Ex01 :

1) Eau (H_2O)

Solution de la série d'exercices N°1

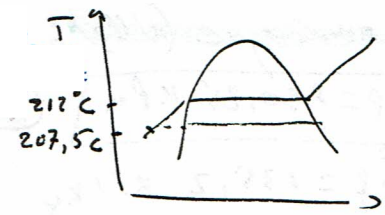
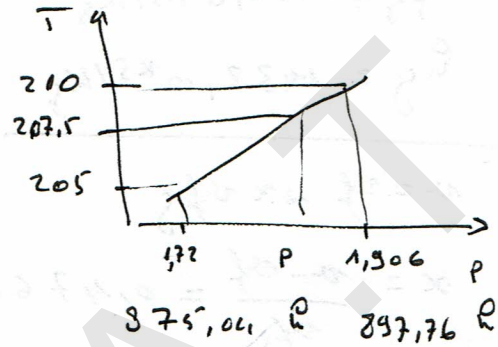


Table A.1.1 page.(656)

$h = h_f$ $\quad P = 2000\ KPa = 2\ MPa$



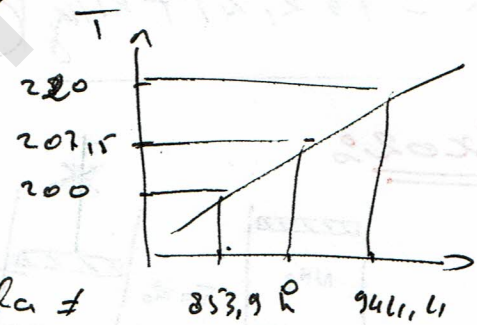
$$\frac{210-205}{897,76-875} = \frac{207-205}{h-875,04}$$

$$h = \frac{2(897,76-875,04)}{5} + 875,04$$

$$\boxed{h = 886,35\ KJ/Kg}$$

ou de la Table A.1.4 liquide comprimé

$P = 5\ MPa$



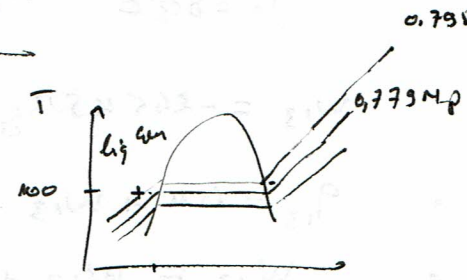
$$\frac{220-200}{941,1-853,9} = \frac{207,15-200}{h-853,9}$$

$$\boxed{h = 887,83\ KJ/Kg}$$ ≠ est due à la ≠ de pression. 2MPa et 5MPa.

2- Azote (N_2)

$T = 100°K \rightarrow P = 0,779\ MPa \rightarrow v_f = 0,001452 \rightarrow h_f = -72,57$

