

OPĆA I ANORGANSKA KEMIJA

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Zavod za opću i anorgansku kemiju

Konzultacije : srijedom 12-14 h

Literatura:

I. Filipović, S. Lipanović

Opća i anorganska kemija (II dio)

2.

Cotton and Wilkinson

Advanced Inorganic Chemistry

3.

N.N. Greenwood and A. Earnshaw

Chemistry of the Elements

4.

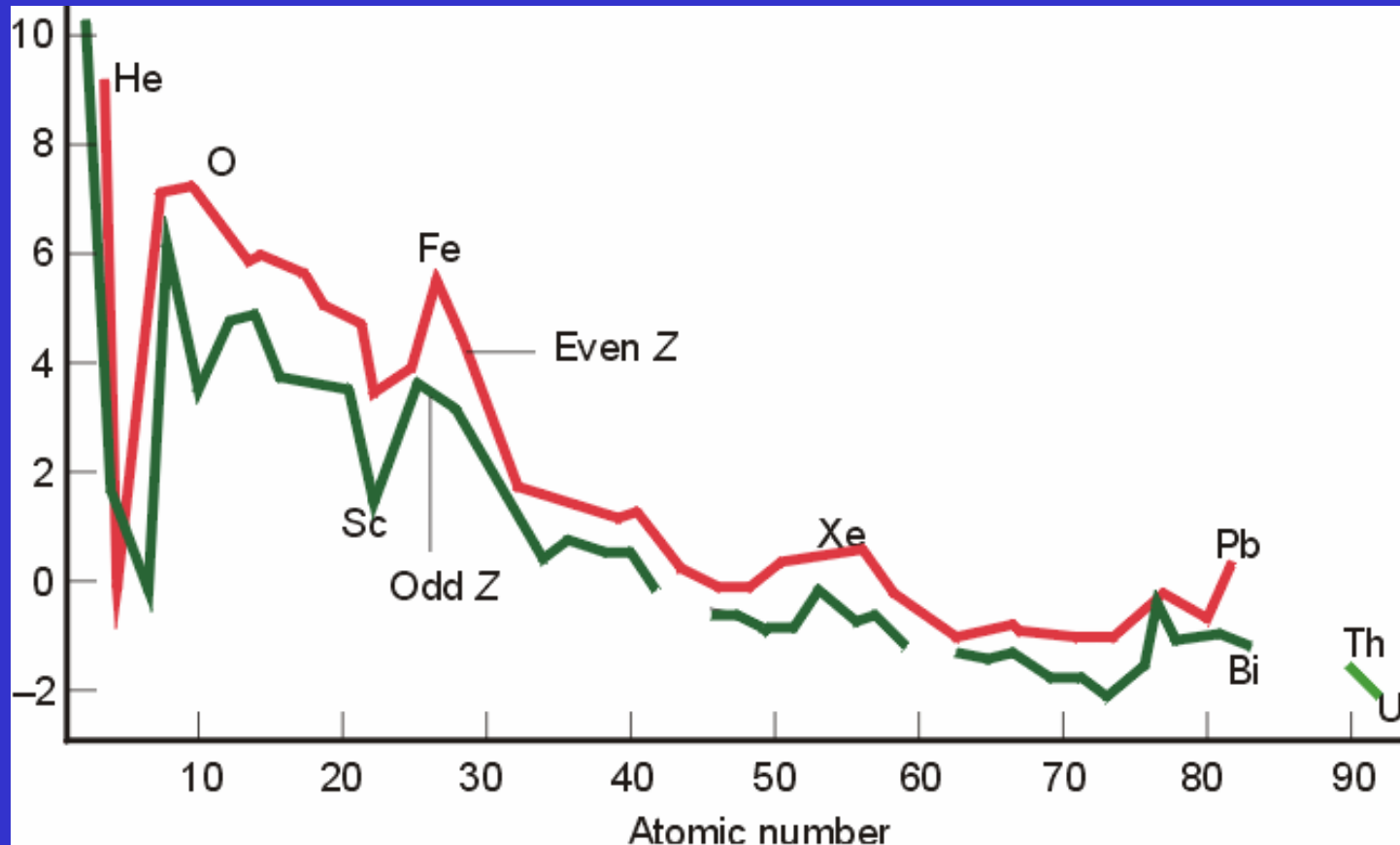
P. Atkins and L. Jones

Chemical Principles

Stvaranje kemijskih elemenata

- 1. periodičnost fizikalnih svojstava
atomski radius, ionski radijusi elemenata
gustoća
talište i vrelište
- 2. periodičnost kemijskih svojstava
energija ionizacije
elektronegativnost
standardni redukcijski potencijal
oksidacijski broj

