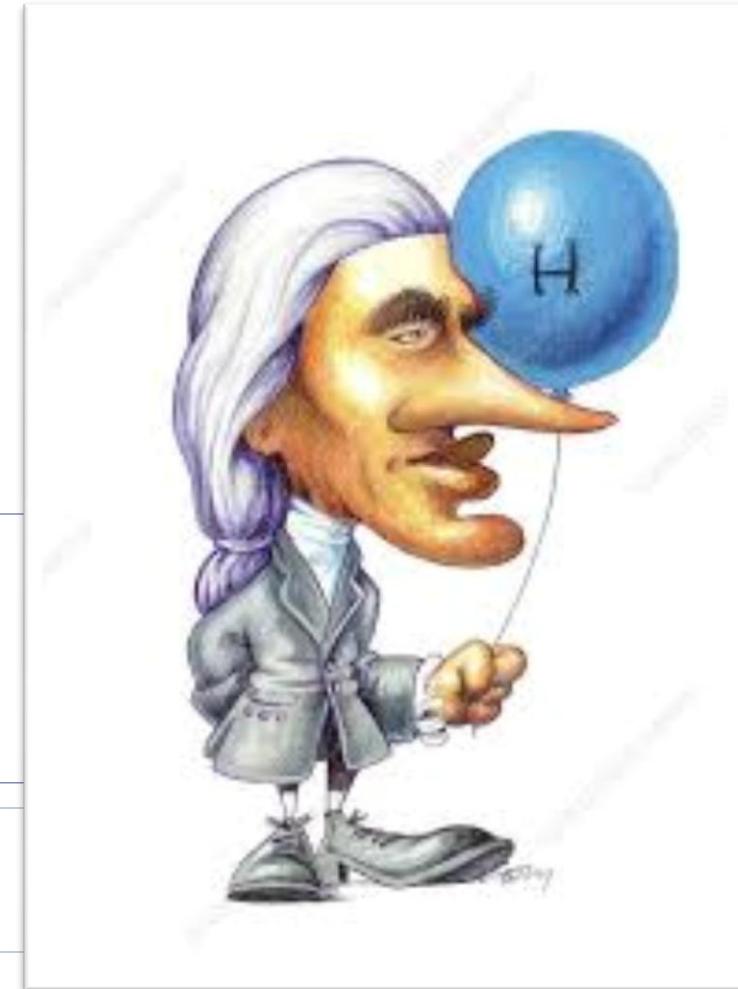


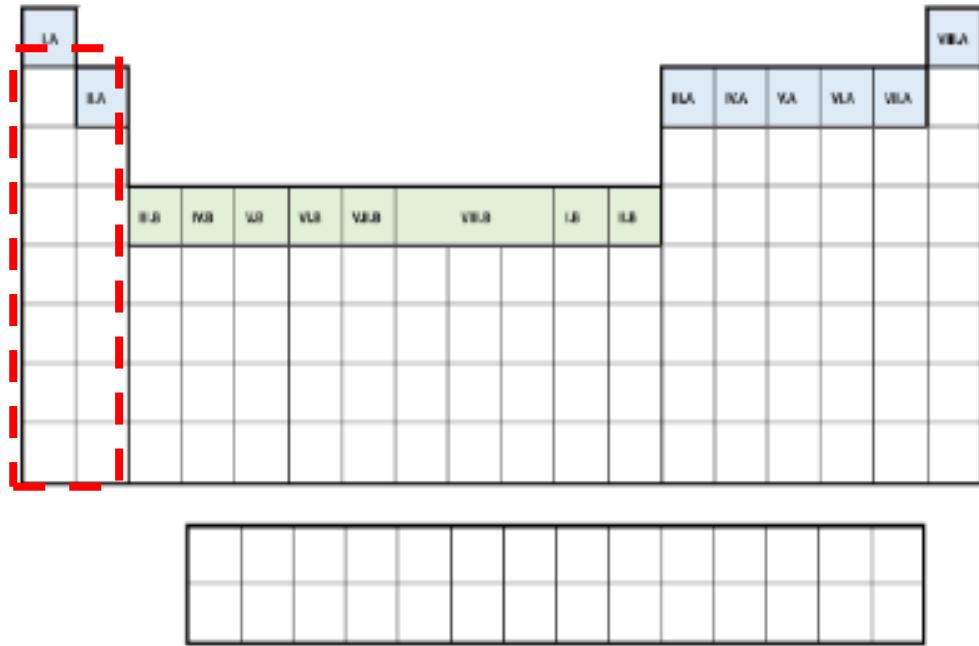
# Vodík

Mgr. Lucia Brezniaková  
GVPT, Martin



# s- prvky

- ▶ Prvky s valenčnými elektrónmi na orbitáli s
- ▶ Prvky I.A a II.A skupiny PSP a He ( He a H výnimočné postavenie)