$P = 0,795\ MPa$



$$\boxed{h = u + Pv}$$

$$u = -Pv + h$$

$u = u_f$, $h = h_f$ et $v = v_f$

$$u = h - Pv$$

$$= -72,57\ \frac{KJ}{Kg} - 779\ KPa \cdot 0,001452\ \frac{m^3}{Kg}$$

KN/m^2

$Pa = N/m^2$

$KPa = KN/m^2$

$$\boxed{u = -73,70\ KJ/Kg}$$

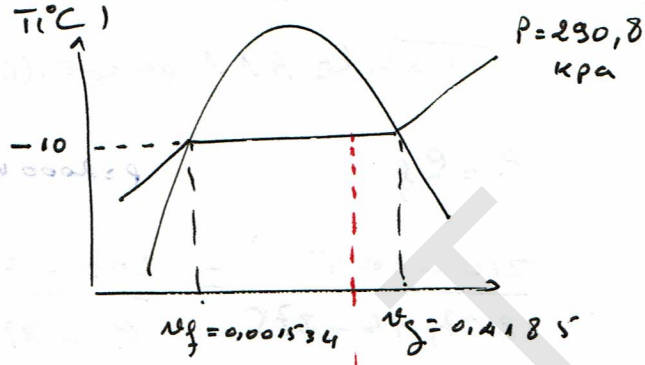
3) **Ammoniaque (NH_3) :**

1 $P = 290,85$ KPa

$h_f = 135,2$ KJ/Kg

$h_{fg} = 1296,8$ KJ/Kg

$h_g = 1432,0$ KJ/Kg



$v = v_f + x v_{fg}$

$x = \dfrac{v - v_f}{v_{fg}} = 0,4760$

$h = h_f + x h_{fg}$

$= 135,2 + 0,4760 \times 1296,8$

$h = 752,477$ KJ/Kg

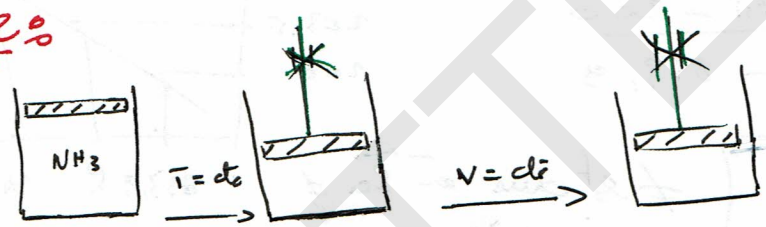
$v = 0,2\ m^3/Kg$

4) **Fréon 12**

$h = 148,076$ KJ/Kg
$T = 100°C$ $\Leftrightarrow$ liquide saturé, car $h = h_f$

$h = h_f = 148,076$ KJ/Kg $\Leftrightarrow$ $P = 3,344$ MPa $= 3344,0$ kpa ; $v = v_f = 0,0011\,13\ m^3/Kg$

Exo2 :



$P_1 = 100$ KPa, $T_1 = 80°C$; $P_2 = 450$ KPa, $T = 80°C$; $T_3 = -10°C$

$W_{13} = -265$ KJ/Kg

fourni
$W > 0$ => Sys cède du Travail
$W < 0$ => Sys reçoit.

- $q_{13} = \Delta u + W_{13} = u_3 - u_1 + W_{13}$
- $W_{13} = W_{12} + W_{23}$ ou $V = cte$ $\Leftrightarrow$ $W_{13} = W_{12} = -265$ KJ/Kg (Sys reçoit)
- $u_1 = h_1 - P_1 v_1$ — Tables : $v_1 = 1,7155\ m^3/Kg$, $h_1 = 1648$ KJ/Kg

$u_1 = 1476,45$ KJ/Kg

- $u_3 = h_3 - P_3 v_3$; $v_3 = v_2$; Table $T_2 = 80°C$, $P_2 = 450$ KPa $\Rightarrow v_2 = 0,3740$

à $T_3 = -10°C$: $v_f = 0,0015\,34 < v_3 = v_2 = 0,3740 < 0,4185$ m^3/Kg

$v_3 = v_f + x v_{fg}$ $\Leftrightarrow$ $x = \dfrac{v_3 - v_f}{v_{fg}} = 0,8934$

$P_3 = 290,85$ KPa

Suite (Ex 02)

