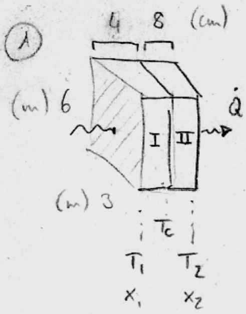
TRANSMISIÓN DE CALOR

Recuerda
misma $\dot{Q} \Rightarrow$ serie
distinto $\dot{Q} \Rightarrow$ paralelo

DATOS:

(1)



$K_1 = 10^{-2} \frac{cal}{s\,cm\,°C}$ $\quad T_1 = 80°C \quad \dot{Q} = ?$

$T_c = ?$

$K_2 = 2\cdot 10^{-2} \frac{cal}{s\,cm\,°C}$ $\quad T_2 = 10°C$

$L_1 = 4\,cm = 0'04\,m \qquad T_1 = 80°C \equiv 353\,K \qquad S = 6\cdot 3 = 18\,m^2$

$L_2 = 8\,cm = 0'08\,m \qquad T_2 = 10°C \equiv 283\,K$

$$K_1 = 10^{-2}\frac{cal}{s\,cm\,°C} \equiv 10^{-2}\frac{\cancel{cal}}{\cancel{s}}\cdot\frac{4'184\,W}{1\,\cancel{cal/s}}\cdot\frac{100\,\cancel{cm}}{1\,m}\,\frac{\cancel{°C}}{K} = 4'184\,\frac{W}{mK}$$

$1\,\frac{cal}{s} = 4'184\,W$

$$K_2 = 2\cdot 10^{-2} \equiv 2\cdot 10^{-2}\cdot 4'184\cdot 100 = 8'368\,\frac{W}{mK}$$

$1\,\frac{cal}{s} = 4'184\,W$

$$\dot{Q}_T = \frac{T_1 - T_2}{\sum_{i=1}^{2}(R_T)_i} = \frac{T_1 - T_2}{\frac{L_1}{S\cdot K_1} + \frac{L_2}{S\cdot K_2}} = \frac{353 - 283}{\frac{0'04}{18\cdot 4'184} + \frac{0'08}{18\cdot 8'368}} = \frac{70}{1'06\cdot 10^{-3}} = 66037'74\,W \equiv \boxed{15783\,\frac{cal}{s}}$$

En regimen estacionario con paredes "en serie" se cumple que:

$$\dot{Q}_T = \frac{T_1 - T_c}{\frac{L_1}{S\cdot K_1}} = \frac{T_c - T_2}{\frac{L_2}{S\cdot K_2}} \Rightarrow T_c = T_1 - \dot{Q}_T\cdot\frac{L_1}{S\cdot K_1} = 353 - 66037'74\,\frac{0'04}{18\cdot 4'184} = 318\,K \equiv \boxed{45°C}$$

Igualmente:

$$T_c = \dot{Q}_T\cdot\frac{L_2}{S K_2} + T_2 = 318\,K \equiv 45°C$$

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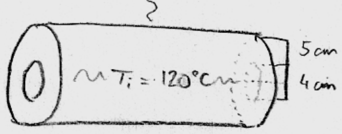
(2)

$T_e = 40°C$



DATOS

$K_e = 0'0001\,\frac{cal}{s\,cm\,°C}$

$R_e = 7\,cm \equiv 0'07\,m$

$R_i = 2\,cm \equiv 0'02\,m$

$T_i = 120°C = 393\,K$

$T_e = 40°C = 313\,K$

$K_e = 0'0001\,\frac{cal}{s\,°C\,cm}$

h para dividido

SI

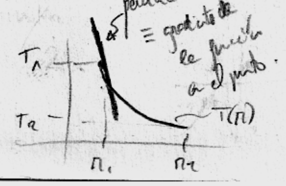
$$\left(\frac{\dot{Q}_{radial}}{h}\right) = 2\pi\cdot K_e\,\frac{T_i - T_e}{\ln\frac{R_e}{R_i}} = 2\pi\cdot 0'0001\cdot\frac{120-40}{\ln\frac{7}{2}}\,\frac{cal}{s\,cm} = \boxed{0'04\,\frac{cal}{s\,cm}}\,\frac{4'184\,W}{1\,cal}\,\frac{100\,cm}{1\,m} = \boxed{16'795\,\frac{W}{m}}$$

(conocido)

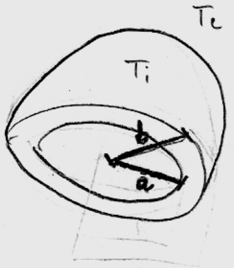
$$\text{ley de Fourier} \Rightarrow \left.\frac{dT}{dr}\right|_{(r\to r_i^+)} = \frac{\dot{Q}}{K\cdot 2\pi\cdot r\cdot h} = \frac{0'04}{0'0001\cdot 2\cdot\pi\cdot 2} = 31'93\,\frac{cal\cdot\cancel{s}\cdot °C\cdot cm}{\cancel{s}\cdot cm\cdot cal\cdot \cancel{cm}} \equiv 31'93\,\frac{°C}{\cancel{cm}}\cdot\frac{100\,\cancel{cm}}{1\,m}\,\frac{1\,K}{1\,°C} = \boxed{3193\,\frac{K}{m}}$$

$\left.\frac{\dot{Q}}{K\cdot A}\right|_{r=r_i}$

nos piden la pendiente de la recta tangente a la función $T(r)$, cuando (r) tiende a (r_i)



(3)