Zdroj: Mgr. Brezniaková

ns I-2

# Vodík ( Hydrogenium)



**P E R I O D A**

|  |  | PERIODICKÁ SÚSTAVA CHEMICKÝCH PRVKOV   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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|  |  | www.publicom.sk  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | <b>s-prvky: ns<sup>1-2</sup></b>   |  | <b>d-prvky: (n-1)d<sup>1-10</sup>+ ns<sup>2</sup></b>  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | <b>p-prvky: ns<sup>1-2</sup>+ np<sup>1-4</sup></b>                                   |  |
|  |  | <b>IA</b><br><b>1 H VODÍK Hydrogenium</b><br><b>2 Li LÍTIUM Lithium</b><br><b>3 Na SODÍK Natrium</b><br><b>4 Mg HORÉDIK Magnesium</b>  |  | <b>79 Au ZLATO Aurum</b><br><b>značka prvku</b><br><b>relatívna atómová hmotnosť prvku</b><br><b>elektronegativita prvku podľa Paulinga</b><br><b>protónové číslo prvku</b><br><b>latinský názov prvku</b><br><b>elektrónová konfigurácia prvku</b><br><b>[Xe]6s 4f<sup>1-5d</sup></b><br><b>elektrónová konfigurácia: 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup> 3s<sup>2</sup> 3p<sup>6</sup> 3d<sup>10</sup> 4p<sup>6</sup> 5s<sup>2</sup> 4d<sup>10</sup> 5p<sup>6</sup> 6s<sup>2</sup> 4f<sup>14</sup> 5d<sup>10</sup> 6p<sup>6</sup> 7s<sup>2</sup> 5f<sup>14</sup> 6d<sup>10</sup></b>  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | <b>VIII.A</b><br><b>2 He HÉLIUM Helium</b><br><b>10 Ne NEÓN Neon</b>                 |  |
|  |  | <b>5 B BÓR Boron</b><br><b>6 C UHLÍK Carbonium</b><br><b>7 DUSÍK Nitrogenium</b><br><b>8 KYSLÍK Oxygenium</b><br><b>9 FLUÓR Fluorium</b>   |  | <b>10 Al ALÍNÍK Aluminum</b><br><b>14 KREMÍK Silicon</b><br><b>15 FOSFOR Phosphorus</b><br><b>16 SÍRA Sulphur</b><br><b>17 CHLÓR Chlorum</b><br><b>18 AR ARGÓN Argon</b>   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | <b>13 Kr KRYPTÓN Krypton</b><br><b>35 Br BRÓM Bromum</b><br><b>36 Xe XENON Xenon</b> |  |
|  |  | <b>19 K DRASLIK Kalium</b><br><b>20 Ca VÁPNIK Calcium</b><br><b>21 Sc SKANDIUM Scandium</b><br><b>22 Ti TITÁN Titanium</b><br><b>23 V VANÁD Vanadium</b><br><b>24 Cr CHROM Chromium</b><br><b>25 Mn MANGÁN Manganese</b><br><b>26 Fe ŽELEZO Ferrum</b><br><b>27 Co KOBALT Cobaltum</b><br><b>28 Ni NIKEL Nickelum</b><br><b>29 Cu MED Cuprum</b><br><b>30 Zn ZINOK Zincum</b>  |  | <b>31 Ga GÁLUM Gallium</b><br><b>32 Ge GERMANIUM Germanium</b><br><b>33 As ARZÉN Arsenicum</b><br><b>34 Se SELÉN Selenium</b><br><b>35 BróM Brómum</b><br><b>36 Kr Kryptón Krypton</b>   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | <b>37 Rb RUBIDIUM Rubidium</b><br><b>38 Sr STRONCIUM Strontium</b><br><b>39 Y VTRIUM Yttrium</b><br><b>40 Zr ZIRKÓNium Zirkonium</b><br><b>41 Nb NIÓB Niobium</b><br><b>42 Mo MOLYBDÉN Molybdenum</b><br><b>43 Tc TECHNECIUM Technetium</b><br><b>44 Ru RUTÉNIUM Ruthenium</b><br><b>45 Rh RÓDIUM Rhodium</b><br><b>46 Pd PALÁDIIUM Palladium</b><br><b>47 Ag STRIEBRO Argentum</b><br><b>48 Cd KADMÍUM Cadmium</b>  |  | <b>49 In INDIUM Indium</b><br><b>50 Sn CÍN Stannum</b><br><b>51 Sb ANTIMON Antimon</b><br><b>52 Te TELLÚRIUM Tellurium</b><br><b>53 I JÓD Jodium</b><br><b>54 Xe XENON Xenon</b>   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | <b>55 Cs CÉZIUM Caesium</b><br><b>56 Ba BÁRIUM Barium</b><br><b>57 La LANTÁN Lanthanum</b><br><b>58 Hf HAFNÍUM Hafnium</b><br><b>59 Ta TANTAL Tantalum</b><br><b>70 W VOLFRÁM Wolfrámium</b><br><b>71 Re RÉNIUM Renium</b><br><b>72 Os OSMIUM Osmium</b><br><b>73 Ir IRÓDIUM Iridium</b><br><b>74 Pt PLATINA Platinum</b><br><b>75 Au ORTU Hydrogenium</b><br><b>76 Hg OLOVO Plumbum</b><br><b>77 Tl TÁLIUM Thallium</b><br><b>78 Pb BIZMUT Bismuthum</b><br><b>79 Po POLÓNium Polonium</b><br><b>80 At ASTAT Astrium</b>  |  | <b>81 Uúu Uúub</b><br><b>82 Uúq UNINQUADIUM</b><br><b>83 Uúuh UNINHEXUM</b><br><b>84 Uuh UNINHEXUM</b><br><b>85 At ASTAT Astrium</b><br><b>86 Rn RADÓN Radon</b><br><b>87 Uuo UNINOCTIUM</b>   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  | <b>88 Ra RÁDIUM Radium</b><br><b>89 Ac AKTÍNIUM Actinium</b><br><b>90 Th TÓRIUM Thorium</b><br><b>91 Pa PROTATÓRNIUM Protactinium</b><br><b>92 U URÁN Uranium</b><br><b>93 Neotonium Neotonium</b><br><b>94 Pu PROTÓTONIUM Prototonium</b><br><b>95 Am AMERICIUM Americium</b><br><b>96 Cm CURMIUM Curium</b><br><b>97 Bk BERKELÉJUM Berkelium</b><br><b>98 Cf KALIFÓRNIUM California</b><br><b>99 Es EINSTEINIUM Einsteinium</b><br><b>100 Fm FERMÍUM Fermium</b><br><b>101 Md NOBELIUM Nobelium</b><br><b>102 No NOBELIUM Nobelium</b><br><b>103 Lr LAWRENCIUM Lawrenceium</b> |  | <b>104 Rf RUTHERFORDIUM Rutherfordium</b><br><b>105 Db DUBNIUM Dubnium</b><br><b>106 Sg SEABORGIUM Seaborgium</b><br><b>107 Bh BOHRIUM Bohrium</b><br><b>108 Hs HASSIUM Hassium</b><br><b>109 Mt MEITNERIUM Meitnerium</b><br><b>110 Uun UNUNIUM Ununiunium</b><br><b>111 Uuu UNUNIUM Ununiunium</b><br><b>112 Uub UNUNIUM Ununiunium</b><br><b>113 Uuh UNINHEXUM Uninhexum</b><br><b>114 Uq UNINQUADIUM Uninquadium</b><br><b>115 Uuh 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# Výskyt