$x = 0,8934$ ou $89,34\%$

$h_3 = h_f + x\, h_{fg}$

$= 135,2 + 0,8934 \cdot 1296,8$

$P_3 = 290,85$ Kpa

$\boxed{h_3 = 1293,76 \text{ KJ/Kg}}$

$u_3 = h_3 - P_3 v_3$

$u_3 = 1293,76 - 290,85 \cdot 0,3740$

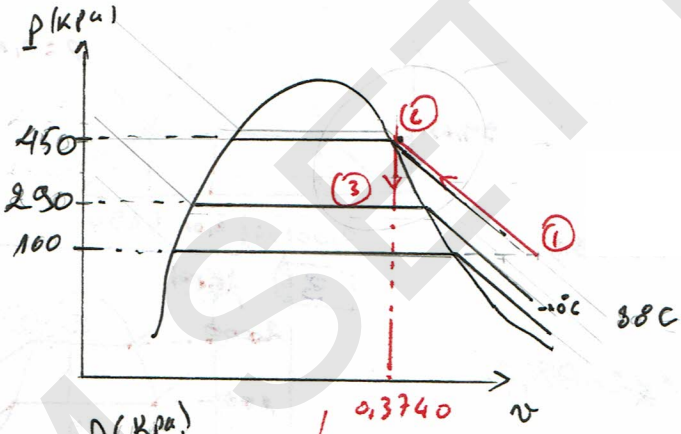
$\boxed{u_3 = 1184,98 \text{ KJ/Kg}}$

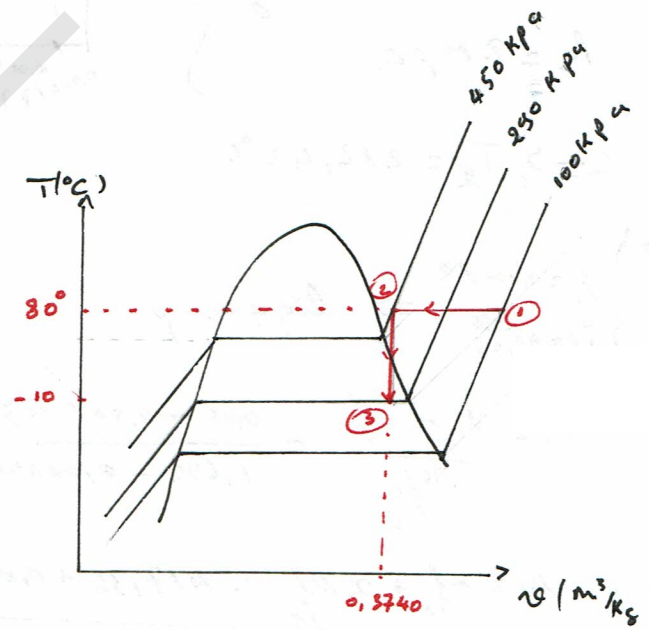
$q_{13} = 1184,98 - 1476,45 \quad (-265)$