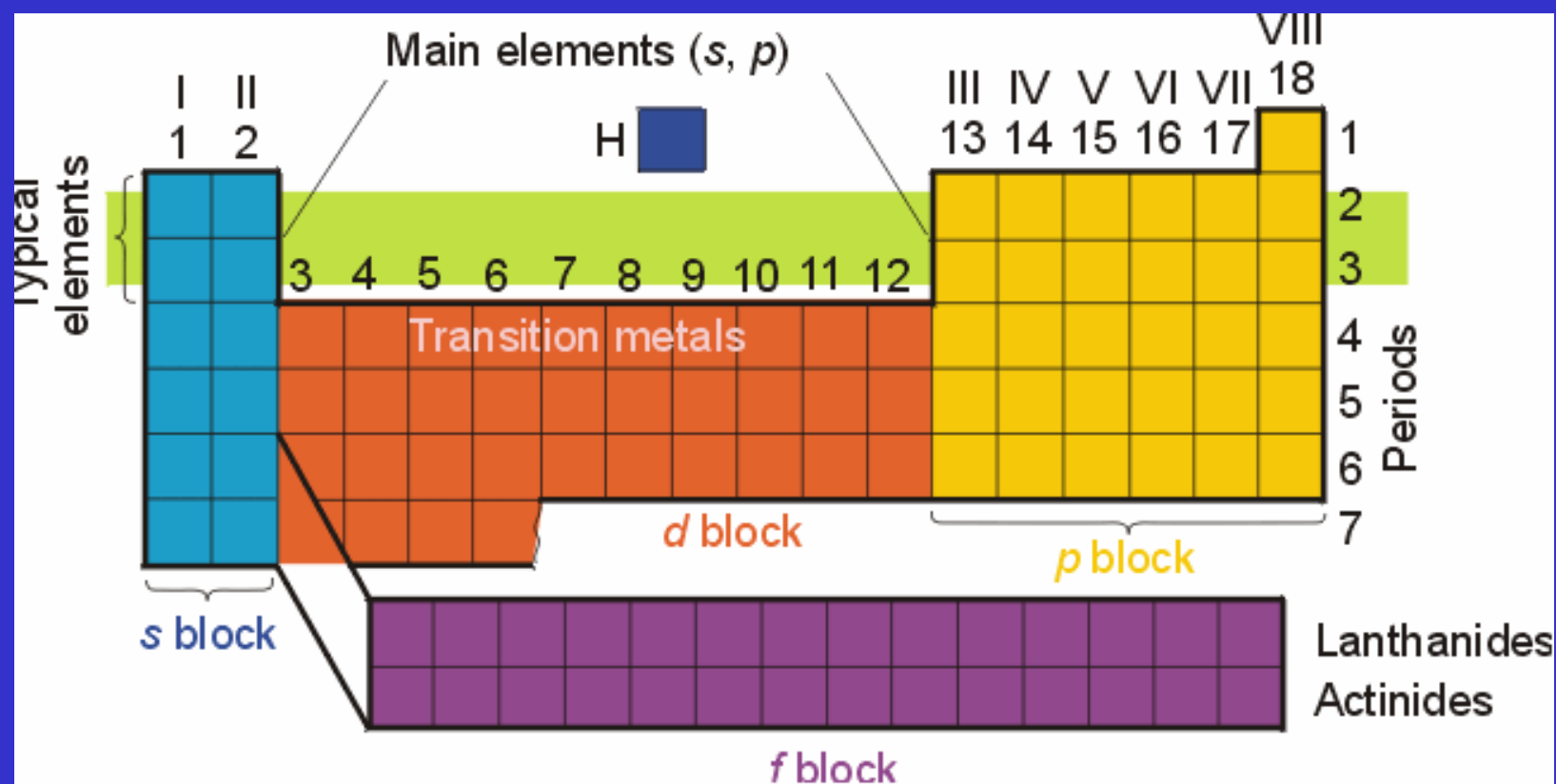
Rasprostranjenost elemenata u Svemiru



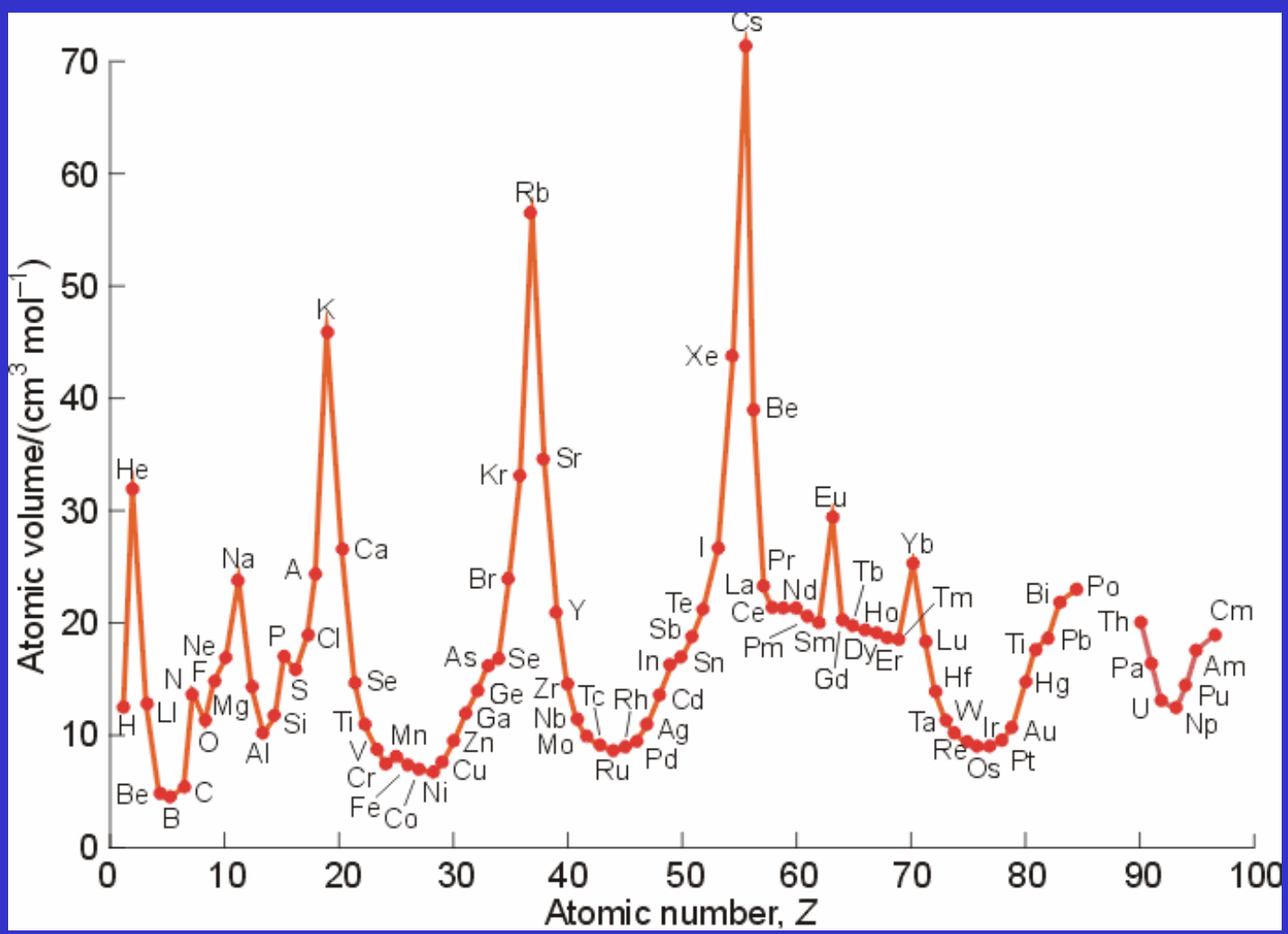
ZEMLJINA KORA

| ELEMENT | W/% |
|-----------------|-------------|
| KISIK | 46.6 |
| SILICIJ | 27.7 |
| ALUMINIJ | 8.1 |
| ŽELJEZO | 5.0 |
| KALCIJ | 3.6 |
| NATRIJ | 2.8 |
| KALIJ | 2.6 |
| MAGNEZIJ | 2.1 |