- ▶ Najrozšírenejší prvek vo vesmíre (91%) a tretí na Zemi (Si, O)

## Volný

- Plynný obal hviezd,  
sopky



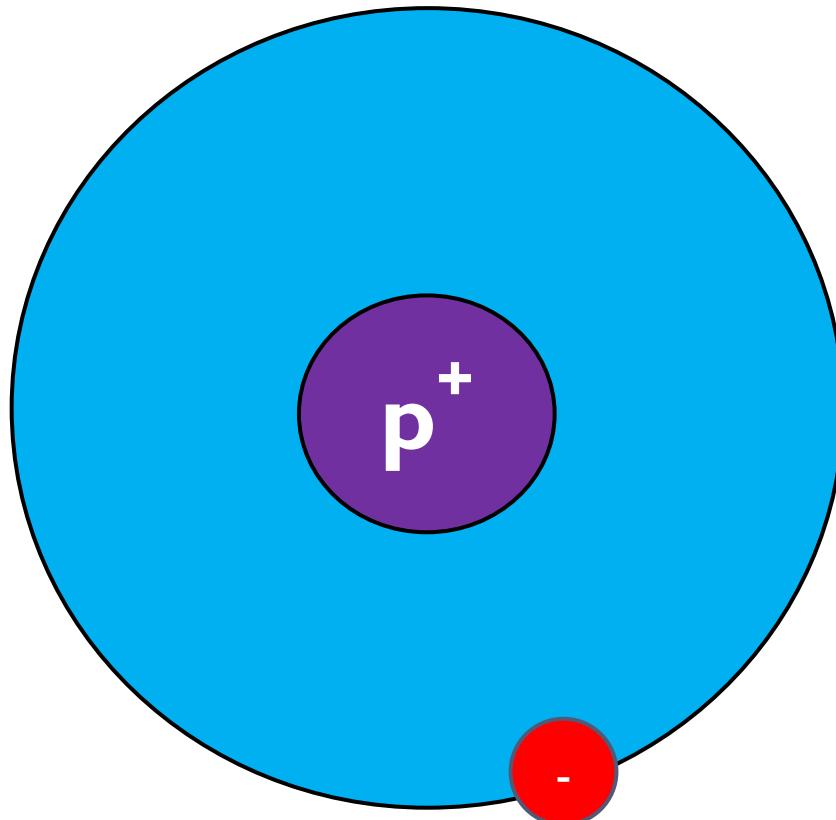
## Viazaný

- V zlúčeninách (najmä voda...)



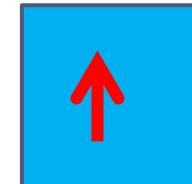
# Elektrónová konfigurácia

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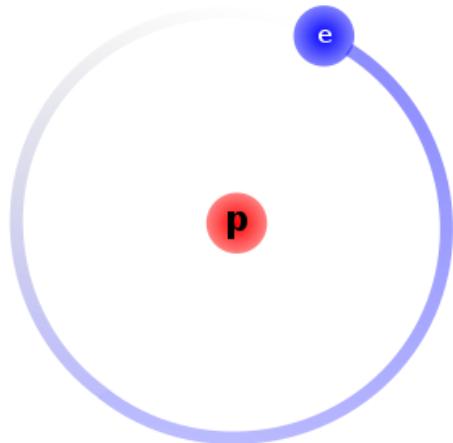


H: 1s<sup>1</sup>

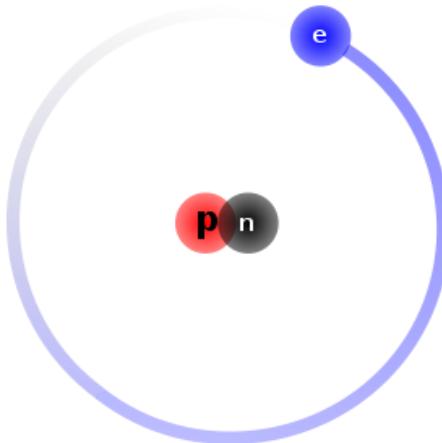
H: 1s



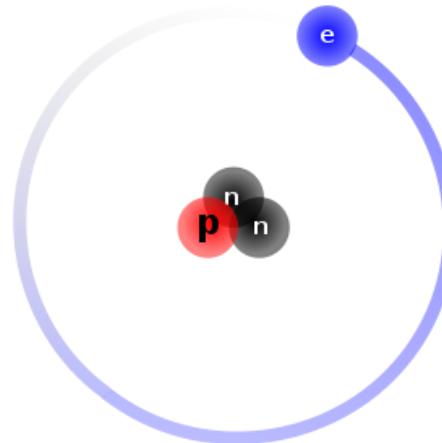
# Izotopy vodíka



Protium



Deuterium



Tritium



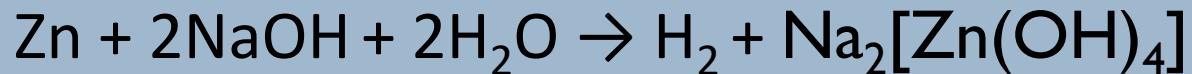
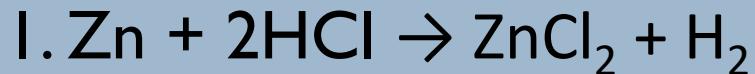
# Prírodné formy vodíka

