PERIODIC TABLE
4.2 Periodicity

Lecture 5

LEARNING OUTCOMES

- At the end of the lesson the students should be able to :
  - Define electron affinity and electronegativity.
  - Explain the variation in electronegativity of elements
    - i. across periods 2 and 3
    - ii. down a group.

4.2.6 Electron Affinity&Electronegativity

Electron Affinity

The change in energy of the reaction when an electron is added to a gaseous atom or ion.

$$X_{(g)} + e^- \longrightarrow X^-_{(g)}$$

- These reactions tend to be exothermic (release energy) because an electron approaching a neutral atom experiences an attraction for the positively charged nucleus.
- So the values of E are generally negative.
- The higher (more negative) the EA, the more easily it accepts an electron.

4.2.6 Electron Affinity&Electronegativity

- The smaller the atom, the closer an added electron can approach the atomic nucleus and the more strongly it is attracted to the nucleus.
- However, affinity does not always release energy. In some cases affinity requires energy.

4.2.6 Electron Affinity&Electronegativity

- Example: Formation of oxide, O^{2-};

  -The addition of the first electron releases energy since the electron added is being pulled towards the nucleus as it enters the neutral atom.

  -The addition of the second electron however requires energy because the second electron is entering a negatively charge ion.

  -This requires work (absorb energy) as the electron is forced onto the negative ion and the process is endothermic.

4.2.6 Electron Affinity&Electronegativity

- **Electronegativity** is the relative tendency of an atom to attract electrons to itself when chemically combined with another atom.
- Atoms with strong attraction for the bonding electrons have the high electronegativity.
- The most widely used scale – developed by Linus Pauling. He assigned the most electronegative element, flourine a value 4.0 and work out the the others relative to flourine.

4.2.7 Variation in Electronegativity

(a) Across Periods 2 and 3

- Going across a period from left to right, the atomic size decreases, while the nuclear charge increases. Hence, the attraction for electrons increases and the electronegativity increases.

