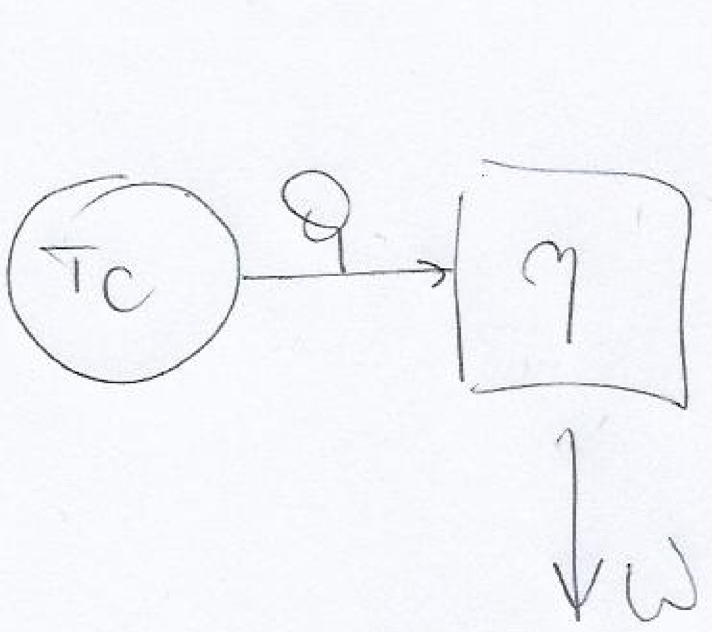


$\Rightarrow \eta = 1 = \frac{W}{Q}$

Movil perpetuo de 2ª especie

3ra especie. Móviles perpetuos lograrían evitar las pérdidas irreversibles

Máquina Carnot (reversible) → Móvil perpetuo de 3ra especie

$pV^{\gamma} = cte$

49

B

isoentrópico $pV^{\gamma} = cte$

↳ Adiabática

↳ reversible

$T_B - r = p_B / p_A$

$$T_B = \left(\frac{r(\gamma - 1) + 1}{\gamma} \right)$$

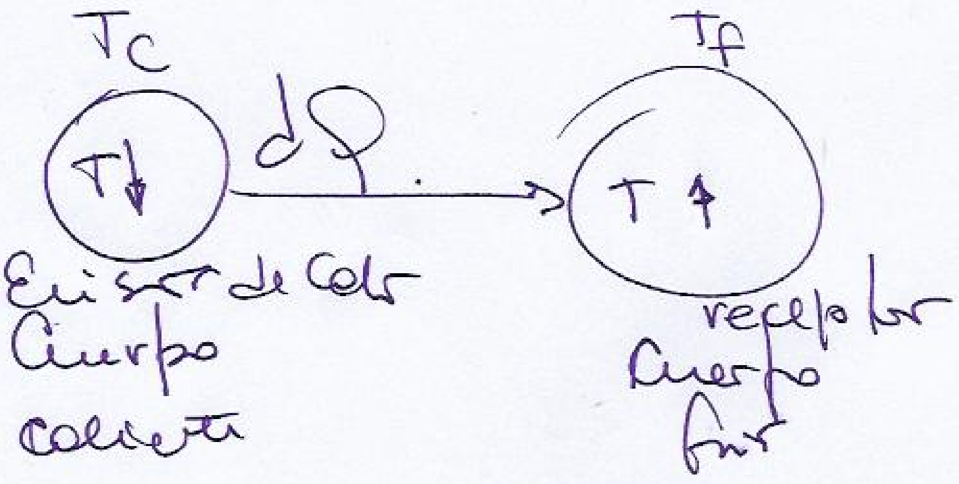
$n_A = n_B$

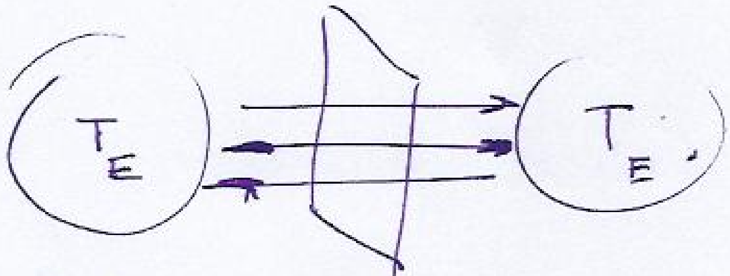
$P_B = 2atm$ $P_A = 1atm$

$$V_B = \left(\frac{r(\gamma - 1) + 1}{\gamma \cdot r} \right) V_A$$

$T_A = 293K$

$V_A = 0,1\ m^3$

