
Example

Let's take one last look at the frozen olive problem. We drop a frozen olive initially at a temperature of $T_i = 0^\circ\text{C}$ into a martini at a temperature $T_\infty = 5^\circ\text{C}$. We then stir the martini with a flamingo swizzle stick resulting in a convection coefficient of $h = 10 \text{ W}/(\text{m}^2 \cdot ^\circ\text{C})$. The olive is modeled as a sphere with 1-cm diameter with $\rho = 850 \text{ kg}/\text{m}^3$, $k = 0.350 \text{ W}/(\text{m}^2 \cdot ^\circ\text{C})$ and $c_p = 1780 \text{ J}/(\text{kg} \cdot ^\circ\text{C})$

- Find the Biot number for the olive in the martini. Is the lumped capacitance model OK?
- Find the time constant for the olive in the martini.
- How long does it take the olive to warm up to 4°C ?
- What is the *rate* of heat transfer into the olive when $T = 4^\circ\text{C}$? What is the total amount of heat transferred (Q with no dot!) to the olive during this time?