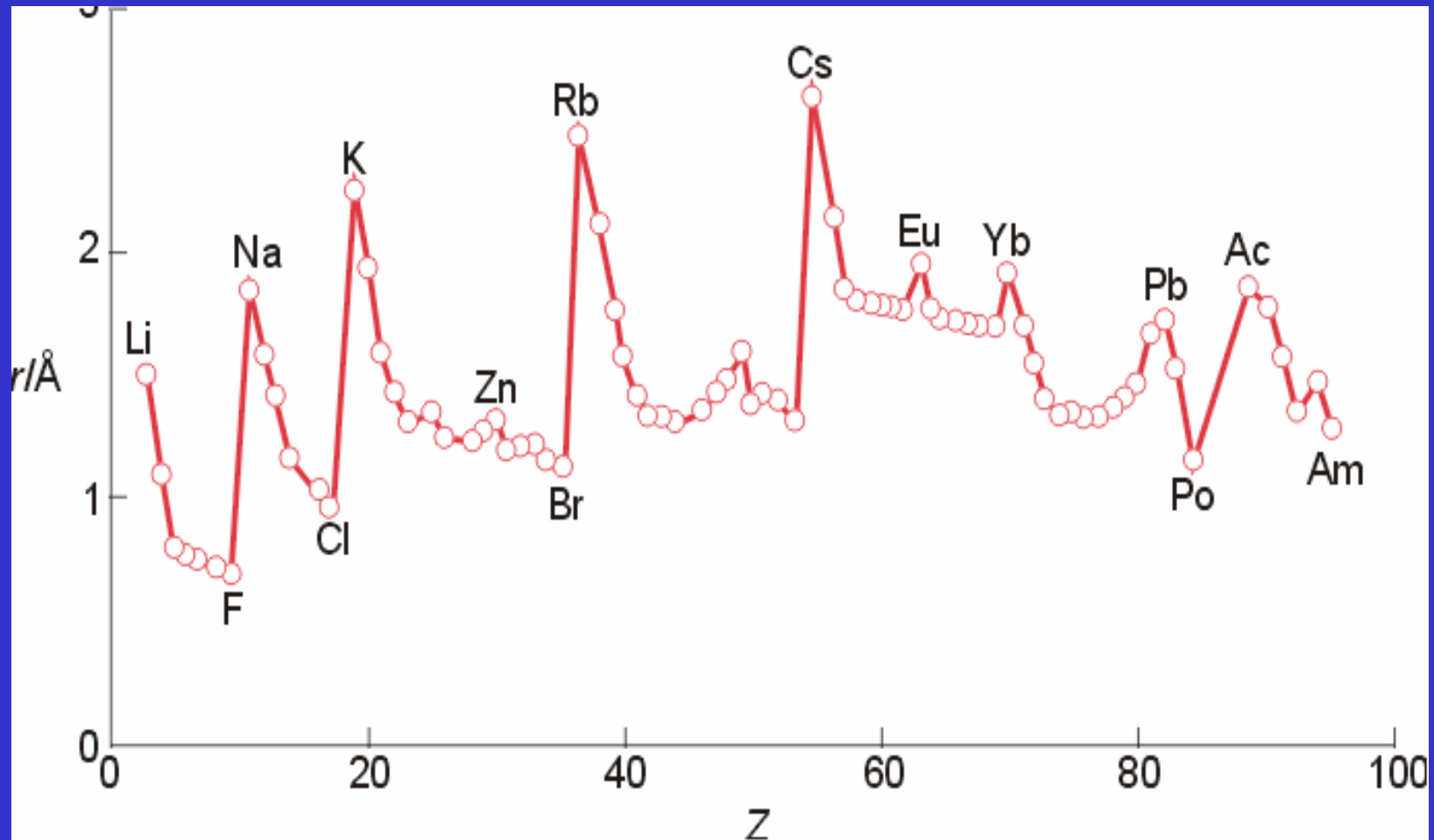
Periodni sustav elemenata



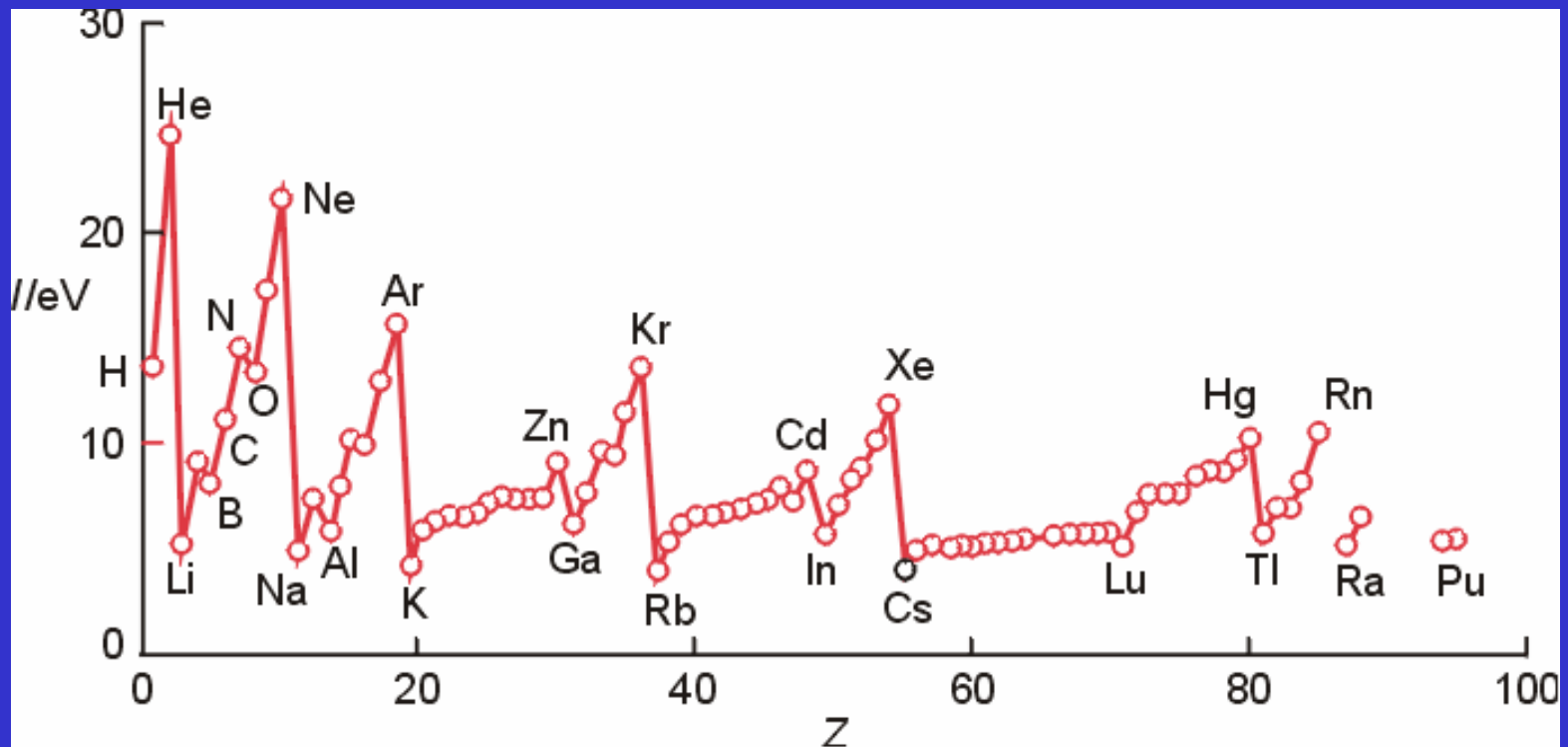
Molarni volumen



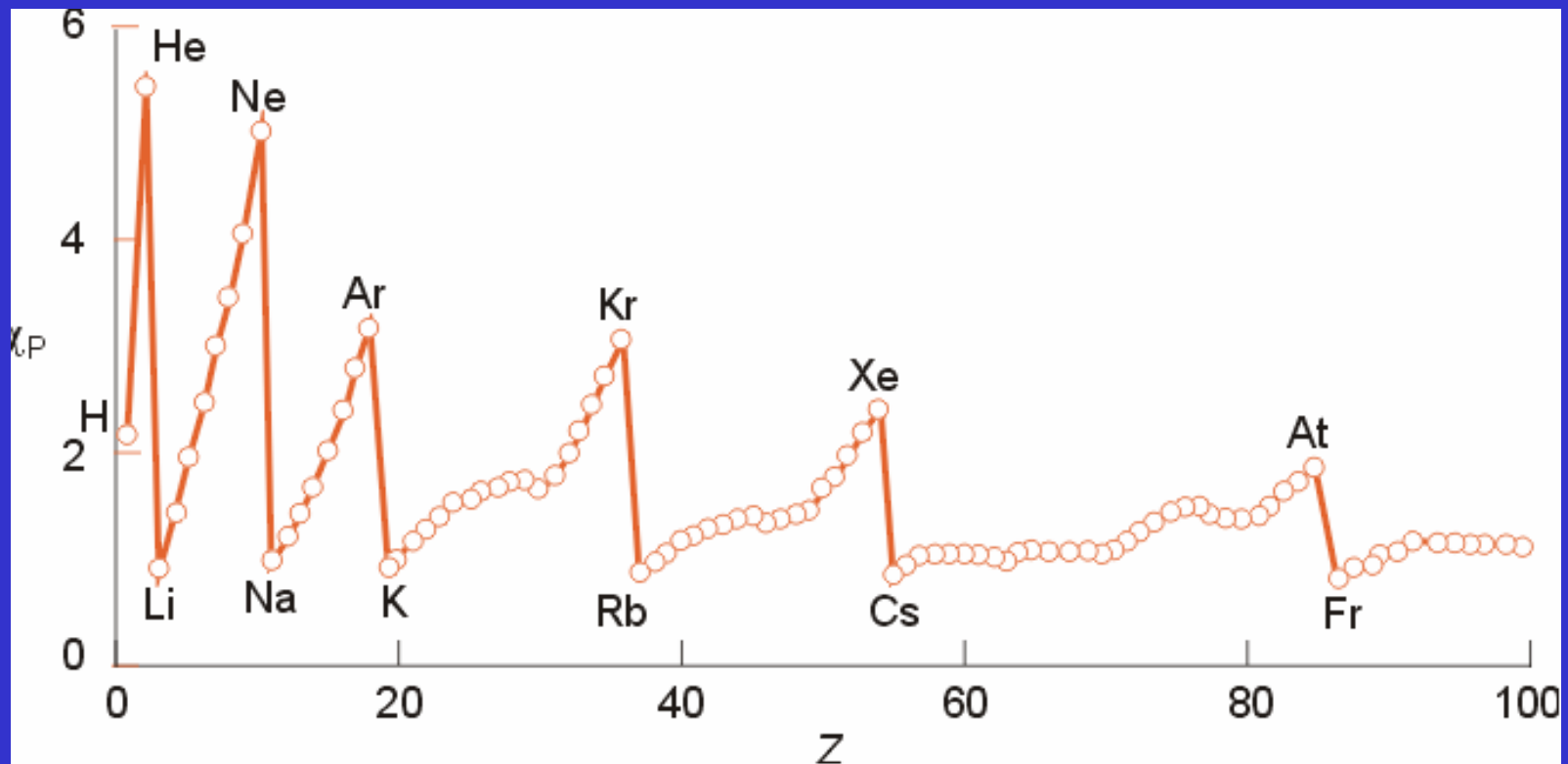
Atomski radijus



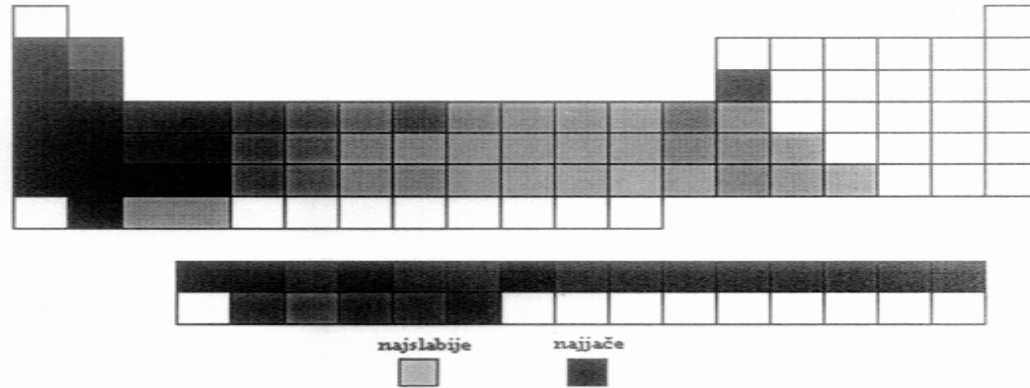
