ATS 2023

27 - $h_3 = 3148$ kJ/kg.
$s_3 \simeq 6300$ J/K/kg.

28 - $h_4 = 1962$ kJ/kg.
$s_4 = s_3 = 6300$ J/K/kg.

29 - $x_4 \simeq 0,75$.

30 - $2 \to 3$ isobare
$\Rightarrow q_{23} = \Delta h_{23} = h_3 - h_2$
$= 3148 - 209 \simeq 2940$ kJ/kg.

31 - $3 \to 4$ adiabatique réversible.
$\Rightarrow w_{i_{34}} = \Delta h_{34} = h_4 - h_3$
$= 1962 - 3148$
$= -1186$ kJ/kg.

32 - $1 \to 2$ adiabatique réversible
$\Rightarrow w_{i_{12}} = \Delta h_{12} = h_2 - h_1$
$= 209 - 197 = 12$ kJ/kg !

33 - $\eta = -\dfrac{w_{12} + w_{34}}{q_{23}}$

34 - $\eta \simeq -\dfrac{-1186 + 12}{2940} \simeq \dfrac{1}{3}$!

35 - P_{hi} en W = $J.s^{-1}$
$\rho = 1000$ $kg.m^{-3}$. D_m en $kg.s^{-1}$
ΔP_{hi} en bar ou $J.m^{-3}$.

Recherche perso

Recherche Perso.

$P_{hi} = \frac{D_m \cdot \Delta Pression}{\rho}$ $\quad \frac{kg}{s} \times \frac{J}{m^3} \times \frac{m^3}{kg} = \frac{J}{s}$

$\Rightarrow D_m = \frac{P_{hi} \times \rho}{\Delta Pression}$

$D_m = \frac{P \times \rho}{(P_3 - P_4)} = \frac{50 \cdot 10^6 \times 10^3}{124 \cdot 10^5 - 10{,}6 \times 10^3}$

Negligeable.

$D_m \simeq \frac{50 \cdot 10^6 \times 10^3}{125 \cdot 10^5} \simeq \frac{500 \cdot 10^5 \times 10^3}{125 \cdot 10^5}$

$kg \cdot s^{-1}$ $\quad \simeq 4 \cdot 10^3 \ kg \cdot s^{-1}$

36. $P_{th} = D_m \times \Delta h_{23} \rightarrow kJ \cdot kg^{-1}$

$= 4 \cdot 10^3 \times 2940 \cdot 10^3$

$\simeq 12000 \cdot 10^6$

$\simeq 12 \ GW$. Pb Puissance

(ou)

$P_{th} = \frac{P}{\eta} = \frac{50}{1/3} = 150 \ MW$

37. $2 \to 3$ isobare

~~$\Rightarrow q_{23} = \Delta h_{23} = h_3 - h_2$~~

~~$= c_p (T_3 - T_2)$~~

~~$\Rightarrow h_3 = c_p (T_3 - T_2) + h_2$~~

GP $\Rightarrow \Delta h_{03} = c_p (T_3 - T_0)$

$\Rightarrow \underline{h_3 = c_p (T_3 - T_0) + h_0}$

38. $3 \to 4$ adiabatique réversible

$\Rightarrow s_4 = s_3$

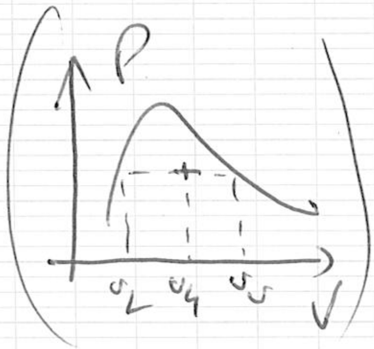
$= s_0 + c_p \ln\left(\frac{T_3}{T_0}\right) - \frac{R}{M} \ln\left(\frac{P_3}{P_0}\right)$

$= \underline{6450 \text{ J.K}^{-1}.\text{kg}^{-1}}$

39. Enthalpie ~~grandeur~~ extensive

~~$\Rightarrow h_4 = x_4$.~~

39. ~~$h_4 = (1 - x_4) h_L$~~ $+ x_4 h_v \to 40$



39. $s_4 = x_4 s_v + (1 - x_4) s_L$

$s_4 - s_L = x_4 (s_v - s_L)$

$x_4 = \frac{s_4 - s_L}{s_v - s_L}$

40. $h_4 = x_4 h_v + (1 - x_4) h_L$ (grandeur extensive).

41. Modèle valable si

$P_3 < 20$ bars ?

