
5. Vaja: Raztopine II

a) Naloga:

Pripravi raztopini npr. natrijevega hidroksida (NaOH) in žveplove(VI) kisline (H₂SO₄)!

b) Eksperimentalne računске naloge:

1. Pripravi 250g 10,4% raztopine NaOH iz 7,5% raztopine z gostoto 1,083g/mL in iz 20% raztopine z gostoto 1,219g/mL. Izmeri temperaturo in gostoto ter izračunaj molarost pripravljene raztopine!

$$\begin{array}{lll} m_{R3} = 250g & \rho_{R1} = 1,083g/mL & \rho_{R2} = 1,326g/mL \\ w_{R3} = 10,4\% & w_{R1} = 7,5\% & w_{R2} = 20,0\% \\ M_T = 40,0g/mol & & \end{array}$$

$$\boxed{m_{T3} = m_{T1} + m_{T2}}$$

$$m_{R3}w_{R3} = m_{R1}w_{R1} + m_{R2}w_{R2}$$

$$\boxed{m_{R1} = m_{R3} - m_{R2}}$$

$$m_{R3}w_{R3} = (m_{R3} - m_{R2})w_{R1} + m_{R2}w_{R2}$$

$$m_{R3}w_{R3} = m_{R3}w_{R1} - m_{R2}w_{R1} + m_{R2}w_{R2}$$

$$m_{R3}(w_{R3} - w_{R1}) = m_{R2}(w_{R2} - w_{R1})$$

$$m_{R2} = \frac{m_{R3}(w_{R3} - w_{R1})}{(w_{R2} - w_{R1})} = \frac{250,0g(0,104 - 0,075)}{0,20 - 0,075} = 58,0g$$

$$m_{R1} = m_{R3} - m_{R2} = 250,0g - 58,0g = 192,0g$$

$$V_{R1} = \frac{m_{R1}}{\rho_{R1}} = \frac{192,0g}{1,083 \frac{g}{mL}} = 177,3mL$$

$$V_{R2} = \frac{m_{R2}}{\rho_{R2}} = \frac{58,0g}{1,219 \frac{g}{mL}} = 47,6mL$$

2. Pripravi 250mL 0,425M raztopine H₂SO₄ iz 20,0% raztopine z gostoto 1,14g/mL. Izmeri temperaturo in gostoto ter izračunaj procentnost pripravljene raztopine!

$$\begin{array}{lll} V_{R1} = 250mL & \rho_{R2} = 1,14g/mL & M_T = 98,1g/mol \\ c_{R1} = 0,425g/mol & w_{R2} = 20,0\% & \end{array}$$

$$c_{R2} = \frac{n_{T2}}{V_{R2}} = \frac{m_{T2}\rho_{R2}}{M_T m_{R2}} = \frac{w_{R2}\rho_{R2}}{M_T} = \frac{0,20 \cdot 1,140 \frac{g}{L}}{98,1 \frac{g}{mol}} = 2,32 \frac{mol}{L}$$

$$\boxed{c_{R1}V_{R1} = c_{R2}V_{R2}} \Rightarrow V_{R2} = \frac{c_{R1}V_{R1}}{c_{R2}} = \frac{0,425 \frac{mol}{L} \cdot 0,25L}{2,32 \frac{mol}{L}} = 45,8mL$$

c) Izvedba vaje:

1. Z merilnim valjem odmerimo preračunani prostornini obeh raztopin v čašo. Bolj koncentrirano raztopino vlivamo v manj koncentrirano ali v vodo. Z delom dobljene raztopine izperemo valj za merjenje gostote (kiveto) in šele nato prelijemo vanjo ostali del raztopine. Izmerimo temperaturo raztopine in nato previdno spustimo v valj areometer. Pri odčitavanju naj areometer prosto plava!
2. V merilno bučko nalijemo nekaj vode ($\frac{1}{3}$ prostornine) in nato prilijemo preračunano prostornino raztopine. Če se pri tem raztopina segreje, jo ohladimo na sobno temperaturo in šele nato dolijemo destilirano vodo do oznake ter premešamo. Temperaturo in gostoto raztopini izmerimo enako, kot pri 1. nalogi.

d) Meritve pri vaji:

1. $T_R = 23^\circ\text{C}$
 $\rho_R^{23} = 1,110\text{g/mL}$
2. $T_R = 22^\circ\text{C}$
 $\rho_R^{22} = 1,030\text{g/mL}$

e) Izračun:

1.
$$c_{R3} = \frac{n_{T3}}{V_{R3}} = \frac{m_{T3}\rho_{R3}}{M_T m_{R3}} = \frac{w_{R3}\rho_{R3}}{M_T} = \frac{0,104 \cdot 1110 \frac{\text{g}}{\text{L}}}{40 \frac{\text{g}}{\text{mol}}} = 2,89 \frac{\text{mol}}{\text{L}}$$
2.
$$w_{R1} = \frac{m_{T1}}{m_{R1}} = \frac{n_T M_T}{\rho_{R1} V_{R1}} = \frac{c_{R1} M_T}{\rho_{R1}} = \frac{0,425 \frac{\text{mol}}{\text{L}} \cdot 98,1 \frac{\text{g}}{\text{mol}}}{1030 \frac{\text{g}}{\text{L}}} = 0,0405 = 4,1\%$$

f) Dodatne računske naloge:

1. V bučko prostornine 250mL dodamo 12,4g Na_2CO_3 in 4,7g $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ ter razredčimo do oznake. Gostota tako pripravljene raztopine znaša 1,054g/mL. Izračunaj masni delež Na_2CO_3 v raztopini!

$$\begin{array}{lll} V_R = 250\text{mL} & m(\text{Na}_2\text{CO}_3) = 12,4\text{g} & M(\text{Na}_2\text{CO}_3) = 106,0\text{g/mol} \\ \rho_R = 1,054\text{g/mL} & m(\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}) = 4,7\text{g} & M(\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}) = 286\text{g/mol} \end{array}$$

$$m_R = V_R \rho_R = 250\text{mL} \cdot 1,054 \frac{\text{g}}{\text{mL}} = 263,5\text{g}$$

$$m_T = m(\text{Na}_2\text{CO}_3) + \frac{m(\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}) M(\text{Na}_2\text{CO}_3)}{M(\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O})} = 12,4\text{g} + \frac{4,7\text{g} \cdot 106 \frac{\text{g}}{\text{mol}}}{286 \frac{\text{g}}{\text{mol}}} = 14,14\text{g}$$

$$w_R = \frac{m_T}{m_R} = \frac{14,14\text{g}}{263,5} 100\% = 5,4\%$$