| prótium  | deutérium   | trítium  |
|--|---|--|
| ${}_1^1\text{H}$                                     | ${}_1^2\text{H}$  | ${}_1^3\text{H}$   |
| <b>99,9% vodíka na Zemi</b> ( voda, organické látky) | V morskej vode,<br>Pri jadrových fúziách,<br>spektroskopii<br>tvorí <b>ťažkú vodu</b> (moderátor a chladič reaktorov) | <b>Rádioaktívny</b><br>vznik pri kozmickej činnosti, jadrových výbuchoch<br>s kyslíkom tvorí <b>supertiažkú vodu</b> |

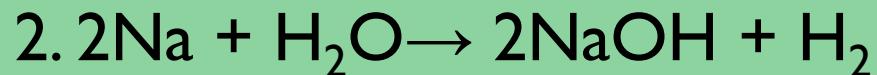
Umelo vytvorený najstabilnejší izotop č. 5, najmenej stabilný izotop č. 7



# Príprava



- Reakciou neušľachtilého kovu s vodnými roztokmi kyselín/hydroxidov



- Reakciou kovu (I. a II.A skupina) s vodou

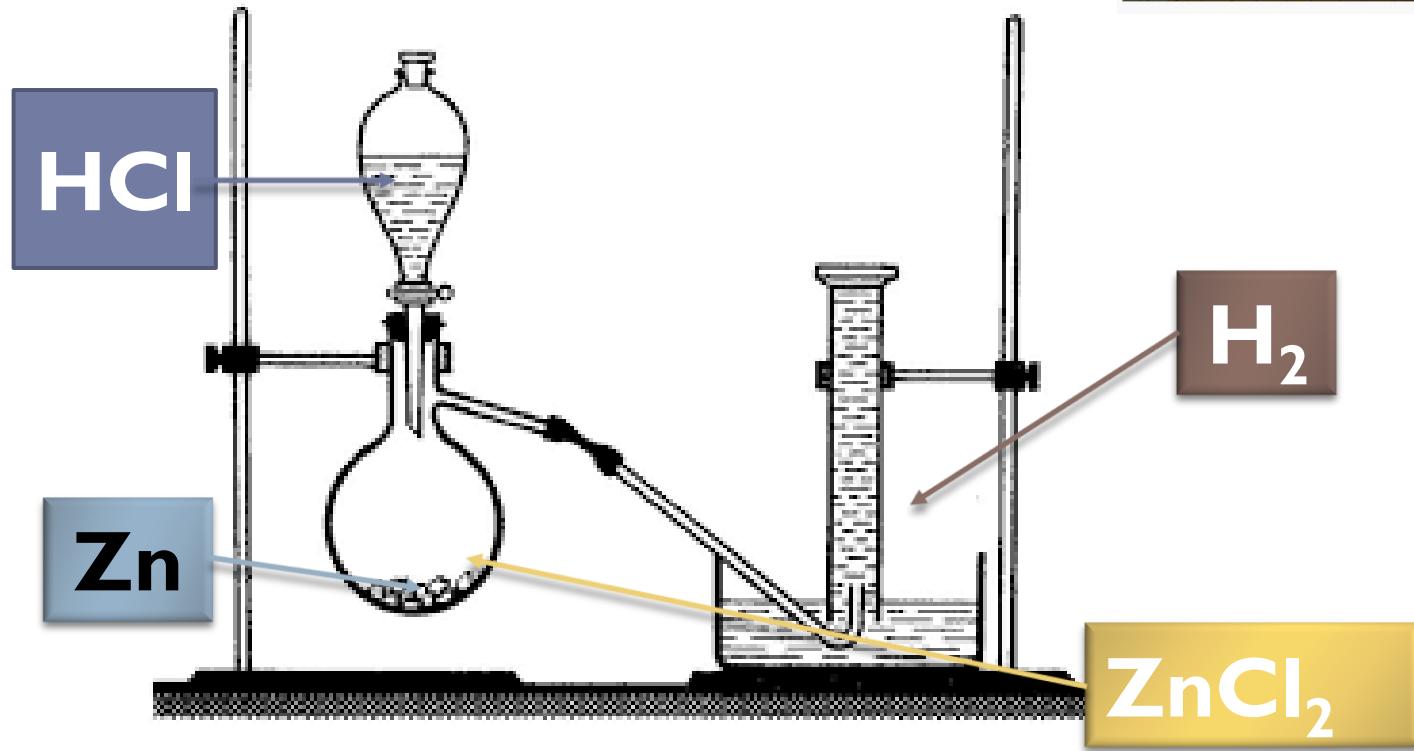
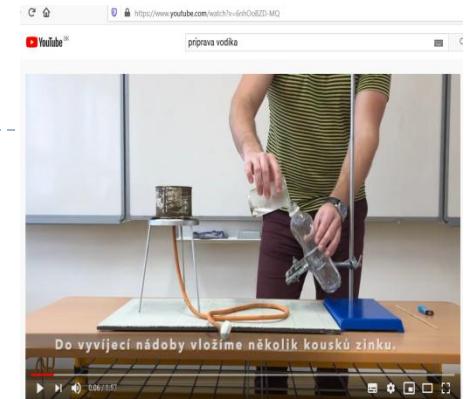