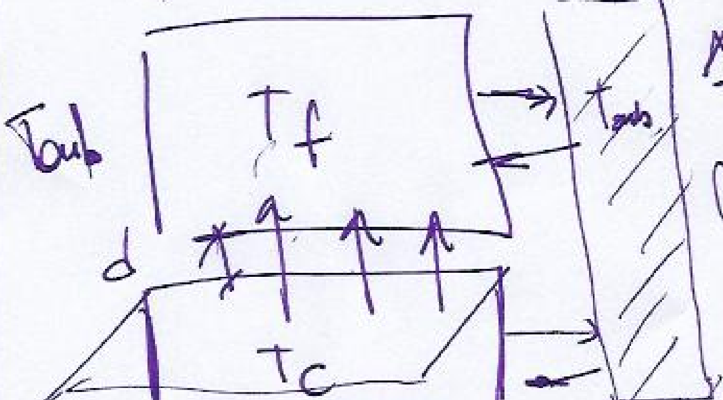




$T_C(t)$ $\quad \dfrac{dT_C}{dt} < 0$ $\qquad T_f(t) \rightarrow \dfrac{dT_f}{dt} > 0$

$$\Delta T(t) \overset{def}{=} T_C(t) - T_f(t) > 0 \rightarrow dQ > 0$$

$$\boxed{\lim_{\Delta T(t) \to 0^+} \frac{dQ}{dt} = 0^+}$$

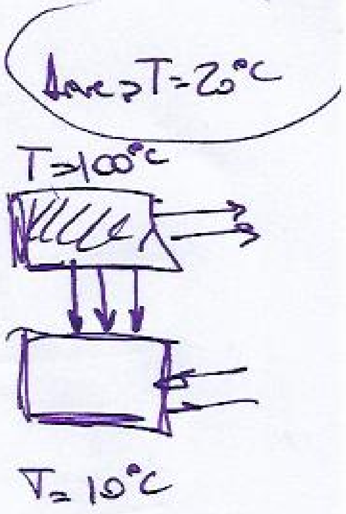


$\Delta T \overset{def}{=} T_C - T_f$

material

dist?

Área contacto?



$$\frac{dQ}{dt}$$

$$\frac{dQ}{dt} \propto A\left(T_c - T_f\right)$$

$$\cancel{\frac{1}{A}}$$

Cuerpo que se calienta

$$\frac{dQ}{dt} = \pm h\, A\left(T_c - T_f\right)$$

Cuerpo que se enfría

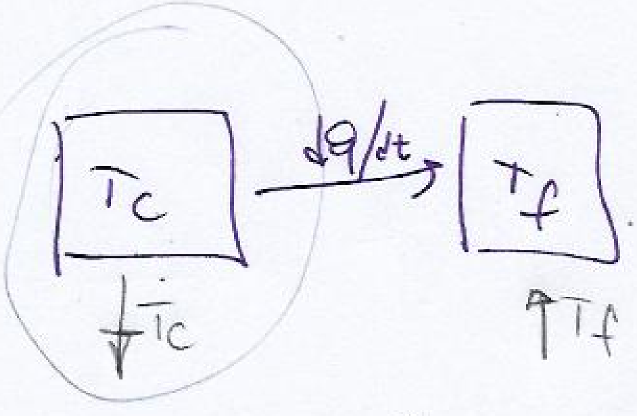
$$\boxed{\frac{dQ}{dt} = \pm h\, A\left(T_c(t) - T_f(t)\right)}$$

