Kool Aid problem - full answer

$$\Delta Q_{tot} = Q_{ice\ accepts} + Q_{kool\ aid\ yields} = 0$$

$$\rightarrow m_{ice} C_{ice} (T_f - T_{o,ice}) + m_{ice} L_{v_{ice}} + m_{kool} C_{kool} (T_f - T_{o,kool}) = 0$$

$$\rightarrow T_f = \frac{-m_{ice} L_{v_{ice}} + m_{ice} C_{ice} T_{o,ice} + m_{kool} C_{kool} T_{o,kool}}{m_{ice} C_{ice} + m_{kool} C_{kool}}$$

$= 277.9\ k$

$\longrightarrow$ no, the kool aid cannot reach $0°C$ or $273.15\ k$

$$m_{kool} = 4 \text{ gallons} \ \frac{3.788\ L}{1\ gallon} \ \frac{10^{-3} m^{-3}}{L} \ \frac{10^3 kg}{m^3} = 15.152\ kg$$

$$m_{ice} = \frac{1}{4} gallon \ \frac{3.788 L}{gallon} \ \frac{0.92 \cdot 10^3 kg}{m^3} \ \frac{10^{-3} m^{-3}}{L} = 0.87124\ kg$$

$C_{ice} = 2100 \ \frac{J}{kg\ k}$ $\qquad$ $C_{kool} = 4190 \ \frac{J}{kg\ k}$

$L_{v_{ice}} = 334 \cdot 10^3 \ \frac{J}{kg}$

$T_{o,ice} = -20°C = 253.15\ k$ $\qquad$ $T_{o,kool} = 10°C = 283.15\ k$