$T_i = 500°C$

$T_e = 20°C$

$a = 2m \equiv 200\ cm \quad (R_i)$

$b = 4m \equiv 400\ cm \quad (R_e)$

$K_c = 0'0007\ \frac{cal}{s\,cm\,°C}$

$$\dot{Q}_{esférica} = 4\pi K \frac{T_i - T_e}{\left(\frac{b-a}{b\cdot a}\right)} = 8'8\cdot 10^{-3}\ \frac{480}{\frac{200}{80000}}\ \frac{\cancel{cm^2}\cdot \cancel{°C}\cdot cal}{cm\cdot s\cdot \cancel{cm}\cdot \cancel{°C}} = \underline{\underline{1689'6\ \frac{cal}{s}}}$$

$1\ día \equiv 24\cancel{h}\ \frac{3600\,s}{1\cancel{h}} = 86400\,s \Rightarrow$ En un día se escapan $1689'6\cdot 86400$ cal $=$

$$= \boxed{1'146\cdot 10^{8}\ cal}$$

Dado que:

$\dot{Q} = 4\pi K\,(a\cdot b)\,\frac{T_i - T_e}{b-a}$; Para una b cualquiera, sea r $\quad \dot{Q}_{(r)} = 4\pi K\ a\cdot r\ \frac{T_i - T(r)}{r-a}$

Despejamos T(r) y obtenemos:

$$\frac{\dot{Q}}{4\pi K\,a\cdot r}(r-a) + T_i = -T(r) \Rightarrow \boxed{T(r) = \frac{\dot{Q}}{4\pi K}\left(\frac{1}{r} - \frac{1}{a}\right) + T_i}$$

$$\frac{(r-a)}{a\cdot r} = \frac{\cancel{r}}{a\cancel{r}} - \frac{\cancel{a}}{\cancel{a}r} = \frac{1}{a} - \frac{1}{r}$$

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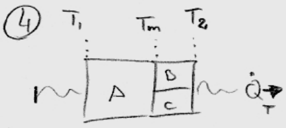
(4)



$T_1 = 100°C = 373\ K$

$T_2 = 0°C = 273\ K$

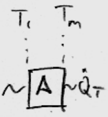
$R_{T_A} = 0'4\ \frac{Ks}{cal}$

$R_{T_B} = 1\ K/scal$

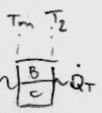
$R_{T_C} = 0'5\ K/scal$

$$\dot{Q}_T = \frac{T_1 - T_2}{R_{T_A} + \frac{R_{T_B}\cdot R_{T_C}}{R_{T_B} + R_{T_C}}} = \frac{100}{0'4 + \frac{1\cdot 0'5}{1+0'5}} = \boxed{136'36\ \frac{cal}{s}}$$

Dado que $\boxed{A}$ y $\boxed{\frac{B}{C}}$ están en serie, podemos decir que $\dot{Q}_T$ (100%) pasa por $\boxed{\frac{B}{C}}$ y por $\boxed{A}$, por tanto:



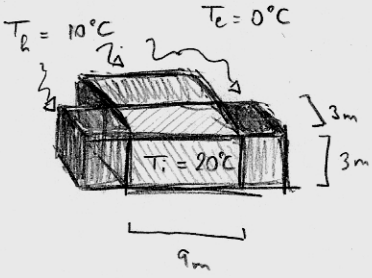
$$\Rightarrow \dot{Q}_T = \frac{T_1 - T_m}{R_{T_A}} \Rightarrow T_m = T_1 - \dot{Q}_T\cdot R_{T_A} \simeq \boxed{318\ K}$$



$$\Rightarrow \dot{Q}_T = \dot{Q}_A + \dot{Q}_B = \frac{T_m - T_2}{R_{T_A}} + \frac{T_m - T_2}{R_{T_B}} = 45'45 + 90'9\ \frac{cal}{s}$$

$$\left\{ \begin{array}{l} \dot{Q}_{A\%} = \frac{45'45\cdot 100}{136'36} = \boxed{33'\widehat{33}\ \%} \\ \dot{Q}_{B\%} = \frac{90'9\cdot 100}{136'36} = \boxed{66'66\ \%} \end{array} \right.$$

⑤



Interiores

$3\,[\,\underset{3}{1}\ \underset{3}{2}\ \underset{9}{3}\,]$

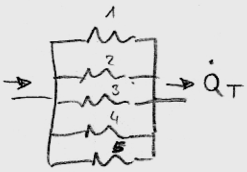
Exteriores

$[\,\underset{9}{4}\ \underset{9}{5}\,]\,3$

$L_i = 10\ cm \equiv 0'1\ m$

$L_e = 15\ cm \equiv 0'15\ m$

Análogamente:



$\dot{Q}_T = 3000\ W = 717\ cal/s$

$$\dot{Q}_T = \dot{Q}_1 + \dot{Q}_2 + \dot{Q}_3 + \dot{Q}_4 + \dot{Q}_5 = 717\ cal/s \Rightarrow$$

$$\frac{T_i - T_h}{\left(\frac{L_i}{K\cdot 3\cdot 3}\right)} + \frac{T_i - T_h}{\left(\frac{L_i}{K\cdot 3\cdot 3}\right)} + \frac{T_i - T_h}{\frac{L_i}{K\cdot 3\cdot 9}} + \frac{T_i - T_e}{\frac{L_e}{K\cdot 3\cdot 9}} + \frac{T_i - T_e}{\frac{L_e}{3\cdot 9\cdot K}} = 717\ cal/s \Rightarrow$$

$$\frac{2\,(T_i - T_h)}{\frac{L_i}{9K}} + \frac{T_i - T_h}{\frac{L_i}{27K}} + \frac{2\,(T_i - T_e)}{\frac{L_e}{27K}} = 717 \Rightarrow 1800K + 2700K + 7200K = 717\ \frac{cal}{s}$$

$$\Rightarrow K = \frac{717}{11700} = \boxed{0'0613\ \frac{cal}{s\,m\,K} \equiv 0'256\ \frac{W}{mK}}$$