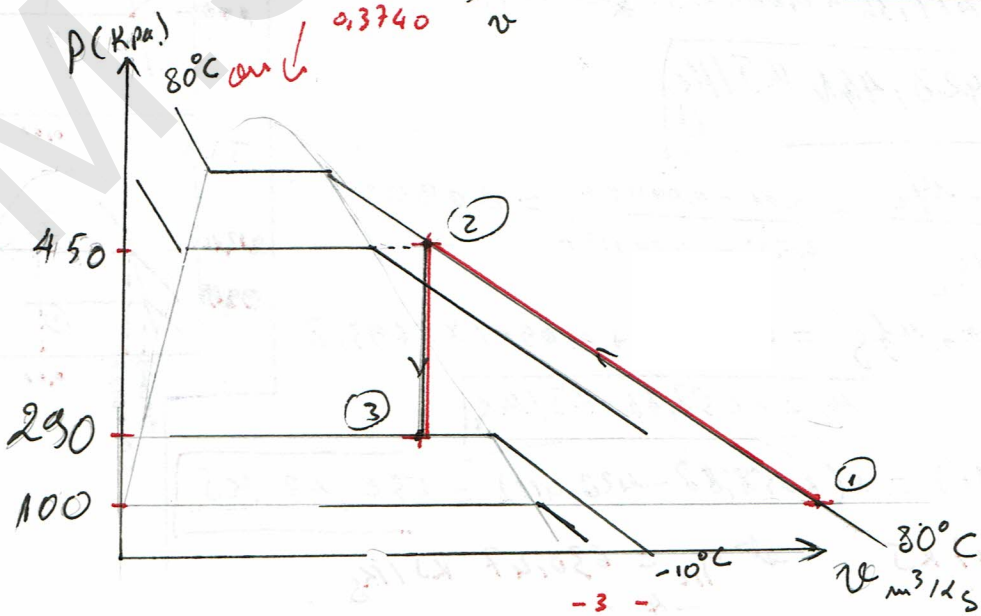
$= 1184,98 - 1476,45 + (-265)$

$= 1184,98 - 1476,45 - 265$

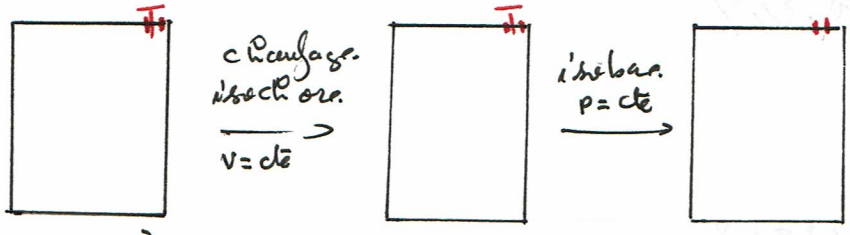
$\boxed{q_{13} = -556,47 \text{ KJ/Kg}}$







Exo3 :



$V_1 = 0{,}01\ m^3$

1 Kg H_2O

$P_1 = 100$ Kpa

$P_2 = P_3$

$V_1 = V_2 = 0{,}01\ m^3$

$v_2 = \frac{0{,}01}{1} = 0{,}01\ \frac{m^3}{Kg}$

$V_3 = 0{,}01$

vapsaturé $\Rightarrow x = 1$

$v_3 = \frac{V}{m_3} = \frac{0{,}01}{0{,}1} = 0{,}1\ m^3/Kg$

$P_3 = ?$ $\Rightarrow$ Table page 658

$P_2 = P_3$

$P_2 = 2$ Kp $\longleftarrow$ $P_3 = 2$ Mpa

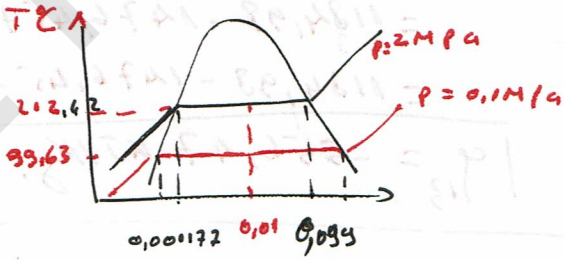
1) $v_3 = \frac{V}{m_3} = 0{,}1\ m^3/Kg$ vapsaturée $x = 1 \xrightarrow{\text{Table}} P_3 = 2$ Mpa

$\Rightarrow P_2 = P_3 = 2$ Mpa

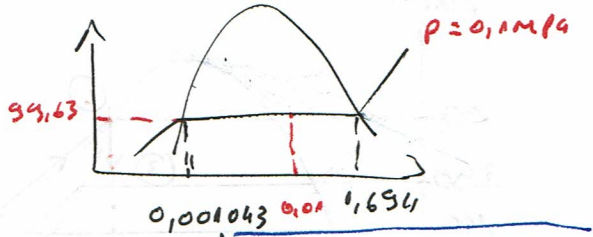
$v_2 = \frac{V}{0{,}1} = 0{,}01\ \frac{m^3}{Kg}$

$P_2 = 2$ Mpa

$\Rightarrow T_2 = 212{,}42\ °C$



2) $P_1 = 0{,}1$ MPa, $T_1 = 99{,}63$ $\Rightarrow$ liq + vap



$x_1 = \frac{v_1 - v_{f1}}{v_{fg}} = \frac{0{,}01 - 0{,}001043}{1{,}694 - 0{,}001043} = 0{,}005291$

$u_1 = u_{f1} + x u_{fg} = 417{,}36 + 0{,}005291 \times 2088{,}7$

$u = 428{,}411\ KJ/Kg$

état 2 : $x_2 = \frac{v_2 - v_{f2}}{v_{fg_2}} = \frac{0{,}01 - 0{,}001177}{0{,}099 - 0{,}001177} \simeq 0{,}0901$

$u_2 = u_{f2} + x_2 u_{fg} = 906{,}44 + 0{,}0901 \times 1693{,}8$

$u_2 = 1058{,}88\ KJ/Kg$

$Q_{12} = m_1 (u_2 - u_1) = 1(1058{,}88 - 428{,}411) = 630{,}47\ KJ$

$Q_{12} = 630{,}47$ KJ et $q_{12} = 630{,}47$ KJ/Kg