4.2.7 Variation in Electronegativity

(b) Down a group

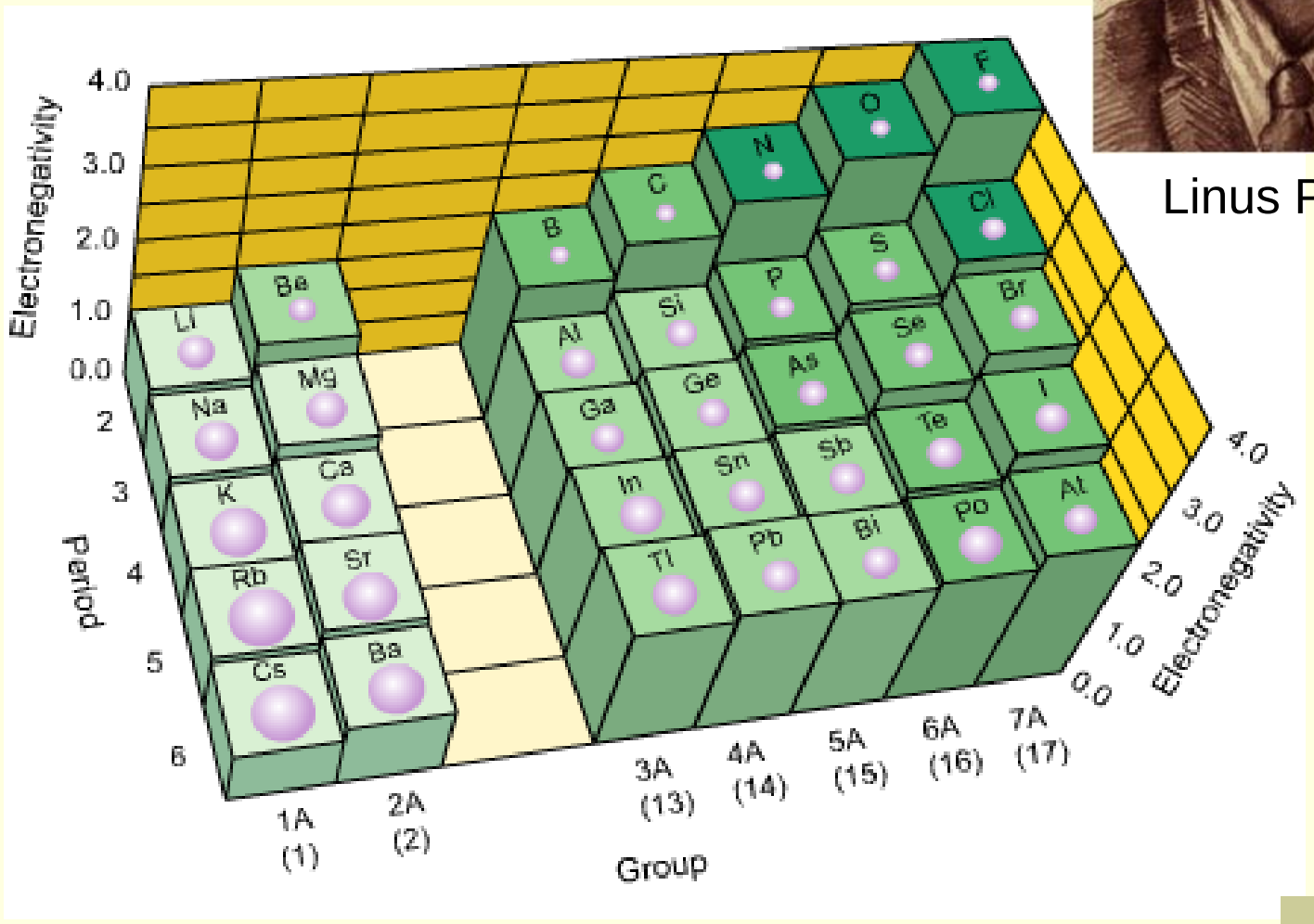
- Going down a group, the atomic size increase because the shielding effect increases. Hence, the attraction for electrons decrease and the electronegativity decreases.
- Example: Na < B < S < F