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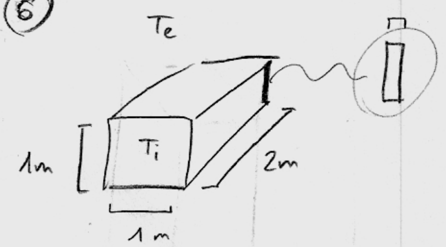
⑥



$L = 5\ cm = 0'05\ m$

$K = 0'04\ \frac{W}{mK}$

$T_i = -2°C \equiv 271\ K$

$T_e = 20°C \equiv 293\ K$

Paredes:

$1\,[\,\underset{1}{1}\ \underset{1}{2}\ \underset{2}{3}\ \underset{2}{4}\ \underset{2}{5}\ \underset{2}{6}\,]$ (en paralelo)

$$\dot{Q}_T = \dot{Q}_1 + \dot{Q}_2 + \dot{Q}_3 + \dot{Q}_4 + \dot{Q}_5 + \dot{Q}_6 \Rightarrow$$

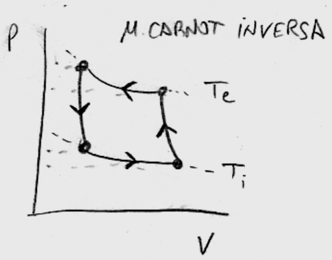
a)

$$\Rightarrow \dot{Q}_T = (T_i - T_e)\left(\frac{1}{\left(\frac{L}{1K}\right)} + \frac{1}{\left(\frac{L}{1K}\right)} + \frac{1}{\left(\frac{L}{2K}\right)} + \frac{1}{\left(\frac{L}{2K}\right)} + \frac{1}{\left(\frac{L}{2K}\right)} + \frac{1}{\left(\frac{L}{2K}\right)}\right) = (T_i - T_e)\ \frac{10K}{L} \Rightarrow$$

$$\Rightarrow \dot{Q}_T = \frac{-22}{0'05}\cdot 10\cdot 0'04\ \frac{W\cdot \cancel{m^2}\cdot K}{\cancel{m}\cdot \cancel{K}\cdot \cancel{m}} = \boxed{-176\ W}$$

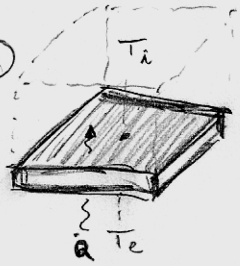
(calor que se ha de ceder al exterior para mantener la cámara a $T_i = -2°C$)

b)



$$\eta_F = \left|\frac{T_i}{T_i - T_e}\right| = 12'31 = \frac{|\dot{Q}|}{|\dot{W}|} \Rightarrow \dot{W} = \frac{|\dot{Q}|}{\eta_F} = \boxed{14'3\ W}$$

7



$S = 300\ cm^2$

$2\ mm = 0'2\ cm = L$

$T_i = 100°C$

$T_e = 150°C$

$K_c = 0'9 \dfrac{cal}{cm\, s\, °C}$

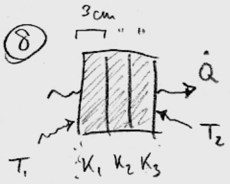
$$\dot{Q} = \frac{T_e - T_i}{\frac{L}{S\cdot K_c}} = \frac{150-100}{\frac{0'2}{300\cdot 0'9}} \frac{\cancel{°C}\cdot cal\cdot \cancel{cm^2}}{cm\cdot s\cdot \cancel{°C}\, \cancel{cm}} = 67500 \frac{cal}{s} \equiv 67'5\ Kcal/s$$

$$\dot{Q}\cdot \frac{60 s}{1 m} = 4'05\cdot 10^3\ Kcal/min$$

$$\dot{Q} = \dot{m}_e \cdot L_v \Rightarrow \dot{m}_e = \frac{\dot{Q}}{L_v} = \frac{4'05\cdot 10^3}{0'537} \frac{\cancel{Kcal}}{min}\frac{g}{\cancel{Kcal}} = 7'54\cdot 10^3\ g/min \equiv 7'54\ Kg/min$$

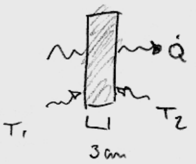
$$L_v = 537 \frac{cal}{g} \equiv 0'537 \frac{Kcal}{g}$$

8



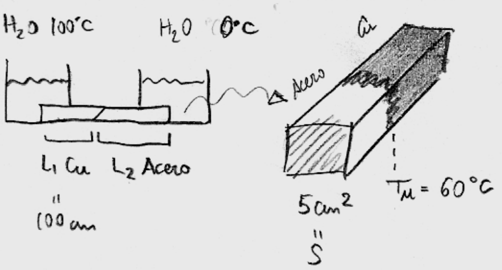
$$\dot{Q} = \frac{\Delta T\cdot S}{3\left(\frac{1}{0'01}+\frac{1}{0'02}+\frac{1}{0'04}\right)} = \frac{\Delta T\cdot S}{525} \frac{cal}{s} \Rightarrow \frac{\dot{Q}}{\Delta T S} = \frac{1}{525}$$

$T_1 - T_2 = \Delta T$



$$\dot{Q} = \frac{\Delta T}{3}\cdot SK \Rightarrow K = \frac{3\dot{Q}}{\Delta T S} = 3\cdot\frac{1}{525} = \boxed{5'71\cdot 10^{-3} \frac{cal}{s\, cm\, °C}}$$