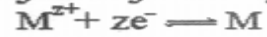
Energija ionizacije



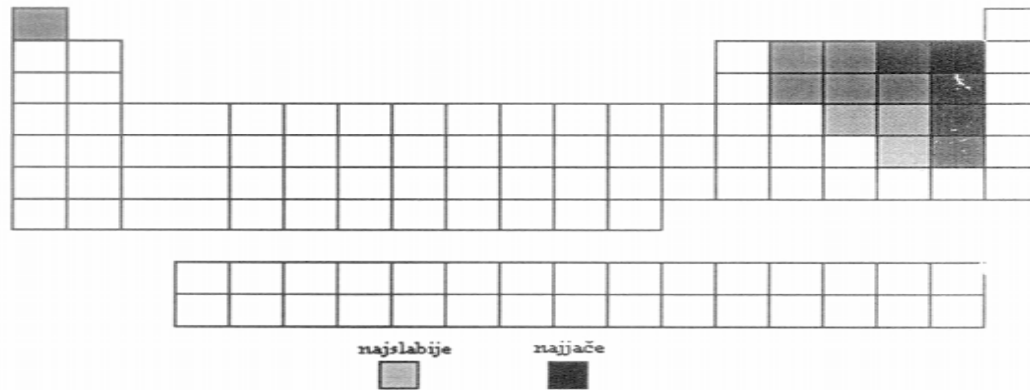
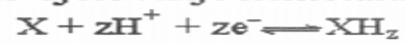
Elektronegativnost



Redukcijsko djelovanje metala



Oksidacijsko djelovanje nemetala i polumetala



VODIK

- $1s^1$ $T_t = 14 \text{ K}$, $T_v = 20 \text{ K}$, $\rho = 0,07 \text{ g/ml}$
- $r_{\text{kov}} = 0,03 \text{ nm}$
- $E_i = 13,6 \text{ eV}$
- $\chi = 2,1$
 - $\text{H}_2 (\text{g}) \rightarrow 2\text{H}$ $\Delta_r H = 436 \text{ KJmol}^{-1}$