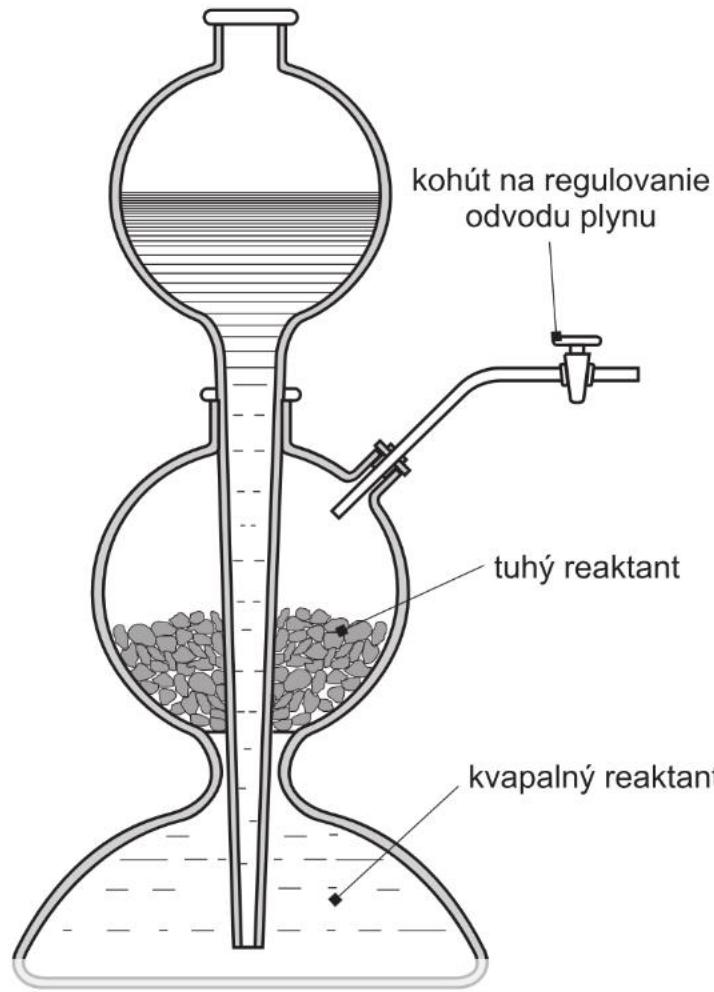
- Elektrolýzou vody



# Pokus č. 1

## Príprava a dôkaz vodíka

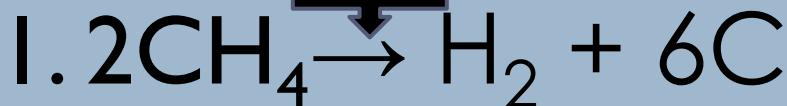




## Kippov prístroj

- ▶ Prístroj na prípravu vodíka v laboratóriu
- ▶ **Výhody-** možnosť plynulej prípravy vodíka, prerušenia, ľahká obsluha

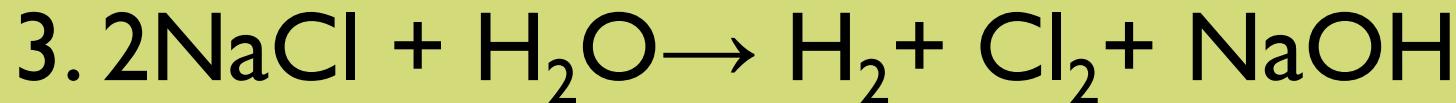
# Výroba



- Termickým rozkladom nasýtených uhľovodíkov (napr. metánu)