9



$K_1 = 0'92 \dfrac{cal}{s\, cm\, °C}$

$K_2 = 0'12 \dfrac{cal}{s\, cm\, °C}$

$T_1 = 100°C$

$T_2 = 0°C$

$$\dot{Q} = \frac{T_1 - T_2}{\frac{L_1}{S\cdot K_1} + \frac{L_2}{SK_2}} \quad ; \quad \dot{Q} = \frac{T_1 - T_u}{\frac{L_1}{SK_1}} = \frac{T_u - T_2}{\frac{L_2}{SK_2}} \Rightarrow$$

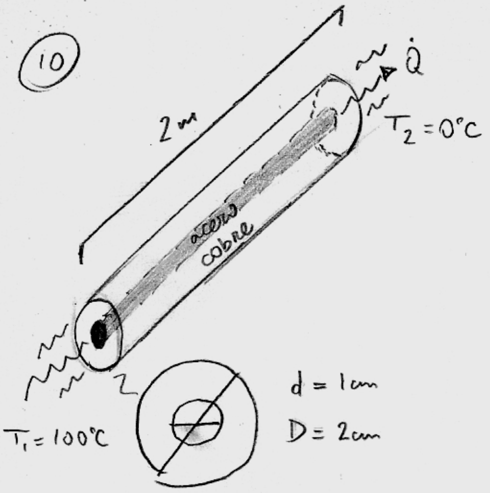
$$L_1 = \frac{T_1 - T_u}{\dot{Q}}\cdot SK_1 = 100\ cm$$

$$L_2 = \frac{T_u - T_2}{\dot{Q}}\cdot SK_2$$

$$\dot{Q} = \frac{(T_1 - T_u)}{L_1}\cdot S\cdot K_1 = \frac{40}{100}\cdot 5\cdot 0'92 = \boxed{1'84 \frac{cal}{s}}$$

$$L_2 = \frac{60-0}{1'84}\cdot 5\cdot 0'12 \simeq \boxed{20\ cm}$$

(10)



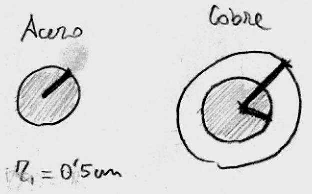
d = 1 cm
D = 2 cm

$L = 200\,cm \quad K_1 = 0'12 \frac{cal}{s\,cm\,°C} \quad K_2 = 0'92 \frac{cal}{s\,cm\,°C}$

$$Q_T = \dot{Q}_{acero} + \dot{Q}_{cobre} = 2\pi \cdot K_1 \cdot L_1 \cdot r_1 (T_1 - T_2) + 2\pi K_2 \cdot L \frac{T_1 - T_2}{\ln \frac{r_{e2}}{r_{i2}}} =$$

$$= 2 \cdot \pi \cdot 0'12 \cdot 200 \cdot 0'5 \cdot 100 + 2\pi \cdot 0'92 \cdot 200 \frac{100}{\ln \frac{1}{0'5}} =$$

$$= 7540 + 166791 = \boxed{174241 \frac{cal}{s} \equiv 41645\,W}$$



$r_{e2} = 1\,cm$

$r_{i2} = 0'5\,cm$

$$\dot{Q}_{acero\,\%} = \frac{\dot{Q}_{acero}}{\dot{Q}_T} \cdot 100 = \boxed{4\%}$$

$$\dot{Q}_{cobre\,\%} = \frac{\dot{Q}_{cobre}}{\dot{Q}_T} \cdot 100 = \boxed{96\,\%}$$

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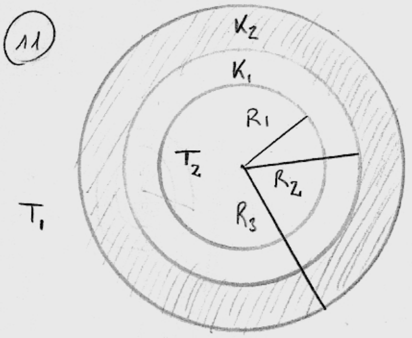
(11)



$K_1 = 2'5 \cdot 10^{-4} \frac{cal}{s\,cm\,K}$

$K_2 = 1'7 \cdot 10^{-4} \frac{cal}{s\,cm\,K}$

$T_1 = 20°C \equiv 293\,K$

$T_2 = 10\,K$

$$\frac{\dot{Q}_{sin\ aislante}}{L} = 2\pi K_1 \frac{T_1 - T_2}{\ln \frac{R_2}{R_1}} = 2\pi \cdot 2'5 \cdot 10^{-4} \frac{283}{\ln \frac{R_2}{R_1}} = \frac{0'44}{\ln R_2/R_1} = \frac{1}{\frac{1}{0'44} \cdot \ln \frac{R_2}{R_1}} = \frac{1}{\ln \left(\frac{R_2}{R_1}\right)^{2'27}}$$

$$\frac{\dot{Q}_{con\ aislante}}{L} = \frac{T_1 - T_2}{\frac{\ln \frac{R_2}{R_1}}{2\pi K_1} + \frac{\ln \frac{R_3}{R_2}}{2\pi K_2}} = \frac{283}{\frac{\ln R_2/R_1}{2\pi \cdot 2'5 \cdot 10^{-4}} + \frac{\ln R_3/R_2}{2 \cdot \pi \cdot 1'7 \cdot 10^{-4}}} = \frac{283}{\left(\frac{1'07 \cdot 10^{-3} \ln \frac{R_2}{R_1} + 1'57 \cdot 10^{-3} \ln \frac{R_3}{R_2}}{1'678 \cdot 10^{-6}}\right)} = \frac{4'75 \cdot 10^{-4}}{\ln\left(\frac{R_2}{R_1}\right)^{1'07 \cdot 10^{-3}} + \ln\left(\frac{R_3}{R_2}\right)^{1'57 \cdot 10^{-3}}} =$$

