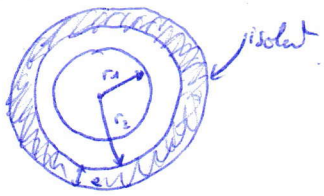
②.

Exercice 2: Isolation d'une conduite de vapeur (Exam 2018/2019)



1) a) $j = -k_a \frac{dT}{dr}$

b) $j = -k_a \frac{dT}{dr}$

2) $\phi = jS = -k_a 2\pi r L \frac{dT}{dr}$

3) $dT = -\frac{1}{k_a 2\pi r L} \phi dr$.

$T(r_2) - T(r_1) = -\frac{\phi}{k_a 2\pi L} \ln\left(\frac{r_2}{r_1}\right)$

$T(r_1) - T(r_2) = \frac{\phi}{k_a 2\pi L} \ln\left(\frac{r_2}{r_1}\right)$ $\Rightarrow R_{th_{acier}} = \frac{1}{2\pi k_a L} \ln\left(\frac{r_2}{r_1}\right)$.

4) $R_{th_{isolant}} = \frac{1}{2\pi k_i L} \ln\left(\frac{r_2+e}{r_2}\right)$

5) a) $\phi_{conv_{eau \to acier}} = h_{int} 2\pi r_1 L (T_i - T(r_1))$

b) $R_{conv,int} = \frac{1}{h_{int} 2\pi r_1 L}$

⚠ $R_{conv} = \frac{1}{hS}$

c) $R_{conv,ext} = \frac{1}{h_{ext} 2\pi (r_2+e) L}$

6) Les murs sont associés en série : $R_{th-eq} = R_{conv,int} + R_{th,acier} + R_{th\,iso} + R_{conv,ext}$

$= \frac{1}{h_{int} 2\pi r_1 L} + \frac{1}{2\pi k_a L} \ln\left(\frac{r_2}{r_1}\right) + \frac{1}{2\pi k_i L} \ln\left(\frac{r_2+e}{r_2}\right) + \frac{1}{h_{ext} 2\pi (r_2+e) L}$

Exercice 3: