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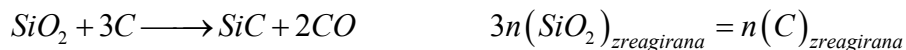
### 3. Vaja: Kemijska reakcija

#### a) Naloga:

Pripravi železov(II) sulfat(VI) heptahidrat ( $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ ) iz železa!

#### b) Računske naloge:

1. 60,7g silicijevega dioksida in 15,8g ogljika reagira po spodnji reakciji. Koliko silicijevega karbida pri tem nastane? Kateri in koliko reaktanta ostane nezreagirane?



$$\begin{aligned} m(\text{SiO}_2) &= 60,7\text{g} & M(\text{SiO}_2) &= 60,1\text{g/mol} \\ m(\text{C}) &= 15,8\text{g} & M(\text{C}) &= 12,0\text{g/mol} \end{aligned}$$

$$n(\text{SiO}_2) = \frac{m(\text{SiO}_2)}{M(\text{SiO}_2)} = \frac{60,7\text{g}}{60,1\frac{\text{g}}{\text{mol}}} = 1,01\text{mol} \qquad n(\text{C}) = \frac{m(\text{C})}{M(\text{C})} = \frac{15,8\text{g}}{12,0\frac{\text{g}}{\text{mol}}} = 1,32\text{mol}$$

$$\frac{3n(\text{SiO}_2)}{n(\text{C})} = \frac{3 \cdot 1,01\text{mol}}{1,32\text{mol}} = 2,30 > 0 \Rightarrow \text{SiO}_2 \text{ je v prebitku}$$

$$n(\text{SiO}_2)_{\text{zreagirana}} = \frac{n(\text{C})_{\text{zreagirana}}}{3} = 0,44\text{mol}$$

$$n(\text{SiO}_2)_{\text{prebitna}} = n(\text{SiO}_2) - n(\text{SiO}_2)_{\text{zreagirana}} = 1,01\text{mol} - 0,44\text{mol} = 0,57\text{mol}$$

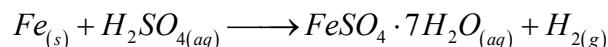
$$m(\text{SiO}_2)_{\text{prebitna}} = n(\text{SiO}_2)_{\text{prebitna}} \cdot M(\text{SiO}_2) = 0,57\text{mol} \cdot 60,1\frac{\text{g}}{\text{mol}} = 34,26\text{g}$$

$$n(\text{SiO}_2)_{\text{zreagirana}} = n(\text{SiC}) = 0,44\text{mol}$$

$$m(\text{SiC}) = n(\text{SiC}) \cdot M(\text{SiC}) = 0,44\text{mol} \cdot 40,1\frac{\text{g}}{\text{mol}} = 17,6\text{g}$$

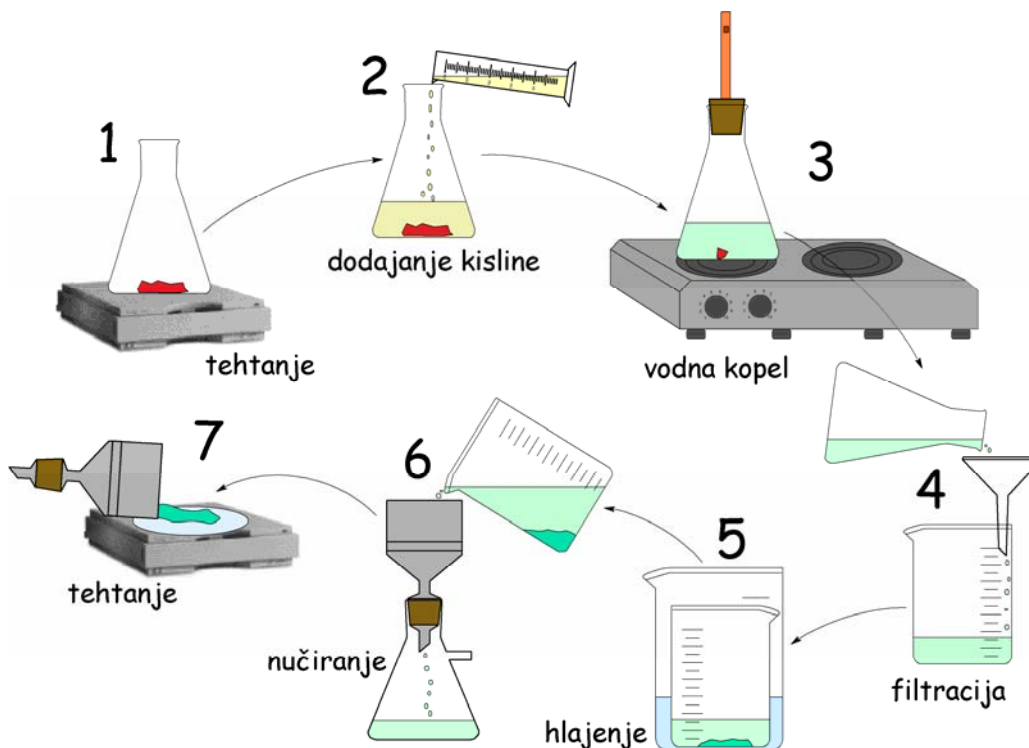
#### c) Izvedba vaje:

Najprej izračunamo, kolikšno prostornino 20% žveplove(VI) kisline ( $\text{H}_2\text{SO}_4$ ) z gostoto 1,139g/mL potrebujemo za raztapljanje (npr. 3,5g) železa.



V erlenmajerico zatehtamo zahtevano maso železa in v odduhi prilijemo izračunano prostornino 20% žveplove(VI) kisline z 10% prebitkom. Reakcija poteka že pri sobni temperaturi. Erlenmajerico opremimo z Bunsenovim ventilom in jo postavimo na

vodno kopel, dokler vse železo ne zreagira. Raztopino ohladimo in še mlačno prefiltriramo v čašo. Filtrat dobro ohladimo. Izločene kristale odfiltriramo s pomočjo Büchnerjevega lija in presesalne buče. Kristale speremo z malo matične lužine. Kristale nato še stehtamo in izračunamo teoretično maso  $\text{FeSO}_4 \cdot 10\text{H}_2\text{O}$  glede na izhodno maso železa. Razmerje med maso nastalih kristalov in teoretično maso je izkoristek kemijske reakcije.



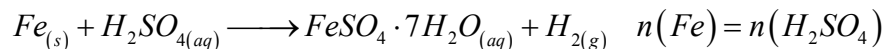
**d) Predračun:**

$$m(\text{Fe}) = 3,5\text{g}$$

$$w(\text{H}_2\text{SO}_4) = 0,20$$

$$M(\text{Fe}) = 55,58\text{g/mol}$$

$$\rho(\text{H}_2\text{SO}_4) = 1,139\text{g/mL}$$



$$m(\text{H}_2\text{SO}_4) = \frac{m(\text{Fe})M(\text{H}_2\text{SO}_4)}{M(\text{Fe})} = \frac{3,5\text{g} \cdot 98,1\frac{\text{g}}{\text{mol}}}{55,6\frac{\text{g}}{\text{mol}}} = 6,146\text{g}$$

$$m(\text{H}_2\text{SO}_4)^{20\%} = \frac{m(\text{H}_2\text{SO}_4)}{w(\text{H}_2\text{SO}_4)} = \frac{6,146\text{g}}{0,20} = 30,72\text{g}$$

$$V(\text{H}_2\text{SO}_4)^{20\%} = \frac{m(\text{H}_2\text{SO}_4)^{20\%}}{\rho(\text{H}_2\text{SO}_4)^{20\%}} = \frac{30,72\text{g}}{1,139\frac{\text{g}}{\text{mL}}} = 27,0\text{mL}$$

$$V(\text{H}_2\text{SO}_4)_{10\% \text{ prebitek}}^{20\%} = V(\text{H}_2\text{SO}_4)^{20\%} \cdot 1,1 = 27,0\text{mL} \cdot 1,1 = 29,7\text{mL}$$

e) Meritve pri vaji:

$$m(\text{FeSO}_4 \cdot 7\text{H}_2\text{O})_{\text{praktično}} = 5,74\text{g}$$

f) Izračun:

$$M(\text{FeSO}_4 \cdot 7\text{H}_2\text{O}) = 277,7\text{g/mol}$$

$$n(\text{Fe}) = n(\text{FeSO}_4 \cdot 7\text{H}_2\text{O}) = \frac{m(\text{Fe})}{M(\text{Fe})} = \frac{3,5\text{g}}{55,58\text{g/mol}} = 0,0627\text{mol}$$

$$m(\text{FeSO}_4 \cdot 7\text{H}_2\text{O})_{\text{teoretično}} = nM = 0,0627\text{mol} \cdot 277,7\text{g/mol} = 17,41\text{g}$$

$$\eta(\text{sintheze}) = \frac{m(\text{FeSO}_4 \cdot 7\text{H}_2\text{O})_{\text{praktično}}}{m(\text{FeSO}_4 \cdot 7\text{H}_2\text{O})_{\text{teoretično}}} 100\% = \frac{5,74\text{g}}{17,41\text{g}} 100\% = 33,0\%$$

g) Dodatne računske naloge:

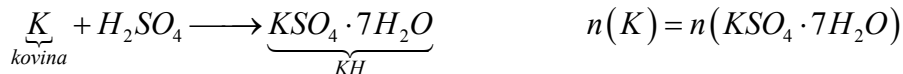
1. 30,1g II valentne kovine reagira z žveplovo(VI) kislino. Pri tem nastane 95,1g kovinskega(II) sulfata heptahidrata. Izkoristek reakcije je 72%. Izračunaj molsko maso kovine!

$$m(\text{kovine}) = 30,1\text{g}$$

$$\eta(\text{sintheze}) = 72\%$$

$$m(\text{KSO}_4 \cdot 7\text{H}_2\text{O})_{\text{praktično}} = 95,1\text{g}$$

$$M(\text{SO}_4 \cdot 7\text{H}_2\text{O}) = 222,0\text{g/mol}$$



$$m(\text{KSO}_4 \cdot 7\text{H}_2\text{O})_{\text{teoretično}} = \frac{m(\text{KSO}_4 \cdot 7\text{H}_2\text{O})_{\text{praktično}}}{\eta(\text{sintheze})} = \frac{95,1\text{g}}{0,72} = 132,08\text{g}$$

$$\frac{m(\text{K})}{M(\text{K})} = \frac{m(\text{KSO}_4 \cdot 7\text{H}_2\text{O})_{\text{teoretično}}}{M(\text{KSO}_4 \cdot 7\text{H}_2\text{O})} = \frac{m(\text{KSO}_4 \cdot 7\text{H}_2\text{O})_{\text{teoretično}}}{M(\text{K}) + M(\text{SO}_4 \cdot 7\text{H}_2\text{O})}$$

$$m(\text{K})(M(\text{K}) + M(\text{SO}_4 \cdot 7\text{H}_2\text{O})) = M(\text{K})m(\text{KSO}_4 \cdot 7\text{H}_2\text{O})$$

$$m(\text{K})M(\text{K}) + m(\text{K})M(\text{SO}_4 \cdot 7\text{H}_2\text{O}) = M(\text{K})m(\text{KSO}_4 \cdot 7\text{H}_2\text{O})$$

$$m(\text{K})M(\text{K}) - M(\text{K})m(\text{KSO}_4 \cdot 7\text{H}_2\text{O}) = -m(\text{K})M(\text{SO}_4 \cdot 7\text{H}_2\text{O})$$

$$M(\text{K})(m(\text{K}) - m(\text{KSO}_4 \cdot 7\text{H}_2\text{O})) = -m(\text{K})M(\text{SO}_4 \cdot 7\text{H}_2\text{O})$$

$$M(\text{K}) = \frac{-m(\text{K})M(\text{SO}_4 \cdot 7\text{H}_2\text{O})}{m(\text{K}) - m(\text{KSO}_4 \cdot 7\text{H}_2\text{O})} = \frac{-30,1\text{g} \cdot 222,0\text{g/mol}}{30,1\text{g} - 132,1\text{g}} = 65,5\text{g/mol}$$