- IZOTOPI ${}_1^1\text{H}$, ${}_1^2\text{H}$, ${}_1^3\text{H}$
- H D T
- $t_{0.5} = 12$ god

- U VODI 10^{17} 2×10^{13} 1 atoma
- 5000 1

- DOB: D_2O ELEKTROLIZA VODE

- Iz $1\text{m}^3 \text{H}_2\text{O} \rightarrow 40 \text{cm}^3 \text{D}_2\text{O}$

- **REAKTIVNOST ATOMNOG VODIKA**



- 9% kod 3000 K $t_{0.5} \sim 0,3 \text{ sec}$

- $2\text{H} \rightarrow \text{H}_2$ *KATALIZIRA* Pt, Pd, W, Fe, Cr, Ag i dr.

- $2\text{H} + \text{Cl}_2 \rightarrow 2\text{HCl}$

- $2\text{H} + \text{S} \rightarrow \text{H}_2\text{S}$

- $2\text{H} + \text{CO}_2 \rightarrow \text{HCOOH}$

REAKTIVNOST VODIKA

- $\text{H}_2 + \text{Cl}_2 \rightarrow 2 \text{HCl}$
 - 400°
- $\text{Ca} + \text{H}_2 \rightarrow \text{CaH}_2$
 - 500°
- $\text{N}_2 + 3 \text{H}_2 \rightarrow 2\text{NH}_3$
 - *kat.*

DOBIVANJE VODIKA

- REDUKCIJA SPOJEVA

I



- $E = E^0 + 0,059 \text{ V} \log (\text{H}^+/\text{mol dm}^{-3})$

- $E = - 0,059 \text{ V} \cdot \text{pH}$



- $\text{Na}^+ + \text{e}^- \leftrightarrow \text{Na}$ $E^0 = - 2,7 \text{ V}$
- $\frac{1}{2} \text{Zn}^{2+} + \text{e}^- \leftrightarrow \frac{1}{2} \text{Zn}$ $E^0 = - 0,76 \text{ V}$
- $\frac{1}{2} \text{Zn} (\text{OH})_4^{2-} + \text{e}^- \leftrightarrow \frac{1}{2} \text{Zn} + 2 \text{OH}^-$ $E^0 = - 1,2 \text{ V}$

H₂O:



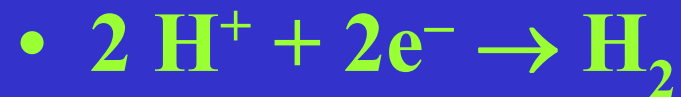
• **H⁺:**



• **OH⁻:**



ELEKTROLIZA



- DRUGI REDUCENSI



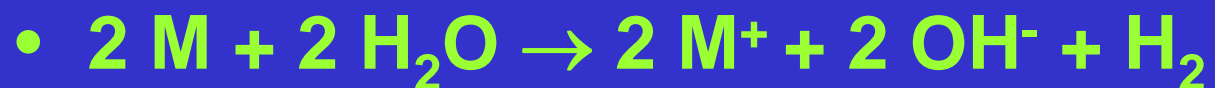
PREGLED REAKCIJA

- 17. $\text{H}_2 + \text{X}_2 \rightarrow 2\text{HX}$ $\text{X} = \text{F, Cl, Br, I}$
- 16. $2 \text{H}_2 + \text{O}_2 \rightarrow 2 \text{H}_2\text{O}$ S
- 15. $3 \text{H}_2 + \text{N}_2 \rightarrow 2 \text{NH}_3$ **katalizator p, t**
- 1,2. $2 \text{M} + x \text{H}_2 \rightarrow 2 \text{MH}_x$ $x = 1, 2$
- **Be, Mg ne reagiraju**
- $y \text{H}_2 + \text{M}_x\text{O}_y \rightarrow x \text{M} + y \text{H}_2\text{O}$

1 SKUPINA

ns^1

| | Li | Na | K | Rb | Cs | Fr |
|-------------------|------|------|------|------|------|----|
| • E_I/eV | 5.4 | 5.1 | 4.3 | 4.2 | 3.9 | |
| • χ | 1.0 | 0.9 | 0.8 | 0.8 | 0.7 | |
| • $E^0_{M+/M}/V$ | -3.2 | -2.7 | -2.9 | -2.9 | -2.9 | |



ELEMENTARNE TVARI

- **Li** silikatne i fosfatne rude
- **DOB.:** elektroliza taline LiCl
- ${}^6_3\text{Li} + n \rightarrow {}^4_2\text{He} + {}^3_1\text{H}$
- **Na**
- Alumosilikati
- NaCl kamena sol
- morska sol
- $\text{NaNO}_3, \text{Na}_3\text{AlF}_6$
- **Dob:** elektroliza taline NaOH $t_t = 320\text{ }^\circ\text{C}$
- NaCl $t_t = 800\text{ }^\circ\text{C}$
- **K:** $\text{Na}^+ + e^- \rightarrow \text{Na}$
- **A:** $4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4e^-$

