
4. Vaja: Raztopine I

a) Osnove:

1. Oznake:

$$\underline{R} = \underline{T} + \underline{t}$$

raztopina topljenec topilo

2. Množinska koncentracija (c) ali molarnost (M):

$$c = \frac{n_T}{V_R} \left[\frac{\text{mol}}{\text{L}}, M \right]$$

3. Masni delež (w):

$$w = \frac{m_T}{m_R} \left[/, \% \right]$$

4. Masna koncentracija (γ):

$$\gamma = \frac{m_T}{V_R} \left[\frac{\text{g}}{\text{L}}, \frac{\text{g}}{\text{mL}} \right]$$

5. Molalnost (b):

$$b = \frac{n_T}{m_t} \left[\frac{\text{mol}}{\text{kg}} \right]$$

6. Volumni se ne seštevajo:

$$V_{R1} + V_{R2} \neq V_{R3}$$

7. Mase raztopin se seštevajo:

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

8. Mase topljencev se seštevajo:

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

b) Naloga:

Pripravi raztopini npr. natrijevega klorida (NaCl) in magnezijevega sulfata (VI) (MgSO₄)!

c) Eksperimentalne računске naloge:

1. Pripravi 210g 3,8% raztopine NaCl. Izmeri temperaturo in gostoto dobljene raztopine. Nato izračunaj še njeno molarnost, molalnost in masno koncentracijo!

$$m_R = 210\text{g} \quad M(\text{NaCl}) = 58,45\text{g/mol}$$
$$w_R = 3,8\% \quad \rho(\text{H}_2\text{O}) = 1,0\text{g/mL}$$

$$m(\text{NaCl}) = m_R w_R = 210\text{g} \cdot 0,038 = 8,0\text{g}$$

$$m(\text{H}_2\text{O}) = m_R (1 - w_R) = 210\text{g} (1 - 0,038) = 202,0\text{g}$$

$$V(\text{H}_2\text{O}) = \frac{m(\text{H}_2\text{O})}{\rho(\text{H}_2\text{O})} = \frac{202,0\text{g}}{1,0\frac{\text{g}}{\text{mL}}} = 202\text{mL}$$

2. Pripravi 230g 2,2% raztopine magnezijevega sulfata(VI), če je izhodna snov magnezijev sulfat heptahidrat. Izmeri temperaturo in gostoto dobljene raztopine ter izračunaj njeno molarnost!

$$m_R = 230g \quad M(\text{MgSO}_4) = 120,37g/mol$$

$$w_R = 0,022 \quad M(\text{MgSO}_4 \cdot 7\text{H}_2\text{O}) = 246,48g/mol$$

$$m(\text{BS}) = m_R w_R = 230g \cdot 0,022 = 5,1g$$

$$m(\text{KH}) = \frac{m(\text{BS})M(\text{KH})}{M(\text{BS})} = \frac{5,1g \cdot 246,5 \frac{g}{mol}}{120,9 \frac{g}{mol}} = 10,4g$$

$$m(\text{H}_2\text{O}) = m_R(1 - w_R) - (m(\text{KH}) - m(\text{BS})) = 230(1 - 0,022)g - (10,4 - 5,1)g = 219,6g$$

$$V(\text{H}_2\text{O}) = \frac{m(\text{H}_2\text{O})}{\rho(\text{H}_2\text{O})} = \frac{219,6g}{1,0 \frac{g}{mL}} \doteq 220mL$$

d) Izvedba vaje:

- Zatehtamo preračunano maso soli v čašo in dolijemo preračunano prostornino destilirane vode z merilnim valjem. Mešamo, dokler se vsa sol ne raztopi. 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!
- Eksperimentalno vajo izvedemo, kot pri 1. nalogi!

e) Meritve pri vaji:

- $T_R = 23^\circ\text{C}$
 $\rho_R^{23} = 1,025g/mL$
- $T_R = 23^\circ\text{C}$
 $\rho_R^{23} = 1,015g/mL$

f) Izračun:

- $$c_R = \frac{m(\text{NaCl})\rho_R}{M(\text{NaCl})m_R} = \frac{w_R\rho_R}{M(\text{NaCl})} = \frac{0,038 \cdot 1,025 \frac{kg}{L}}{0,05845 \frac{kg}{mol}} = 0,67 \frac{mol}{L}$$

$$b_R = \frac{m(\text{NaCl})}{M(\text{NaCl})m_R(1 - w_R)} = \frac{w_R}{M(\text{NaCl})(1 - w_R)} = \frac{0,038}{0,05845 \frac{kg}{mol}(1 - 0,038)} = 0,68 \frac{mol}{kg}$$

$$\gamma_R = \frac{m(\text{NaCl})\rho_R}{m_R} = w_R\rho_R = 0,038 \cdot 1,025 \frac{g}{L} = 39 \frac{g}{L}$$
- $$c_R = \frac{m(\text{BS})\rho_R}{M(\text{BS})m_R} = \frac{w_R\rho_R}{M(\text{BS})} = \frac{0,022 \cdot 1,015 \frac{kg}{L}}{0,12037 \frac{kg}{mol}} = 0,19 \frac{mol}{L}$$