## Answer on Question \#48540 - Physics - Molecular Physics | Thermodynamics

1. A copper cup holds some cold water at 4 C . The copper cup weighs 140 g while the water weighs 80 g . If 100 g of hot water, at 90 C is added, what will be the final temperature of the water?
$T_{0}=4^{0} \mathrm{C}=277 \mathrm{~K}$
$m_{0}=140 \mathrm{~g}=0.14 \mathrm{~kg}$
$m=80 \mathrm{~g}=0.08 \mathrm{~kg}$
$m_{1}=100 \mathrm{~g}=0.1 \mathrm{~kg}$
$T_{1}=90^{\circ} \mathrm{C}=363 \mathrm{~K}$
$c_{1}=385 \frac{\mathrm{~J}}{\mathrm{~kg} \cdot \mathrm{~K}}$
$c=4200 \frac{\mathrm{~J}}{\mathrm{~kg} \cdot \mathrm{~K}}$
$T$ - ?

## Solution.

The cold water and the cup will neated, while the hot water will cool. We can write the heat balance equation:
$m_{0} c_{1}\left(T-T_{0}\right)+m c\left(T-T_{0}\right)=m_{1} c_{1}\left(T_{1}-T\right)$.
Here, $c$ and $c_{1}$ are specific heat of water and cooper, respectively.
One can find the final temperature:

$$
T=\frac{m_{1} c_{1} T_{1}+\left(m_{0} c_{1}+m c\right) T_{0}}{\left(m_{1}+m_{0}\right) c_{1}+m c}
$$

Let check the dimension: $[T]=\frac{\mathrm{kg} \cdot \frac{\mathrm{J}}{\mathrm{kg} \cdot \mathrm{K}} \cdot \mathrm{K}}{\mathrm{kg} \cdot \frac{\mathrm{J}}{\mathrm{kg} \cdot \mathrm{K}}}=K$.
Let evaluate the quantity:
$T=\frac{0.1 \cdot 385 \cdot 363+(0.14 \cdot 385+.08 \cdot 4200) \cdot 277}{(0.1+0.14) \cdot 385+0.08 \cdot 4200}=284.7(K)=11.7\left({ }^{0} \mathrm{C}\right)$.
Answer: $11.7^{0} \mathrm{C}$.