- ***K***
- **Glinenci**
- **KCl silvin**
- **Dob:** **elektroliza taline KOH**
- **Rb,Cs** **uz kalijeve spojeve**
- **Dob:** **redukcija hidroksida s Al**

Pregled reakcija

- $M + \frac{1}{2} X_2 \rightarrow MX$
- $2 M + \frac{1}{2} O_2 \rightarrow M_2O$
- $2 M + O_2 \rightarrow M_2O_2$
- $M + O_2 \rightarrow MO_2$
- $2 M + S \rightarrow M_2S$
- $3 M + \frac{1}{2} N_2 \rightarrow M_3N$
- $3 M + P \rightarrow M_3P$
- $M + H_2O \rightarrow MOH + \frac{1}{2} H_2$
- $M + ROH \rightarrow MOR + \frac{1}{2} H_2$
- $M + NH_3 \rightarrow MNH_2 + \frac{1}{2} H_2$
katalizira Fe
- $M + H^+ \rightarrow M^+ + \frac{1}{2} H_2$

Li

Na, K, Rb, Cs

K, Rb, Cs

i za Se i Te

samo Li

i s As, Sb

burno

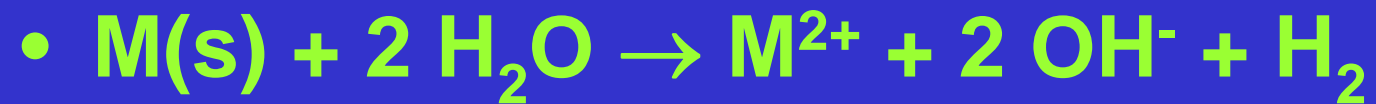
snažno

2. SKUPINA

ns^2

- | | Be | Mg | Ca | Sr | Ba | Ra |
|-------------------------|-------|-------|-------|-------|------|-------|
| • $E_i(I+II)/\text{eV}$ | 27.5 | 22.6 | 18 | 16.7 | 15.2 | 15.4 |
| • χ | 1.5 | 1.2 | 1.0 | 1.0 | 0.9 | 0.9 |
| • $E^0_{M^{2+}/M}/V$ | -1.85 | -2.37 | -2.87 | -2.89 | -2.9 | -2.92 |

- $-\Delta_{\text{h}}H = k \cdot z^2 / r$ energija hidratacije



- Elementarne tvari

- **Be** $3 \text{ BeO} \cdot \text{Al}_2\text{O}_3 \cdot 6 \text{ SiO}_2$ beril
- (smaragd, akvamarin)

- **Dob:** elektroliza taline BeF_2



- **Mg**

- $\text{CaCO}_3 \cdot \text{MgCO}_3$ dolomit
- MgCO_3 magnezit
- $\text{MgCl}_2 \cdot \text{KCl} \cdot 6 \text{ H}_2\text{O}$ karnalit
- Do 0.3% MgCl_2 u morskoj vodi

- **Ca**
- **CaCO₃** **vapnenac**
- **CaSO₄ · 2 H₂O** **sadra**
- **Fluorit, fosforit, silikati**
- **Dob: elektroliza taline CaF₂, CaCl₂**
- **Sr**
- **SrSO₄** **celestin**
- **SrCO₃** **stroncijanit**
- **Dob: elektroliza taline SrCl₂**

• PREGLED REAKCIJA

- $M + X_2 \rightarrow MX_2$ $X_2 = \text{halogen}$
- $M + \frac{1}{2} O_2 \rightarrow MO$
- $M + O_2 \rightarrow MO_2$ Ba, Sr uz tlak
- $M + S \rightarrow MS$ i za Se i Te
- $3 M + N_2 \rightarrow M_3N_2$ grijanjem
- $M + H_2 \rightarrow MH_2$ Ca, Sr, Ba, Ra, grijati
- $M + 2 H^+ \rightarrow M^{2+} + H_2$ osim Be
- $M + 2H_2O \rightarrow M(OH)_2 + H_2$ grijati, Be i Mg ne
- $M + OH^- + H_2O \rightarrow HMO_2^- + H_2$ samo Be
- $M + 2 H^+ \rightarrow M^{2+} + H_2$ spora za Ca, Sr, Ba- netopljivi sulfat
- $3 M + 8 H^+ + 2 NO_3^- \rightarrow 3 M^{2+} + 2 NO + 4 H_2O$ osim Be(Mg)



Vrsta problema i pitanja