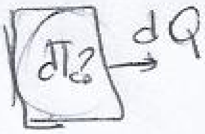
Ley de Enfriamiento

$$\underbrace{\left[dQ/dt\right]}_{W = \frac{J}{s}} = [h]\cdot[A]\cdot\left[T_c - T_f\right]$$

$$= [h]\cdot m^2 \cdot K$$

$$\boxed{[h] = \frac{J}{K\, m^2\, s} = \frac{W}{m^2 K}}$$





$$\frac{dQ}{dt} = -hA\left(T_c - T_f\right)$$

$$dQ = C_c m_c \, dT$$

$$\frac{d}{dt}\left(c_c m_c \, dT\right) = -hA\left(T_c - T_f\right)$$

$$c\, m \frac{dT}{dt} = -hA\left(T_c - T_f\right)$$

$$\frac{dT_c}{dt} = -\underbrace{\left(\frac{hA_c}{m_c c_c}\right)}_{r_c}\left(T_c - T_f\right)$$

$$\frac{dT_f}{dt} = +\left(\frac{hA}{m_f c_f}\right)\left(T_c - T_f\right)$$

$$\frac{dT_c}{dt} = -r_c\left(T_c - T_f\right)$$

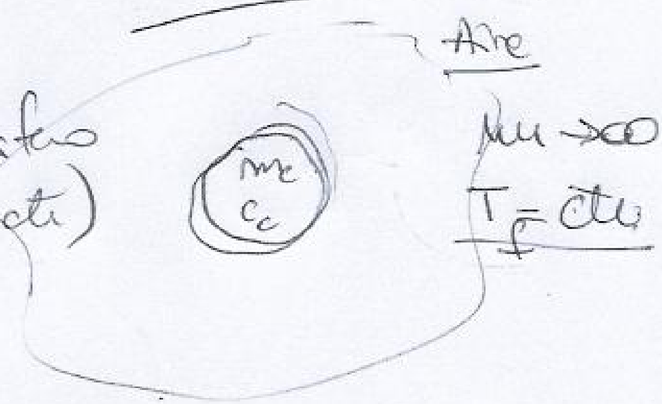
$$[r] = \frac{W/\cancel{m^2 K} \cdot m^2}{\cancel{kg} \cdot \frac{J}{\cancel{kg K}}} = \frac{W}{J} = \frac{\cancel{J}}{s \cdot \cancel{J}} = 1/s$$

$$[r] = 1/s \checkmark$$

$$\frac{dT_c}{dt} = -r\,(T_c - T_f)$$

Aire (Atmosfera $\rightarrow T_f = cte$)

T_f es el aire



$$\frac{dT_c}{dt} = -r\,(\underbrace{T_c - T_{amb}}_{\Delta T})$$

$$\frac{dT_c}{dt} = -r\,T_c(t) + \overbrace{r\,T_{Amb}}^{cte}$$

$$\Delta T = T_c(t) - T_{amb}$$

$$\frac{d\Delta T}{dt} = \frac{d}{dt}\left(T_c(t) - T_{amb}\right)$$

$$= \frac{dT_c}{dt} - \cancel{\frac{dT_{amb}}{dt}} \quad 0$$

$$= \frac{dT_c}{dt} \qquad = T_c(t) - T_{amb}$$

$$\frac{d\Delta T}{dt} = -r\,\Delta T(t)$$

defino $\tau \overset{def}{=} 1/r$

$[\tau] = \frac{1}{s^{-1}} = s$

$$r = \frac{hA}{m_c c_c} \Rightarrow \boxed{\tau = \frac{1}{r} = \frac{m_c c_c}{hA}}$$

tiempo característico del sistema

$$\frac{d\Delta T}{d\tau} = -\frac{\Delta T(t)}{\tau} = -\frac{1}{\tau}\Delta T(t)$$

$$\Delta T(t) = e^{-t/\tau} \cdot \Delta T(t=0)$$

$$\frac{\partial \Delta T}{\partial t} = e^{-t/\tau}\left(-\frac{1}{\tau}\right) \cdot \Delta T(t=0)$$

$$\Delta T(t)$$

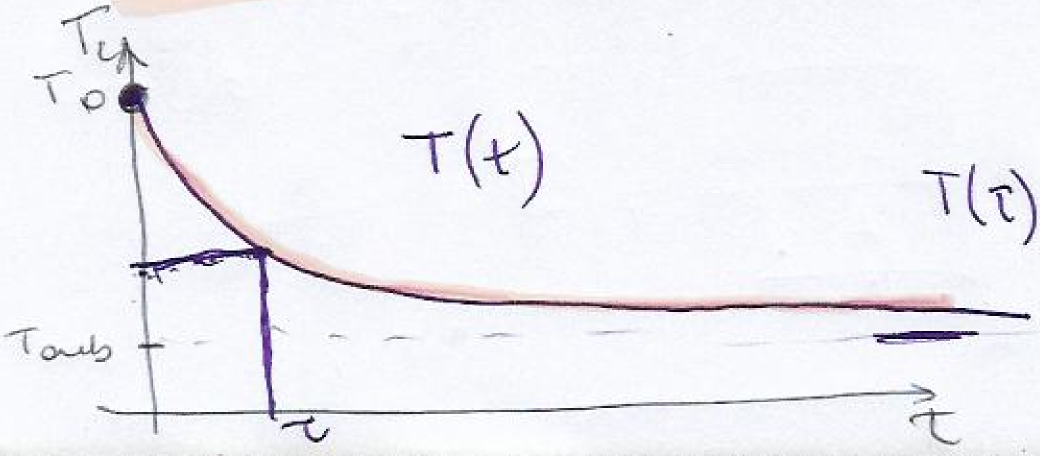
$$\frac{\partial \Delta T}{\partial t} = -\frac{1}{\tau}\Delta T(\tau)$$

