Final Question 2

Thursday, May 13, 2021 12:18 PM

"I pledge my honor I have abided by the Stevens Honor system."
- Alex Gaskins

An egg is cooked by dropping it into boiling water. In this situation the egg is cooked by convection of heat from the boiling water. The egg has a mass of 65g, a specific heat capacity of 3.18 kJ/kg·K and can be treated as a sphere with a radius of 3cm.

A. If the egg is initially at a temperature of 6°C, the water is boiling at 100°C and the convective heat transfer coefficient is 1200 W/m^2·K, determine the rate of convective heat transfer to the egg.

$65\ g = .065\ kg \qquad 3\ cm = .03\ m.$

$T_2 = 100°C \qquad T_{surface} = 6°C \qquad h = 1200\ \frac{W}{m^2 K}$

$A = 4\pi r^2 = 4\pi (.03)^2 = .0113\ m.^2$

$Q_{conv} = h A (T_{surface} - T_2)$

$= 1200\ (.0113)(6 - 100)$

$= \boxed{-1275.6\ W.}$

B. Assume the egg can be modeled as a closed system. Using the rate of heat transfer you found in part (a), how long would it take to cook the egg if its temperature must be raised from an initial 6°C to a final temperature of 75°C? *If you did not answer part (a), use a Q of 1000 W.*

$Q = \frac{m C_p (T_{surface} - T_f)}{t}$

$Q = -1.2756\ \frac{kJ}{s}$

$C_p = 3.18\ \frac{kJ}{kgK}$

$t = \frac{(.065)(3.18)(6 - 75)}{-1.2756}$

$\boxed{t = 11.18\ seconds}$