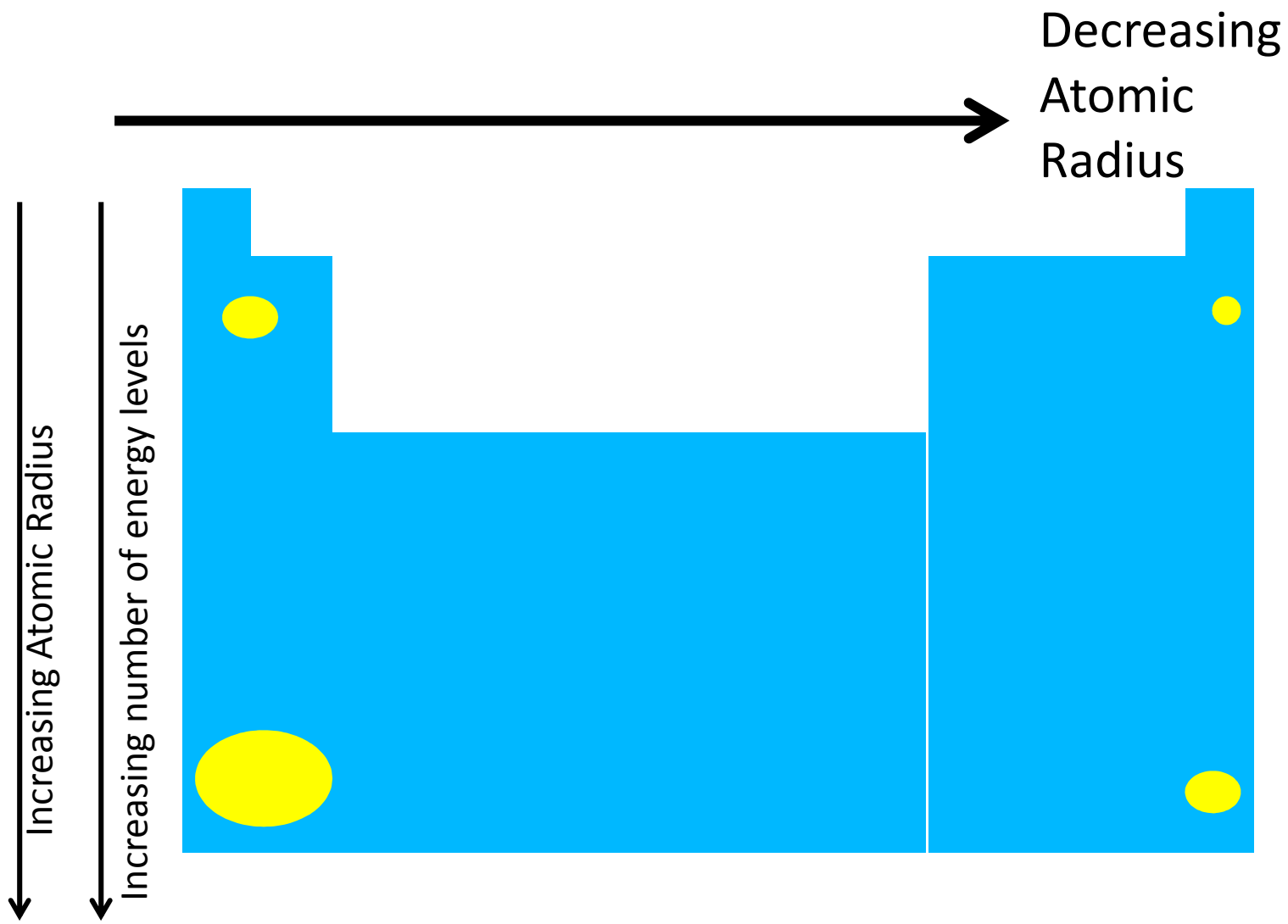
- Down the group, nuclear charge increases, however a new valence shell is added i.e. the incoming electron is accommodated in the next shell.
- Hence, the EFFECTIVE NUCLEAR CHARGE Z_{eff} decreases down the group.
- Shielding effect of these inner electrons increases and so does the ATOMIC RADIUS down the group.


Atomic radius decreases
1A
2A
3A
4A
5A
6A
7A
8A
Atomic radius increases
H
37
He
32
B
C
N
O
F
Ne
Li
Be
152
113
88
77
70
66
64
69
Na
Mg
Al
Si
P
S
Cl
Ar
186
160
143
117
110
104
99
97
K
Ca
Ga
Ge
As
Se
Br
Kr
227
197
122
122
121
117
114
110
Rb
Sr
In
Sn
Sb
Te
I
Xe
247
215
163
140
141
143
133
130
Cs
Ba
Tl
Pb
Bi
Po
At
Rn
265
217
170
175
155
167
140
145



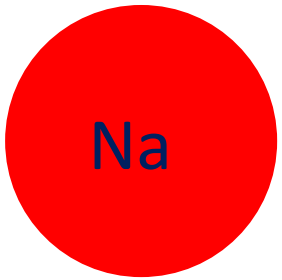
Li: Group 1 Period 2

Cs: Group 1 Period 6

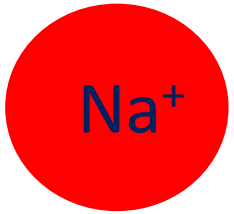

Decreasing
Atomic
Radius
Increasing Atomic Radius
Increasing number of energy levels

An ion is formed when an atom, or group of atoms, has a net positive or negative charge.

If a neutral atom **looses** one or more electrons it becomes a cation.

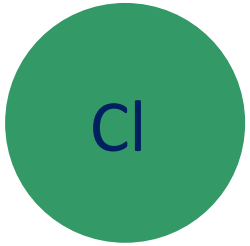


11 protons
11 electrons

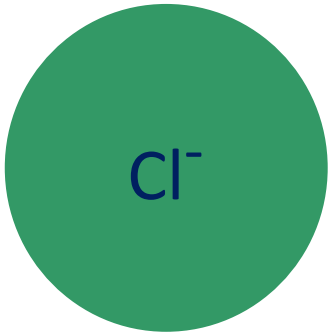


11 protons
10 electrons

If a neutral atom **gains** one or more electrons it becomes an anion.



17 protons
17 electrons



17 protons
18 electrons

Any Question



“It is not the answer that enlightens, but the question.”

- Eugene Ionesco