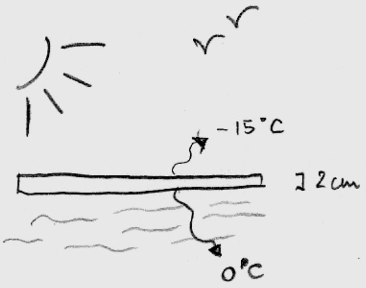
$$= \frac{1}{\frac{1}{4'75 \cdot 10^{-4}}\left(\ln\left(\frac{R_2}{R_1}\right)^{1'07 \cdot 10^{-3}} + \ln\left(\frac{R_3}{R_2}\right)^{1'57 \cdot 10^{-3}}\right)} = \frac{1}{\ln\left(\frac{R_2}{R_1}\right)^{2'25} + \ln\left(\frac{R_3}{R_2}\right)^{3'3}}$$

Imponemos:

$$\dot{Q}_{sin\ aislante} \cdot \frac{10}{100} = \dot{Q}_{con\ aislante} \Rightarrow \frac{1}{\ln\left(\frac{R_2}{R_1}\right)^{22'7}} = \frac{1}{\ln\left(\frac{R_2}{R_1}\right)^{2'25} + \ln\left(\frac{R_3}{R_2}\right)^{3'3}} \Rightarrow \ln\left(\frac{R_2}{R_1}\right)^{22'7} - \ln\left(\frac{R_2}{R_1}\right)^{2'25} = \ln\left(\frac{R_3}{R_2}\right)^{3'3} \Rightarrow$$

$$\Rightarrow \ln\left(\frac{R_2}{R_1}\right)^{20'45} = \ln\left(\frac{R_3}{R_2}\right)^{3'3} \Rightarrow \left(\frac{R_2}{R_1}\right)^{\frac{20'45}{3'3}} = \frac{R_3}{R_2} \Rightarrow \boxed{\frac{R_3}{R_2} = \left(\frac{R_2}{R_1}\right)^{6'2}}$$

(12)



$L_f = 80 \ \frac{cal}{g}$

$\rho_h = 0'91 \ g/cm^3$

$K_h = 0'005 \ \frac{cal}{cm \, s \, °C}$

$T_1 = 0°C \equiv 273 K$

$T_2 = -15°C \equiv 258 K$

$L = 2 cm$

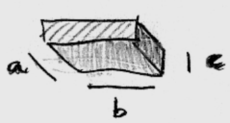
$$\frac{\dot{Q}}{S} = KS\frac{T_1 - T_2}{L} = 0'005 \cdot \frac{15}{2} = 0'0375 \ \frac{cal}{s \cdot cm^2}$$

Es decir, a través del hielo se van escapando $0'0375 \ \frac{cal}{s}$ del agua líquida.

Por tanto:

$$\frac{\dot{Q}}{S} = m_e \cdot L_f$$

; Nótese que:



$$\rho_h = \frac{m_h}{V_h} = \frac{m_h}{S \cdot e} \Rightarrow m_h = \rho_h \cdot S \cdot e$$

$$\underbrace{a \cdot b}_{S} \cdot \underbrace{c}_{e} = V_h = S \cdot e$$

superficie espesor

Además:

$\rho_e = 1 \ \frac{g}{cm^3}$

$\rho_h = 0'91 \ g/cm^3$

$$\Rightarrow m_e = 0'91 \, m_h$$

Por tanto:

$$\frac{\dot{Q}}{S} = m_e \cdot L_f = 0'91 m_h \cdot L_f \Rightarrow 0'91 \cdot \rho_h \cdot S \cdot e \cdot L_f = \frac{\dot{Q}}{S} \Rightarrow$$

$m_e = 0'91 \, m_h$

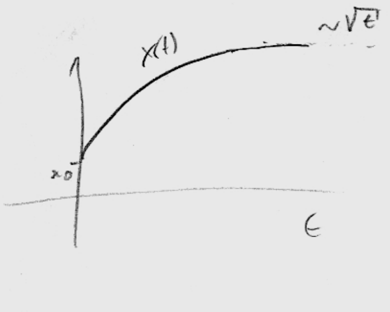
$m_h = \rho_h \cdot S \cdot e$

$$\Rightarrow e = \frac{\dot{Q}}{0'91 \cdot \rho_h \cdot L_f S^2} = \frac{0'0375}{0'91 \cdot 0'91 \cdot 80 \cdot S^2} \frac{cal \cdot cm^3 \cdot g}{s \cdot g \cdot cal \, cm^2} = \frac{5'66 \cdot 10^{-4}}{S^2} \cdot \frac{cm}{s} \equiv \frac{5'66 \cdot 10^{-4}}{S^2} \frac{cm}{s} \frac{3600 s}{1 h} = \boxed{\frac{2'04}{S^2} \frac{cm}{h}}$$

~~Mal Seguir~~

$$\frac{dx}{dt} = \frac{K}{\rho_h L_f} \frac{\Delta t}{\Delta x} = 1'8544 \ cm/h$$

$$\frac{dx}{dt} = \left(\frac{K}{\rho_h L_f}\frac{\Delta T}{x}\right) = cte \overset{\text{val}}{=} \beta \Rightarrow \int_{x_0}^{x(t)} x dx = \int_0^t \beta dt \Rightarrow x(t) = \sqrt{x_0^2 + 2\beta t}$$

