6.6
a) Calculate the range of temperatures within which the vapor-air mixture above the liquid surface in a can of n-hexane at atmospheric pressure will be flammable. Data are found in Table 4.5.

a) The boiling temperature at 1 atmosphere is shown below.

$Tb := 342$ $\qquad$ $Pkpa := 101000$

The lower and upper flammability limits and the latent heat are:

$xl := 0.012$ $\qquad$ $xu := 0.074$ $\qquad$ $hfg := 0.35 \cdot 1000$

The universal gas constant and themolecular weight are found.

$Rgas := 8.314$ $\qquad$ $M1 := 12 \cdot 6 + 14$ $\qquad$ $M1 = 86$

Invert C-C for the temperature in terms of the mole fraction.

$$Tl := \left(\frac{1}{Tb} - \frac{Rgas \cdot \ln(xl)}{hfg \cdot M1} \right)^{-1} \qquad Tl = 241.218 \quad K$$

$$Tu := \left(\frac{1}{Tb} - \frac{Rgas \cdot \ln(xu)}{hfg \cdot M1} \right)^{-1} \qquad Tu = 274.488 \quad K$$

b) Calculate the range of ambient pressures within which the vapor-air mixture above the liquid surface in a can of n-hexane or n-decane will be flammable at 25C.

We first need to get the vapor pressure at 25C. Once we know the vapor pressure we then find the atmospheric pressure that allows the vapor pressure divided by atmospheric pressure to equal the mole fraction.

If we are looking for n-hexane results we get: $Te := 25 + 273$

$$Pvap := \exp\left[-hfg \cdot \frac{M1}{Rgas} \cdot \left(\frac{1}{Te} - \frac{1}{Tb}\right)\right] \cdot Pkpa \qquad Pvap = 2.116 \times 10^{4}$$

$$Plow := \frac{Pvap}{xl} \qquad Pup := \frac{Pvap}{xu} \qquad Plow = 1.763 \times 10^{6} \ \text{Pa} \qquad Pup = 2.859 \times 10^{5} \ \text{Pa}$$

For n-decane

The boiling temperature at 1 atmosphere is shown below.

$$Tb := 447 \qquad Pkpa := 101000$$

The lower and upper flammability limits and the latent heat are:

$$xl := 0.006 \qquad xu := 0.054 \qquad hfg := 0.28 \cdot 1000$$

The universal gas constant and themolecular weight are found.

$$Rgas := 8.314 \qquad M1 := 12 \cdot 10 + 22 \qquad M1 = 142$$

$$Pvap := \exp\left[-hfg \cdot \frac{M1}{Rgas} \cdot \left(\frac{1}{Te} - \frac{1}{Tb}\right)\right] \cdot Pkpa \qquad Pvap = 479.888 \ \text{Pa}$$

$$Plow := \frac{Pvap}{xl} \qquad Plow = 7.998 \times 10^{4} \ \text{Pa} \qquad \frac{Plow}{101000} = 0.792 \ \text{atm}$$

$$Pup := \frac{Pvap}{xu} \qquad Pup = 8.887 \times 10^{3} \ \text{Pa} \qquad \frac{Pup}{101000} = 0.088 \ \text{atm}$$

$$xu1 := 6.5 \cdot (0.6)^{.5} \qquad xu1 = 5.035$$