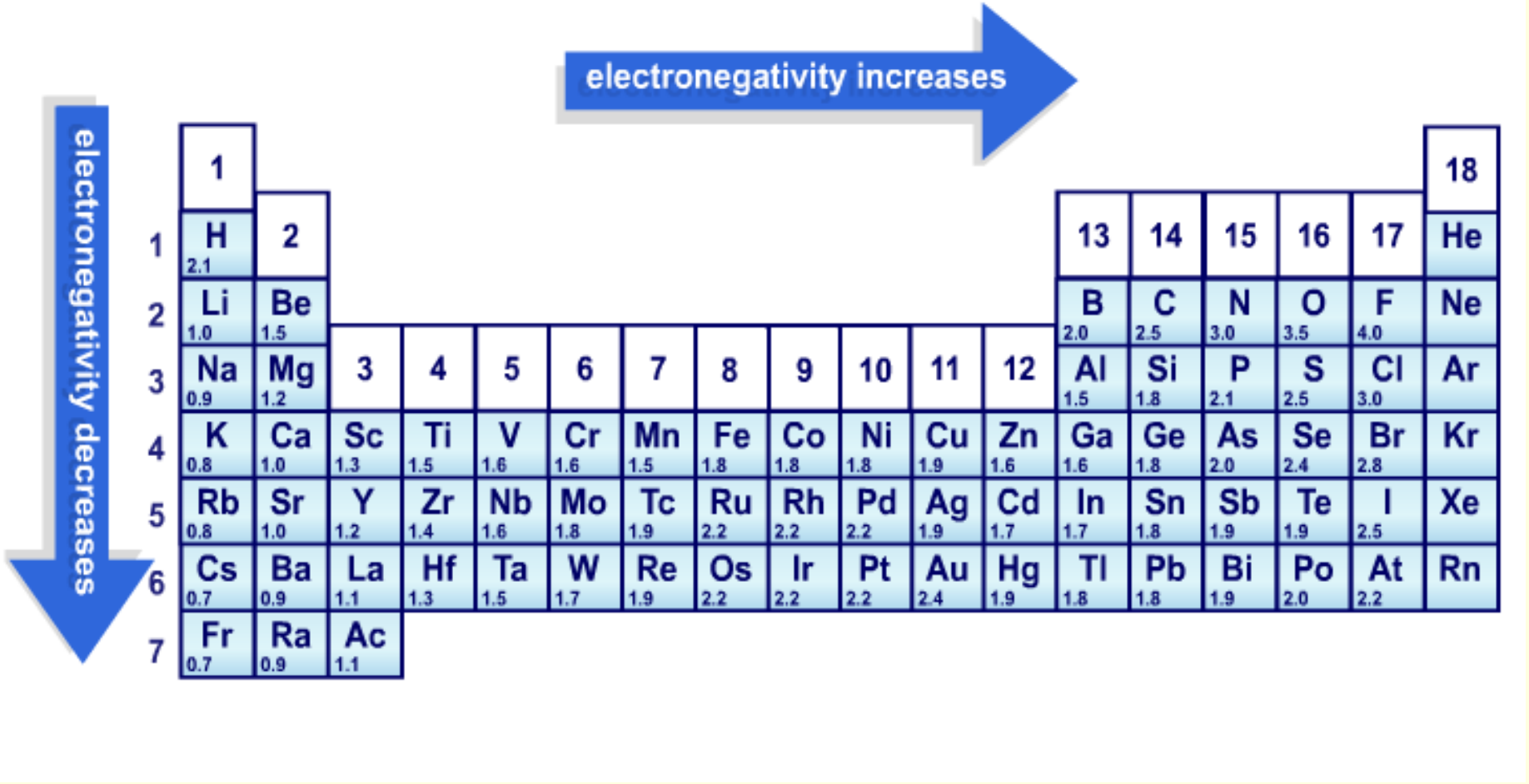
4.2.7 Variation in Electronegativity

- **Electronegativity decreases down a group, and increases across a period**.

Chart 1: electronegativities of elements

Linus Pauling




electronegativity increases
electronegativity decreases
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
1 H 2.1
2 Li 1.0 Be 1.5
3 Na 0.9 Mg 1.2
4 K 0.8 Ca 1.0 Sc 1.3 Ti 1.5 V 1.6 Cr 1.6 Mn 1.5 Fe 1.8 Co 1.8 Ni 1.8 Cu 1.9 Zn 1.6 Ga 1.6 Ge 1.8 As 2.0 Se 2.4 Br 2.8 Kr
5 Rb 0.8 Sr 1.0 Y 1.2 Zr 1.4 Nb 1.6 Mo 1.8 Tc 1.9 Ru 2.2 Rh 2.2 Pd 2.2 Ag 1.9 Cd 1.7 In 1.7 Sn 1.8 Sb 1.9 Te 1.9 I 2.5 Xe
6 Cs 0.7 Ba 0.9 La 1.1 Hf 1.3 Ta 1.5 W 1.7 Re 1.9 Os 2.2 Ir 2.2 Pt 2.2 Au 2.4 Hg 1.9 Tl 1.8 Pb 1.8 Bi 1.9 Po 2.0 At 2.2 Rn
7 Fr 0.7 Ra 0.9 Ac 1.1
B 2.0 C 2.5 N 3.0 O 3.5 F 4.0 Ne
Al 1.5 Si 1.8 P 2.1 S 2.5 Cl 3.0 Ar
He

Exercise:

1. Indicate which element of each pair has the lower electron affinity.

a) Na or K

b) Mg or Be

c) Li or O

d) Cl or Br

e) Ca or Br

Answers:
a) K
b) Mg
c) Li
d) Br
e) Ca

2. Arrange the elements in order of their increasing electronegativity.

a) Na, Li, Cs, K

b) B, F, Li, C

c) Cl, S, Si, Na

Answers:
a) Cs, K, Na, Li
b) Li, B, C, F
c) Na, Si, S, Cl


THE
END