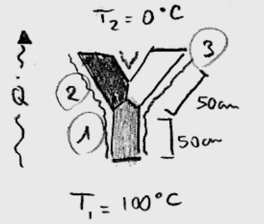


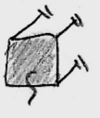
(13) DATOS:

1 cobre
2 latón
3 acero

$K_1 = 0'092$
$K_2 = 0'026$ $\left(\frac{Kcal}{m \cdot s \cdot K}\right)$
$K_3 = 0'012$

$T_1 = 100°C \equiv 373\ K$
$T_2 = 0°C \equiv 273\ K$
$L = 50\ cm \equiv 0'5\ m$





a)

$$\dot{Q}_T = \frac{T_1 - T_2}{R_{T_1} + \frac{R_{T_2} R_{T_3}}{R_{T_2} + R_{T_3}}}$$

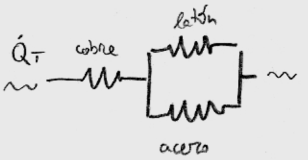
$$R_{T_1} = \frac{L}{K_1 \cdot S} = 272\ \frac{\cancel{m} \cdot s \cdot K\ \cancel{m}}{Kcal \cdot \cancel{m^2}} \quad \left(\frac{sK}{Kcal}\right)$$

$$R_{T_2} = \frac{L}{K_2 \cdot S} = 962\ \frac{sK}{Kcal}$$

$$R_{T_3} = \frac{L}{K_3 \cdot S} = 2083\ \frac{sK}{Kcal}$$

$$\Rightarrow \dot{Q}_T = \frac{373 - 273}{272 + \frac{963 \cdot 2083}{963 + 2083}} = \frac{100}{930} = 0'107\ \frac{Kcal \cdot \cancel{K}}{s\cancel{K}} \quad \left(\frac{Kcal}{s}\right) \equiv 1'07 \cdot 10^2\ \frac{cal}{s}$$

b) $\dot{Q}_T$ pasa por el cobre al 100% $\Leftrightarrow$ $\dot{Q}_{cobre\,\%} = 100\%$ $\Rightarrow$



$$\Rightarrow \dot{Q}_T = \frac{T_1 - T_M}{R_{T_1}} \Rightarrow T_M = T_1 - \dot{Q}_T R_{T_1} = 344\ K$$

$$\dot{Q}_T = \dot{Q}_{acero} + \dot{Q}_{latón} \Rightarrow$$

$$\dot{Q}_{latón} = \frac{T_M - T_2}{R_{T_2}} = 0'074\ \frac{Kcal}{s}$$

$$\dot{Q}_{acero} = \frac{T_M - T_2}{R_{T_3}} = 0'034\ \frac{Kcal}{s}$$

$$\Rightarrow \dot{Q}_{latón\,\%} = \frac{\dot{Q}_{latón}}{\dot{Q}_T} \cdot 100 = 69\%$$

$$\dot{Q}_{acero\,\%} = \frac{\dot{Q}_{acero}}{\dot{Q}_T} \cdot 100 = 31\%$$

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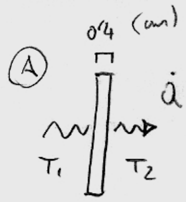
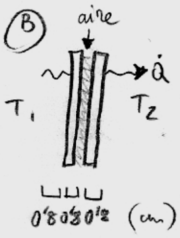
(14)



$$K_{aist.} = 0'0026\ \frac{cal}{m \cdot s K} \equiv 2'6 \cdot 10^{-5}\ \frac{cal}{cm \cdot s \cdot K}$$

$$K_{aire} = 5'7 \cdot 10^{-5}\ \frac{cal}{cm \cdot s \cdot K}$$



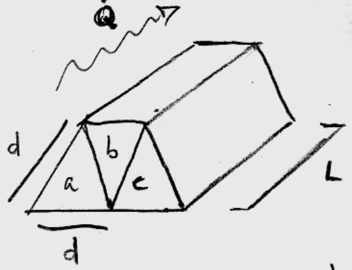
$$\dot{Q}_A = \frac{\Delta T}{L} \cdot K \cdot S = 6'5 \cdot 10^{-5}\ \Delta T \cdot S\ \frac{cal}{s}$$

$$\dot{Q}_B = \frac{\Delta T}{\frac{L}{K_c \cdot S} + \frac{L}{K_a \cdot S} + \frac{L}{K_c \cdot S}} = \frac{\Delta T}{\frac{0'8}{S}\left(\frac{1}{K_c} + \frac{1}{K_a} + \frac{1}{K_c}\right)} = 1'32 \cdot 10^{-5}\ \Delta T \cdot S\ \frac{cal}{s}$$

Se ha reducido en un $\boxed{80\%}$

$$100 - \frac{\dot{Q}_B}{\dot{Q}_A} \cdot 100 = 80$$

(15)



DATOS:

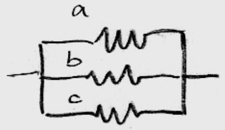
K_a

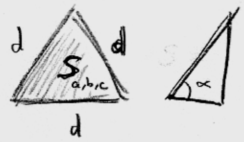
K_b

K_c

$T_1 - T_2 \overset{def}{=} \Delta T$

Analogía:





