1) a- $\left(\frac{\partial P}{\partial T}\right)_v = \frac{L_v}{T(v_v - v_l)}$ Si $v_l \ll v_v$

GP $\Rightarrow v_v = \frac{RT}{MP} \Rightarrow \left(\frac{\partial P}{\partial T}\right)_v = \frac{MP}{RT^2} \cdot L_v$

L_v = cste.

d'où $\frac{dP}{P} = \frac{ML_v}{RT^2} \cdot dT \Rightarrow \ln P = \frac{\alpha}{T} + \beta$

b- $\alpha = -\frac{ML_v}{R} = -\frac{18.10^{-3} \times 2442,31.10^3}{8,314} = -5,4.10^3$

$\beta = \ln P_0 - \frac{\alpha}{T_0} = \ln 3,1690.10^3 + \frac{5,4.10^3}{25+273,15} = +26,17$

2) a) Q_H^1 → TG → Q_3^1 → E → Q_4^2 → TV → Q_3^2

$\eta_{TG} = \frac{Q_H^1 + Q_3^1}{Q_H^1}$; $\eta_{TV} = \frac{Q_4^2 + Q_3^2}{Q_4^2}$; $Q_4^2 = -\varepsilon Q_3^1 \Rightarrow \eta_{TOT} = \frac{-W_{TG} - W_{TV}}{Q_H^1}$

$\eta_{TOT} = \frac{Q_H^1 + Q_3^1 + Q_4^2 + Q_3^2}{Q_H^1} = \eta_{TG} + \frac{Q_4^2 + Q_3^2}{Q_H^1} = \eta_{TG} + \frac{Q_4^2 + Q_3^2}{Q_H^2} \cdot \frac{Q_H^2}{Q_H^1} = \eta_{TG} + \eta_{TV} \cdot \frac{Q_H^2}{Q_H^1}$

$= \eta_{TG} - \varepsilon \cdot \frac{Q_3^1}{Q_H^1} \eta_{TV} = \eta_{TG} - \varepsilon(\eta_{TG} - 1)\eta_{TV}$

b) AN : $\eta_{TOT} = 0,3 + 0,87(1-0,3) \cdot 0,33 = 0,50$.

3) a) $q = \frac{n_v}{n_0} \cdot \frac{e}{P-e} = \varepsilon \frac{e}{P-e}$ $\varepsilon = 0,622$

b). $q \simeq \varepsilon \frac{e}{P} \rightsquigarrow e = \frac{P \cdot q}{\varepsilon} = \frac{101325 \times 5,75.10^{-3}}{0,622} = 936,69$ Pa.

$\Rightarrow HR = \frac{e}{e_{sat}} = \frac{936,69}{1170,8} = 80\%$.

4) a) $\frac{dE}{dt} = \dot{Q} + \dot{W} + \sum_{ep} \dot{m}_k \left(h + \frac{1}{2}\vec{v}^2 + gz\right)_k$

ENP $\Rightarrow \frac{dE}{dt} = 0$; $\dot{m}_e = -\dot{m}_s = \dot{m}$; adiabatique $\Rightarrow \dot{Q} = 0$; Ep négligeable $\Rightarrow (gz) \simeq 0$; $v_e \ll v_s$.

$\Rightarrow \dot{W} = \dot{m}(h_s - h_e) + \dot{m}\frac{1}{2}v_s^2$

b). $\Delta h = c_p \Delta T$ et $c_p = \frac{R\gamma}{M(\gamma-1)} \Rightarrow \frac{\dot{W}}{\dot{m}} = \frac{R\gamma}{M(\gamma-1)}(T_s - T_e) + \frac{1}{2}v_s^2$

$\frac{\dot{W}}{\dot{m}} = 16077 \text{ J/kg} + 7,2 \text{ J/kg} = 167,97 \text{ kJ/kg}$.

c) $W = P \cdot t \Rightarrow \frac{\dot{W}}{\dot{m}} = \frac{P \cdot t}{\dot{m}} \Rightarrow \dot{m} = P \cdot \left[\frac{\dot{W}}{\dot{m}}\right]^{-1} = \frac{3000}{167,97} = 17,86 \text{ kg/s}$.