Answer on Question#63513 – Physics – Molecular Physics

A kettle contains 1.2kg of water and is supplied with energy at a rate of 2kw from the mains. Assuming the kettle is 80% effecient, how long would it take to heat the water from 20°C to the boiling point of 100°C if no energy is dissapated from the water to the environment?

Solution. The amount of heat required to heat water from temperature 20^0C to 100^0 without phase change can be calculated using the formula

$$Q_1 = Cm(t_2 - t_1)$$

where

$C = 4184\frac{J}{kg \cdot K}$ – specific heat capacity for water

$m = 1.2$ kg – mass water

$t_1 = 20^0C$ and $t_2 = 100^0$ – the initial and final temperature, respectively.

On the other hand, the amount of heat transferred to the water, taking the efficiency of kettle can be calculated using the formula

$$Q_2 = \eta Pt$$

where

$\eta = 0.8(80\%)$ – efficiency

$P = 2000W$ – power of kettle

t – time

Because no energy is dissapated from the water to the environment get $Q_1 = Q_2$.

Hence $Cm(t_2 - t_1) = \eta Pt$ $t = \frac{Cm(t_2 - t_1)}{\eta P} = \frac{4184 \cdot 1.2(100-20)}{0.8 \cdot 2000} = 251$s. (4 minutes 11 seconds).

Answer. 251s (4 minutes 11 seconds)