$\alpha = 60^\circ$

$h = \sin 60 \cdot d = d \cdot \frac{\sqrt{3}}{2}$

$S_\Delta = \frac{d \cdot h}{2} = \frac{d^2\sqrt{3}}{4}$

a)

$$\dot{Q}_{barra} = K \cdot S \frac{\Delta T}{L} \quad ; \quad S = 3 \cdot S_\Delta = \frac{d^2\, 3\sqrt{3}}{4}$$

$$\dot{Q} = \Delta T \left(\frac{1}{R_{T_a}} + \frac{1}{R_{T_b}} + \frac{1}{R_{T_c}} \right) = \Delta T \left(\frac{K_a S_\Delta}{L} + \frac{K_b S_\Delta}{L} + \frac{K_c S_\Delta}{L} \right) = \frac{\Delta T\, S_\Delta}{L} (K_a + K_b + K_c)$$

$$= \frac{\sqrt{3}}{4} d^2 \frac{\Delta T}{L} (K_a + K_b + K_c)$$

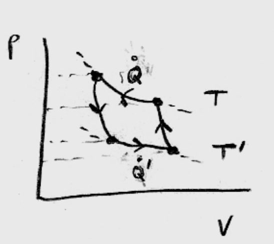
Imponemos:

$$\dot{Q} = \dot{Q} = \frac{3\sqrt{3}}{4} \cdot d^2 \frac{\Delta T}{L} K = \frac{\sqrt{3}}{4} d^2 \frac{\Delta T}{L} (K_a + K_b + K_c)$$

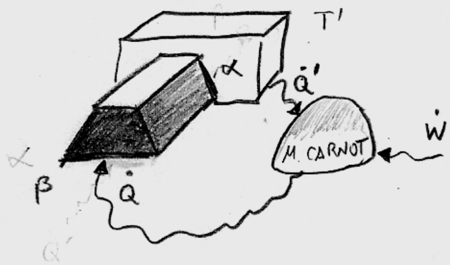
$$\Rightarrow K = \frac{(K_a + K_b + K_c)}{3} \quad \Rightarrow R_T = \frac{3L}{(K_a + K_b + K_c) \cdot S} = \frac{\cancel{3}L \cdot 4}{d^2 (K_a + K_b + K_c)\, \cancel{3}\sqrt{3}}$$

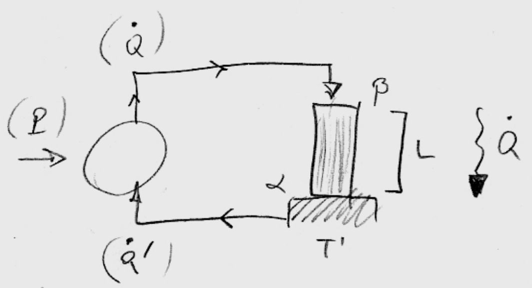
$$= \boxed{\frac{4L}{d^2 (K_a + K_b + K_c)\sqrt{3}}}$$

b)



$$\eta_F = \left| \frac{\dot{Q}'}{\dot{W}} \right| = \frac{T'}{T' - T} \Rightarrow \frac{T' - T}{T'} = \frac{\dot{W}}{\dot{Q}'} \Rightarrow T = T' - \frac{\dot{W} T'}{\dot{Q}'}$$





ciclo reversible

$$\Delta S_u = 0$$

$$\Downarrow$$

$$\underbrace{\frac{\dot{Q}}{T} + \frac{\dot{Q}'}{T'}}_{\frac{\Delta S_1}{dt} + \frac{\Delta S_2}{dt}} = 0 \Rightarrow$$

$$\Downarrow$$

$$\dot{Q}' = -\frac{T'}{T} \cdot \dot{Q} =$$

$$= -\frac{T'}{T} \left(\frac{T' - T}{R} \right) \Rightarrow$$

$$\Rightarrow \dot{Q} + \dot{Q}' + P = 0$$

$$\Swarrow$$

multiplicamos por $\times RT$

$$\Rightarrow \frac{T' - T}{R} - \frac{T'}{T}\left(\frac{T' - T}{R} \right) + P = 0 \quad \Rightarrow \boxed{T^2 - [2T' + RP]\, T + T'^2 = 0}$$ resolvemos ec. de 2º grado.

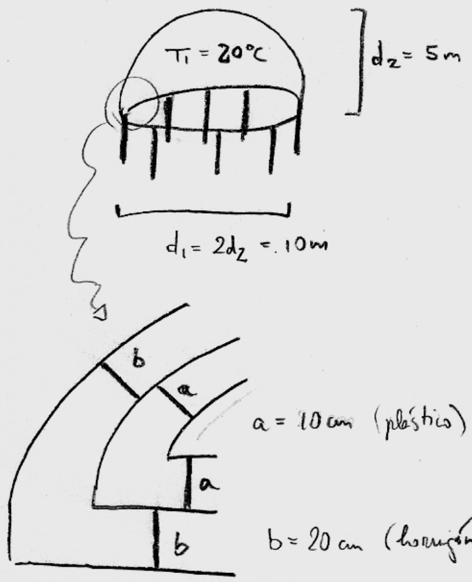
$$T = \frac{(2T' + RP) \oplus [(2T' + RP)^2 - 4T'^2]^{1/2}}{2} = T' + \frac{RP}{2} + \frac{RP}{2}\left(1 + \frac{4T'}{RP}\right)^{1/2}$$

(16)

$T_2 = -60°C$

10 personas disipan cada una

$\left\{ \begin{array}{ll} \times \text{ equipo} & 50\,W \\ \times \text{ ellas mismas} & 100\,W \end{array} \right. \Rightarrow 1500\,W$ disipados

