exercises:

① H_2O: $c_p^{sp} = 4182\ JK^{-1}kg^{-1}$ $|:1000 = 4{,}182\ JK^{-1}g^{-1}$

$\rightarrow c_p = M\, c_p^{sp} \approx 75{,}36\ JK^{-1}mol^{-1}$

② Ice: $\Delta_m H^{sp} = 3{,}338 \cdot 10^5\ Jkg^{-1}$ $|:1000 = 3{,}338 \cdot 10^2\ Jg^{-1}$

$\Delta_m H = M\, \Delta_m H^{sp} = 3{,}338 \cdot 10^2 \cdot 18{,}02 \approx 6{,}015 \cdot 10^3\ J\,mol^{-1}$

③ $Q = C_p \cdot \Delta T = (C_{p,W} + C_{p,K})\Delta T = (c_p^{spez}{}_W \cdot m_W + C_{pK})\Delta T =$

$= (4182\ JK^{-1}kg^{-1} \cdot 0{,}1kg + 120\ JK^{-1})\Delta T = 538{,}2\ JK^{-1}\Delta T = 500\ J \rightarrow \Delta T = 0{,}929\ K$

if assumption: $C_{p,K} \approx 0 \rightarrow Q = C_{pW} \cdot \Delta T = c_p^{spez}{}_W \cdot m_W \cdot \Delta T = 418{,}2\ JK^{-1} \cdot \Delta T = 500\ J \rightarrow \Delta T = 1{,}196\ K$

④ $Q = \underbrace{m_{ICE}\,\Delta_m H}_{\text{diff. amount for melting of 10g ice at } T_E} + \underbrace{m_{ICE}\, c_p^{spez}{}_W\,(T_f - T_E)}_{\text{diff. amount for heating of ice water}} + \underbrace{m_W\, c_p^{spez}{}_W\,(T_f - T_i)}_{\text{diff. amount for cooling of (rest) water}} + \underbrace{C_{pK}\,(T_f - T_i)}_{\text{diff. amount for cooling of calorimeter}} = 0$

$\rightarrow T_f = \dfrac{(m_W c_p^{spez}{}_W + C_{pK})T_i + m_E c_p^{spez}{}_W T_E - m_E \Delta_m H}{(m_W + m_E)c_p^{spez}{}_W + C_{pK}}$

for $m_W = 100 = 0{,}1$ kg, $C_{pK} = 120\ JK^{-1}$,
$T_i = 293{,}15\ K\ (20°C)$, $T_E = 273{,}15\ K\ (0°C)$
& $m_{ICE} = 10g = 0{,}01$ kg $(c_p^{spez}{}_W = 2100\ JK^{-1}kg^{-1})$

$\Rightarrow T_f = 285{,}95\ K\ (12{,}8°C)$

if ice water (0°C) is add instead of ice:

$Q = m_{ICEWATER}\, c_p^{spez}{}_W\,(T_f - T_E) + m_W\, c_p^{spez}{}_W\,(T_f - T_i) + C_{pK}(T_f - T_i) = 0$

$\rightarrow T_f \cdot (c_p^{spez}{}_W \cdot m_{ICEW.} + c_p^{spez}{}_W \cdot m_W + C_{pK}) = m_{ICEW.} \cdot T_E \cdot c_p^{spez}{}_W + T_i \cdot (m_W \cdot c_p^{spez}{}_W + C_{pK})$

$\rightarrow T_f = \dfrac{T_E \cdot m_{ICEW.} \cdot c_p^{spez}{}_W + T_i(m_W \cdot c_p^{spez}{}_W + C_{pK})}{c_p^{spez}{}_W \cdot (m_{ICEW} + m_W) + C_{pK}}$

for $m_W = 0{,}1$ kg, $C_{pK} = 120\ JK^{-1}$,
$T_i = 293{,}15\ K\ (20°C)$, $T_E = 273{,}15\ K\ (0°C)$
& $m_{ICEW} = 0{,}01$ kg $(c_p^{spez}{}_W = 2100\ JK^{-1}kg^{-1})$

$\Rightarrow T_f = 291{,}95\ K\ (18{,}8°C)$

⑤ $0 = c_p^{spez}{}_{\substack{Lik \\ sol.}} \cdot m_{\substack{Lik \\ sol}} \cdot \Delta T + n_{Lik} \cdot \Delta_{sol} H_{Lik}$

$c_p^{spez}{}_{\substack{Lik \\ sol.}} = 4{,}053\ JK^{-1}g^{-1}$ $\quad m_{\substack{Lik \\ sol}} = 1\,mol \cdot 42{,}9\,\frac{g}{mol} + 100\,mol \cdot 18{,}02\,\frac{g}{mol} = 222{,}6\ g$ $\quad \Delta_{sol} H_{\substack{Lik \\ sol}} = -35{,}941$

$\Delta T = -\dfrac{n_{Lik} \cdot \Delta_{sol} H_{Lik}}{c_p^{spez}{}_{\substack{Lik \\ sol}} \cdot m_{\substack{Lik \\ sol}}} = \dfrac{1 \cdot 35{,}941}{4{,}053 \cdot 222{,}6} \approx 0{,}04\ K = 0{,}04°C$