Lösningar 140109 Termodynamik för C och D.

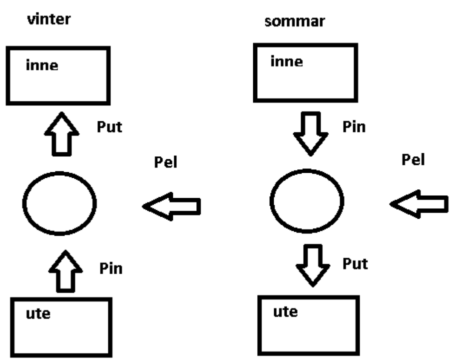
1a) $p = p_0\, e^{-Mgh/RT} = 1\,\mathrm{atm}\, e^{-29\cdot 10^{-3}\cdot 9{,}81\cdot 5000/8{,}31\cdot 273} = 0{,}534\,\mathrm{atm} = 54\,\mathrm{kPa}$

b) Tefyma: Mättnadstrycket är 54 kPa för 83 ^{o}C

2. $\beta_{Al} = 3\cdot 23\cdot 10^{-6}\ \mathrm{K}^{-1}$, $\beta_M = 1{,}20\cdot 10^{-3}\ \mathrm{K}^{-1}$, $V = V_0(1+\beta\cdot \Delta T)$
$V_{Al} = 30{,}06\ l$, $V_M = 30{,}04\ l$, rinner inte över

3. $1/k = (1/8 + 0{,}01/0{,}13 + 0{,}1/0{,}2 + 0{,}12/0{,}6 + 1/25)\ \mathrm{m^2 \cdot K/W}$
$P/A = k\cdot \Delta T = 5{,}1\ \mathrm{W/m^2}$

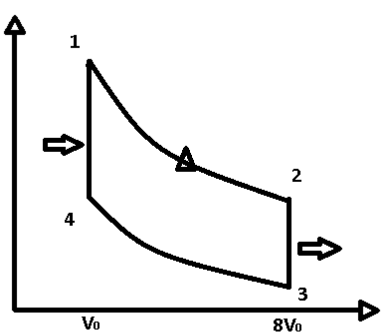
4.



Vinter: $P_{ut} = P_{el}\cdot V_f = 3{,}0$ kW

Sommar: $P_{in} = 3{,}0$ kW
$P_{el} = P_{ut} - P_{in} = V_f \cdot P_{el} - P_{in} \Rightarrow P_{el} = 1{,}5$ kW

5.



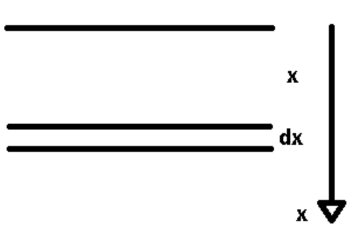
$$\eta = 1 - \frac{Q_{ut}}{Q_{in}} = 1 + \frac{nC_V(T_3 - T_2)}{nC_V(T_1 - T_4)}, \quad r = \frac{V_2}{V_1}$$

$$1 \to 2 \text{ adiabat, Poisson}: T_1 = T_2\left(\frac{V_2}{V_1}\right)^{\gamma-1} = T_2 \cdot r^{\gamma-1}$$

$$\text{pss } T_4 = T_3 \cdot r^{\gamma-1}$$

$$\text{insättning ger } \eta = 1 + \frac{T_3 - T_2}{r^{\gamma-1}(T_2 - T_3)} = 1 - \frac{1}{r^{\gamma-1}}$$

6. Under tiden *dt* växer istäcket *dx*, samtidigt leds värmen *P=dQ/dt* genom istäcket.



$$P = \frac{dQ}{dt} = A\lambda \cdot \frac{\Delta T}{x}$$

$$dQ = dm \cdot l_s = dx \cdot A \cdot \rho \cdot l_s$$

$$dt = \frac{\rho \cdot l_s}{\lambda \cdot \Delta T} x \cdot dx$$

$$t = \frac{\rho \cdot l_s}{\lambda \cdot \Delta T}\int_{0.01}^{0.1} x \cdot dx = \frac{920 \cdot 334 \cdot 10^3}{2{,}1 \cdot 10}\frac{1}{2}(0{,}01 - 0{,}0001) = 72{,}3 \cdot 10^3 \text{ s} =$$

$$= 20 \text{ timmar}$$