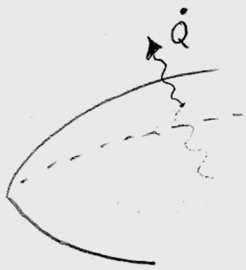


$K_{plástico} = 0'05\ \frac{W}{mK}$

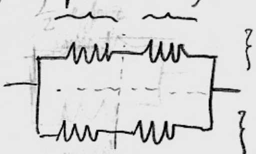
$K_{hormigón} = 0'2\ \frac{W}{mK}$

a = 10 cm (plástico)

b = 20 cm (hormigón)



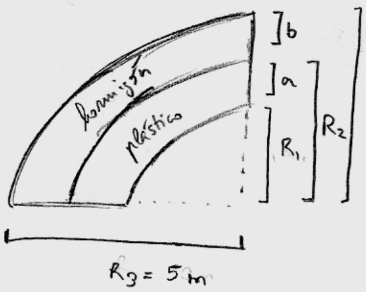
a)



} esférico $\left(\frac{1}{2}\right)$

} pared

$$\Rightarrow \dot{Q}_T = \frac{1}{2}\left(\frac{\Delta T}{R_{T_{esf.pl.}} + R_{T_{esf.h.}}}\right) + \frac{\Delta T}{R_{pared\,pl.} + R_{T_{pared\,h.}}}$$



$R_2 = R_3 - 0'2 = 4'8\ m$

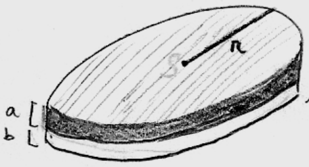
$R_1 = R_2 - 0'1 = 4'7\ m$

$$\Rightarrow R_{T_{esf.\,plást.}} = \frac{R_2 - R_1}{4\pi K_p \cdot R_2 R_1} = 7'05 \cdot 10^{-3}\ \frac{K}{W}$$

$$R_{T_{esf.\,h}} = \frac{R_3 - R_2}{4\pi \cdot K_h \cdot R_2 \cdot R_3} = 3'32 \cdot 10^{-3}\ \frac{K}{W}$$

$r = 5m$

$S = \pi \cdot r^2 = 5^2 \cdot \pi$



plástico $L_p = 0'1$

hormigón $L_h = 0'2$

$$\Rightarrow R_{T_{pared\,pl.}} = \frac{L_p}{K_p \cdot S} = 2'55 \cdot 10^{-2}\ \frac{K}{W}$$

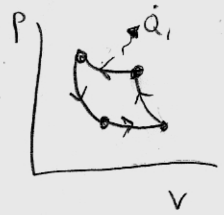
$$R_{T_{pared\,h.}} = \frac{L_h}{K_h \cdot S} = 1'27 \cdot 10^{-2}\ \frac{K}{W}$$

$$\Rightarrow \dot{Q}_T = \frac{1}{2}\left(\frac{\Delta T}{R_{T_{esf\,pl}} + R_{T_{esf\,h}}}\right) + \left(\frac{\Delta T}{R_{T_{par\,pl}} + R_{T_{par\,h}}}\right) = \frac{1}{2}\left(\frac{80}{(7'05 + 3'32)\cdot 10^{-3}}\right) + \frac{80}{(2'55 + 1'27)\cdot 10^{-2}} = 5950\ W$$

Hay que disipar $\dot{Q}_T - 1500\,W = \boxed{4450\ W}$

corrección al dorso

%

b) 

$$\eta_{BC} = \left|\frac{\dot{Q}_1}{\dot{W}}\right| = \frac{T_C}{T_C - T_F} = \frac{293}{293-213} = 3'66$$

Potencia teórica

$$\Rightarrow \quad \dot{W} = \frac{\dot{Q}}{3'66} = \frac{4450}{3'66} = \boxed{1215\ W}$$

Potencia real (40%)

$$\eta_R = \eta_{BC} \cdot \frac{40}{100} = 1'464 \qquad \dot{W}_R = \frac{\dot{Q}}{1'464} = \boxed{3040\ W}$$

c) ?

d) $C_{int.} = 4'18 \cdot 10^7\ J/K$

$$\dot{Q} = C_{int.}\,(253 - 293) = -1'67 \cdot 10^9\ J \equiv -4 \cdot 10^8\ cal$$

Sin el personal

$T_i = 20\,°C \equiv 293\,K$

$T_f = -20\,°C \equiv 253\,K$

Suponiendo que se disiparan 5950 W (independientemente de la Tª)

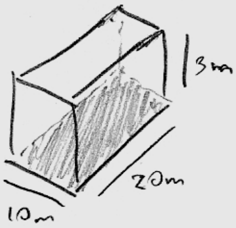
$$5950\ W \equiv 1'42 \cdot 10^3\ \frac{cal}{s}$$

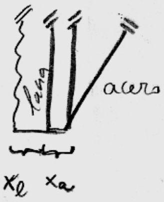
$$\frac{4 \cdot 10^8\ \cancel{cal} \cdot s}{1'42 \cdot 10^3\ \cancel{cal}} = 2'82 \cdot 10^5\ s \equiv 78\ h \quad (3\ \text{días y } 6\ \text{horas})$$

(17)

$T_{int} = 20°C$

$T_{ext} = -40°C$





$K_a = 16 \frac{W}{mK}$

$K_\ell = 0'042 \frac{W}{mK}$

$x_a = 5mm \equiv 0'005 m$

$x_\ell = 20 cm \equiv 0'2 m$

Paredes:

$\boxed{1}$ $\boxed{2}$ $10 \times 3 = 30 m^2$

$\boxed{3}$ $\boxed{4}$ $\boxed{5}$ $20 \times 3 = 60 m^2$