- Reakciou vodnej pary a žeravým koksom



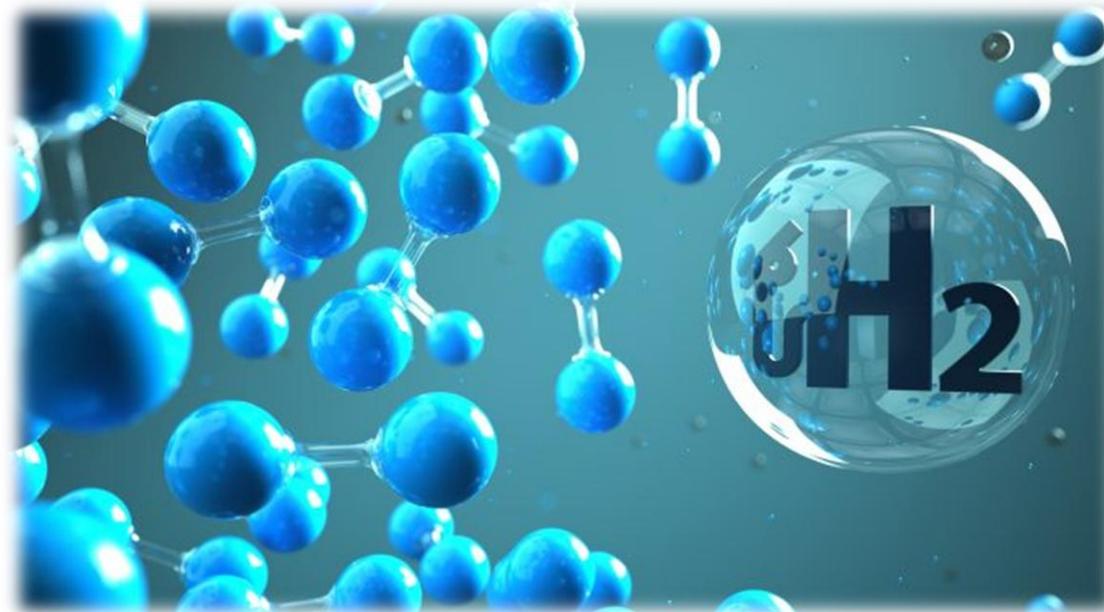
- Elektrolýzou vodného roztoku NaCl



# Vlastnosti

## A. fyzikálne

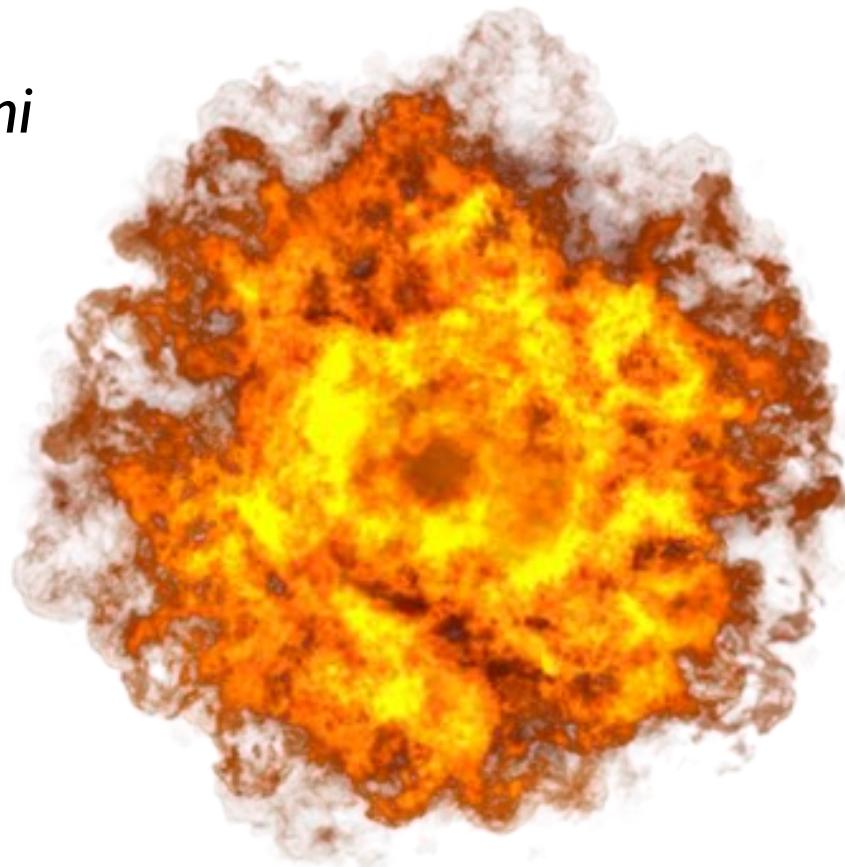
- ▶ bezfarebný, bez zápachu, väčšinou **plynný**
- ▶ **najľahší prvak** (*14,5x ľahší ako vzduch*)
- ▶ **najmenšia Ar a atómový polomer**, nízke TT a TV
- ▶ **ľahko pohlcovaný** niektorými **kovmi** (*Pt, Pd, Mn, Ni*) a zliatinami



# Vlastnosti

## B. chemické

- ▶ **nekov**
- ▶ **reaktivita-** (jednoatómový veľmi reaktívny, molekulový menej za pomoci teploty, katalyzátorov)
- ▶ **s kyslíkom tvorí výbušnú zmes** ( traskavý plyn)
- ▶ málo rozpustný vo vode
- ▶ **redukčné vlastnosti** ( molekulový slabé, jednoatómový silné)



# Tvorba stabilnej štruktúry

I.

- Tvorbou **polárnej** (HCl) alebo **nepolárnej** kovalentnej väzby (H2)
- ak atóm viazaný polárne na elektronegatívny prvok (F, O, N)- možnosť **vodíkovej väzby**

2.

- Prijatím elektrónu od atómov s malou elektronegativitou, vzniká **hydridový anión H⁻** (NaH, BaH2)

3.

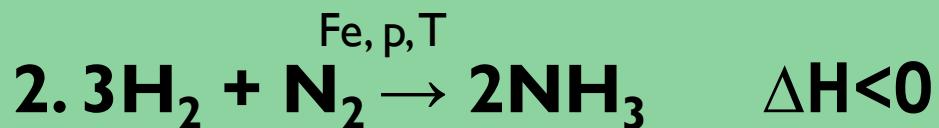
- Odovzdaním elektrónu, vznik **protónu vodíka H<sup>+</sup>** a naviazaním sa na molekulu s volným elektrónovým párom (H3O+, NH4+)



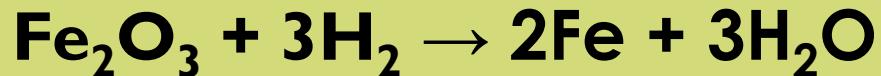
# Reakcie vodíka



- s kyslíkom ( tvorba výbušnej zmesi- traskavý plyn)