$$\Delta T(t) = \Delta T(t=0) \cdot e^{-t/\tau}$$

$$T_c - T_{amb} = (T_0 - T_{amb})\, e^{-t/\tau}$$

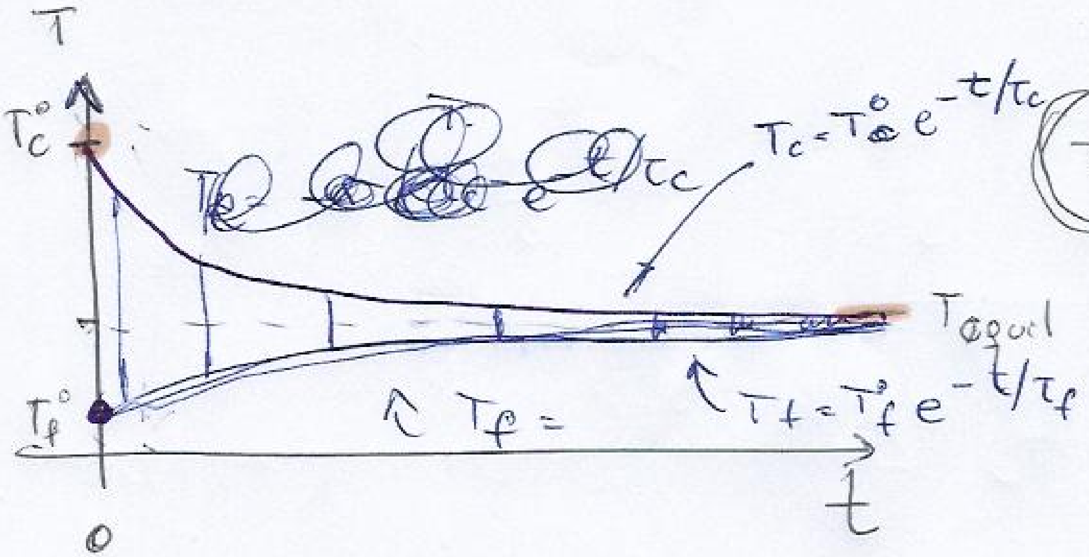
$$\boxed{T_c(t) = T_{amb} + (T_0 - T_{amb})\, e^{-t/\tau}}$$

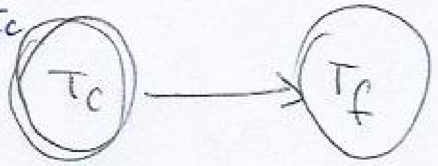
$t=0 \Rightarrow T_c = T_0$



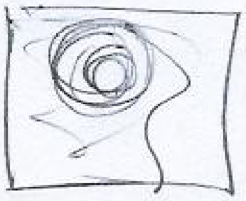
$t=\tau$

$T(\tau) = T_{amb} + (T_0 - T_{amb})e^{-1}$

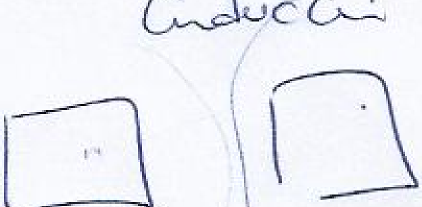




$$T_{equil} = \frac{m_c \cdot c_c T_c^0 + m_f c_f T_f^0}{m_c c_c + m_f c_f}$$



Conducción



Ley de Planck

Ley de Stefan Boltzmann

radió

radiación

radiación electromagnética

Convección