P faible $\Rightarrow$ gaz parfait

AB 2023

15. $\vec{F_L} = \int i\,\vec{dl} \wedge \vec{B} = iL\,\vec{e_y} \wedge B_0\vec{e_z}$
$= iLB_0\,\vec{e_x}$.

16. $e = -\frac{d\phi}{dt} = -\frac{d}{dt}(BLx) = -BLv$.

17. $i = \frac{e}{R} = -\frac{B_0Lv}{R}$

18. $\vec{F_L} = -\frac{B_0Lv}{R} \times LB_0\,\vec{e_x} = -\frac{B_0^2L^2}{R}v\,\vec{e_x} = -\frac{B_0^2L^2}{R}\vec{v}$

D'où : $\alpha = \frac{B_0^2L^2}{R}$

Loi de Lenz !

19. $\vec{P_L} = \vec{F_L}\cdot\vec{v} = -\frac{B_0^2L^2}{R}v^2$ (cte) $-\alpha v^2$.

$P_L < 0$: Force freinante.

20. $P_R = Ri^2 = \frac{B_0L^2v^2}{R}$!

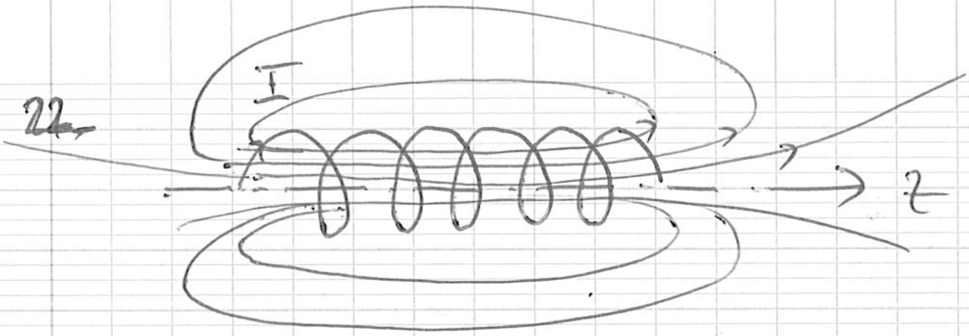
$P_R = -P_L$!

21. $f = 3\,Hz \Rightarrow \frac{P_{elec}}{A^2} = 12\,000\ W/m^2$

$\Rightarrow P_{elec} = 12.000 \times A^2$
$= 12.000 \times (5.10^{-2})^2$
$= 1{,}2.10^4 \times 25.10^{-4}$
$\simeq 30\ W$

ODG ok

22 -



23 - Plan $(\vec{e_r}, \vec{e_\theta})$ plan de symétrie -

$\Rightarrow \vec{B} \perp$ plan de symétrie,

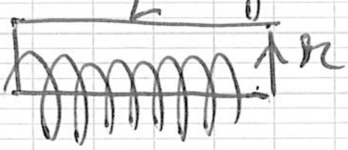
$\Rightarrow \vec{B}$ suivant $\vec{e_z}$ - $\vec{B} = B(M).\vec{e_z}$

Invariances suivant z et θ

$$\Rightarrow \vec{B} = B(r)\,\vec{e_z}.$$

24 - Contour d'Ampère :

Rectangle, longueur L, largeur r



$$\int \vec{B}.\vec{dl} = \mu_0 I = \mu_0 N I$$

$$B.L = \mu_0 N I$$

$$B = \mu_0 \frac{N}{L} I = \mu_0 n I$$

$$\vec{B} = \mu_0 n I \vec{e_z}$$

ATS 2023

25. $E_p = mgh$

$= 5000 \times 30 \times 10 \times 120$ ($\times 30^3$)

$= 5 \times 3 \times 12 \times 10^3 \times 10 \times 10 \times 10 \times 10^3$

$= 15 \times 12 \times 10^6 \times 10^3$

$= 180 \times 10^6 \times 10^3$

$= 180 \times 10^9$

$= 1{,}8 \cdot 10^{11}$ J

~~26. $v = \frac{d}{t}$~~

~~$\Rightarrow t = \frac{d}{v} = \frac{120}{3} = 40$ s.~~

~~$P = \frac{E_p}{t} = \frac{1{,}8 \cdot 10^{11}}{40} = \frac{180 \cdot 10^{10}}{40}$~~

~~$= 4{,}5 \cdot 10^{10}$ W~~

~~$= 45$ GW.~~

26. $P = \vec{P} \cdot \vec{v}$

$= 6 \text{ grues} \times mg \times v$

$= 6 \times 30 \cdot 10^3 \times 10 \times 3$

$\simeq 6 \times 3 \times 3 \times 10^5$

$\simeq 50 \cdot 10^5$ W

$\simeq 5$ MW