- s dusíkom, výroba  $\text{NH}_3$  a  $\text{HNO}_3$

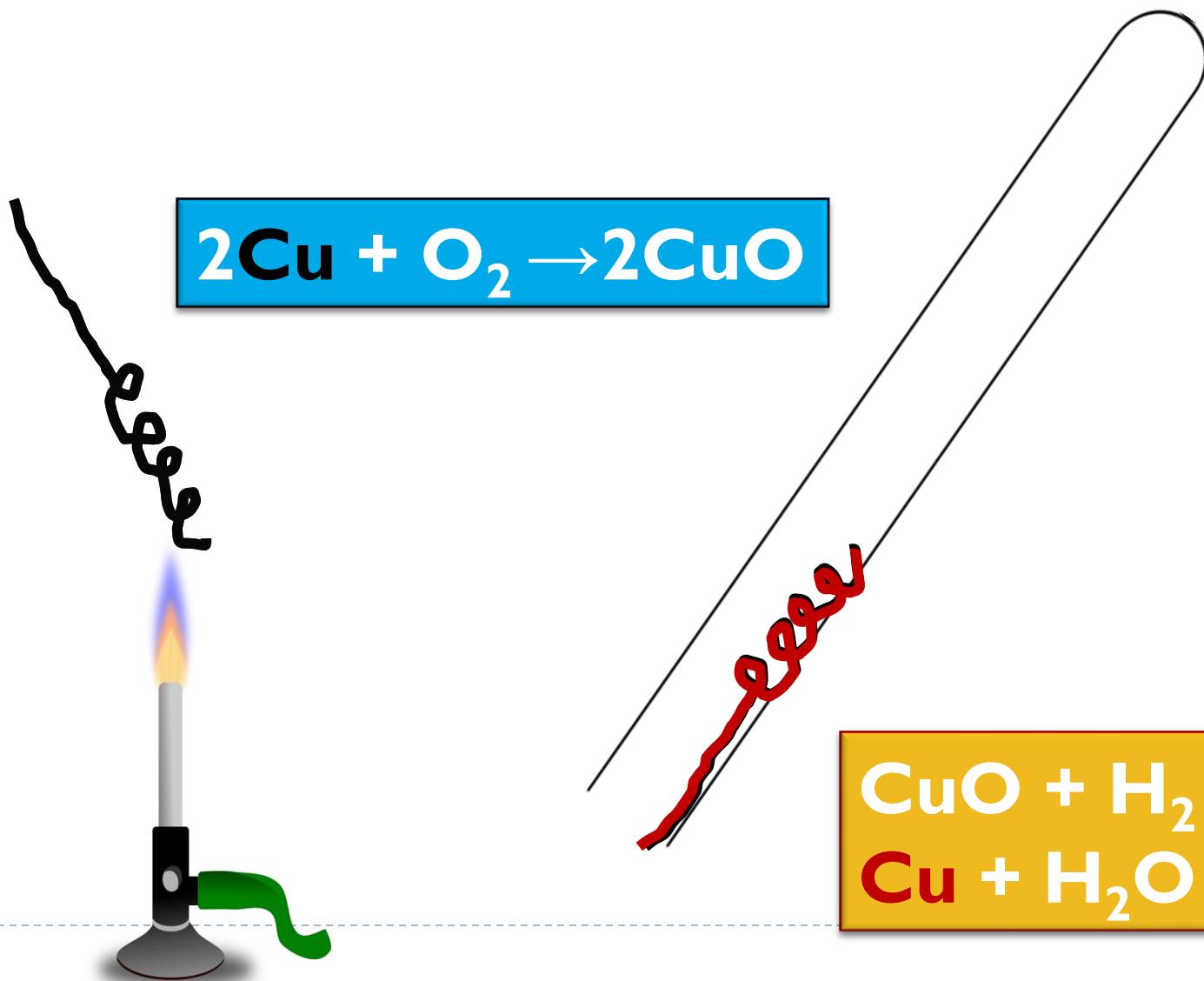


- Redukčné vlastnosti vodíka



## Pokus č. 2:

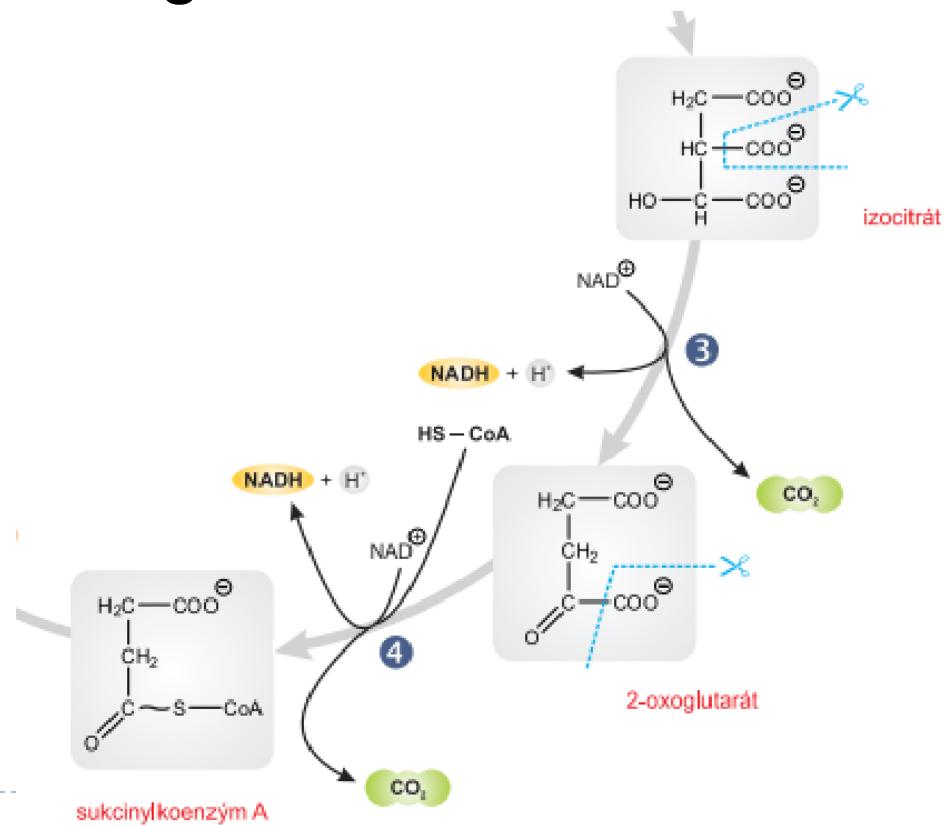
### Reakcia vodíka s oxidom med'natým



# Využitie

## I. makrobiogénny prvok

- ▶ základný stavebný prvok látok v tele
- ▶ získavanie energie v živých organizmoch- *bunkové dýchanie, tvorba tepla*



# Využitie

## 2. chemický priemysel

- ▶ redukčné činidlo
- ▶ výroba ( *amoniak, chlorovodík, syntetický benzín, metanol*)



# Využitie

## 3. Zváranie a rezanie kovov

- ▶ *spolu s kyslíkom*
- ▶  $3000^{\circ}\text{C}$  plameň



# Využitie

## 4. Palivo

- ▶ ekologické palivo v autách
- ▶ pohonná zmes do raket



# Využitie

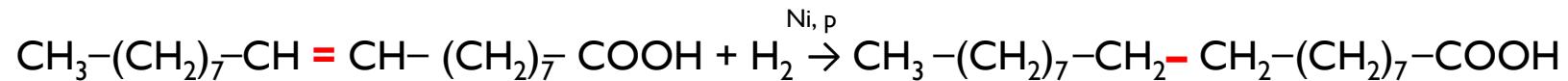
## 5. Vodíkové bomby



# Využitie

## 6. Potravinárstvo

- ▶ **stužovanie tukov** – katalytická hydrogenácia pod tlakom, adícia nenasýtených mastných kyselín na nasýtené, zmena skupenstva tukov, odolnejšie voči žltnutiu, menší zápach



# Využitie

## 7. Farmaceutický priemysel

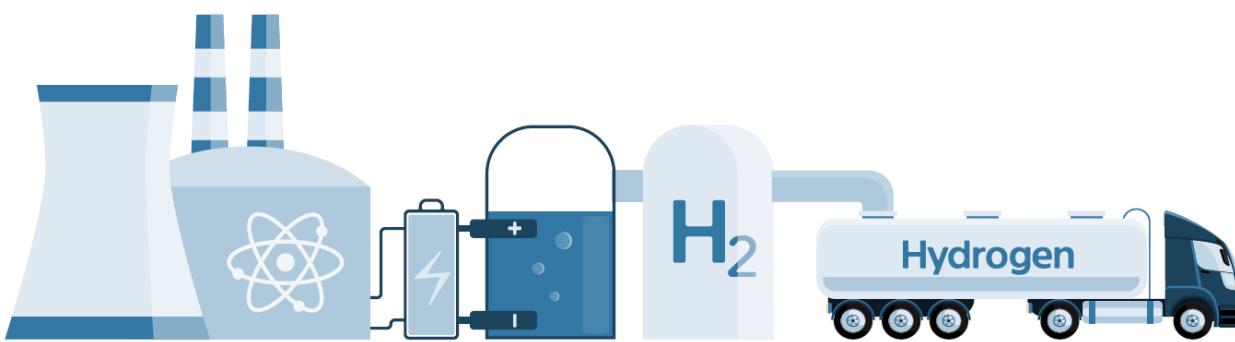
- ▶ Výroba liekov



Optimalizuje imunitný systém a chráni pred vírusovými infekciami a chorobami, podporuje zdravé funkcie orgánov. Zlepšuje regeneráciu a zotavenie sa po športe. Bojuje proti ochoreniam súvisiacim s vekom a zvyšuje úroveň vášho zdravia. Má antioxidačný efekt.

# Preprava

- ▶ v ocelových nádobách s červeným pruhom



# Zdroje

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- ▶ <https://www.pbgas.sk/produkt/vodik/>
  - ▶ <http://www.vitalfit.sk/Molekularny-vodik-H2-Forte-d226.htm>
  - ▶ <https://www.nuclear.sk/bude-vodik-palivom-buducnosti/>
  - ▶ [https://sk.wikipedia.org/wiki/Raketov%C3%BD\\_motor\\_na\\_tuh%C3%A9\\_pohonn%C3%A9\\_l%C3%A1tky](https://sk.wikipedia.org/wiki/Raketov%C3%BD_motor_na_tuh%C3%A9_pohonn%C3%A9_l%C3%A1tky)
  - ▶ <https://www.techbox.sk/vodikove-auta-mozu-byt-do-roku-2025-za-cenu-benzinovych-tvrdi-bmw>
  - ▶ <https://www.profigaraz.sk/profi-poradna/sprievodca-zvaracimi-metodami/>
  - ▶ [https://en.wikipedia.org/wiki/Haber\\_process](https://en.wikipedia.org/wiki/Haber_process)
  - ▶ [https://sk.wikipedia.org/wiki/Hans\\_Adolf\\_Krebs](https://sk.wikipedia.org/wiki/Hans_Adolf_Krebs)
  - ▶ <http://z-moravec.net/chemie/periodicka-soustava-prvku/vodik/>
  - ▶ <https://beliana.sav.sk/media/1092>
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- ▶ Kmeťová, J. et al.: Chémia pre 2. ročník gymnázia so štvorročným štúdiom a 6.ročník gymnázia s osemročným štúdiom. Bratislava : Expolpedagogika, 2012. 11 s. ISBN 978-80-8091-271-0.
  - ▶ Kmeťová, J. et al.: Chémia pre 3. ročník gymnázia so štvorročným štúdiom a 7.ročník gymnázia s osemročným štúdiom. Martin: Vydavateľstvo Matice Slovenskej, 2011. 98 s. ISBN 978-80-8115-042-5.
  - ▶ <https://vosveteit.sk/dokaze-zem-prezit-meniace-sa-slnko-co-sa-s-nami-stane-na-konci-zivota-nasej-hviezdy/>
  - ▶ <https://www.history.com/news/the-hindenburg-disaster-9-surprising-facts>
  - ▶ <https://zpravy.aktualne.cz/ekonomika/auto/vodikove-auto-za-cenu-hybridu-podle-japonske-toyoty-dodeset/r~1cc25c5a974711e9b16b0cc47ab5f122>
  - ▶ PSP, Publicom s.r.o, datakabinet
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