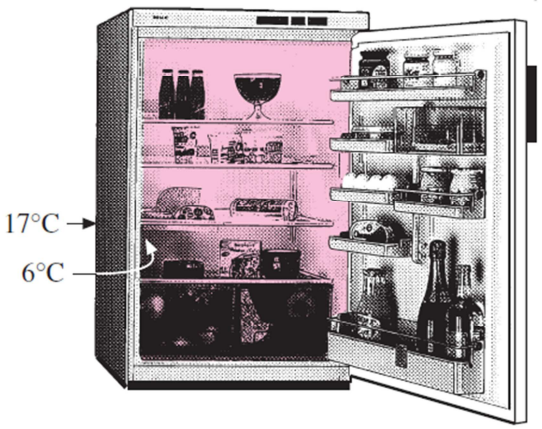
# LISTA DE EXERCÍCIOS – 1° PROVA

1) The roof of a house consists of a 15-cm-thick concrete slab ($k = 2$ W/m · °C) that is 15 m wide and 20 m long. The emissivity of the outer surface of the roof is 0.9, and the convection heat transfer coefficient on that surface is estimated to be 15 W/m$^2$ · °C. The inner surface of the roof is maintained at 15°C. On a clear winter night, the ambient air is reported to be at 10°C while the night sky temperature for radiation heat transfer is 255 K. Considering both radiation and convection heat transfer, determine the outer surface temperature and the rate of heat transfer through the roof.

If the house is heated by a furnace burning natural gas with an efficiency of 85 percent, and the unit cost of natural gas is $0.60/therm (1 therm = 105,500 kJ of energy content), determine the money lost through the roof that night during a 14-hour period.

R: 8,64 °C e $ 8,58

2) Consider a refrigerator whose dimensions are 1.8 m × 1.2 m × 0.8 m and whose walls are 3 cm thick. The refrigerator consumes 600 W of power when operating and has a COP of 2.5. It is observed that the motor of the refrigerator remains on for 5 minutes and then is off for 15 minutes periodically. If the average temperatures at the inner and outer surfaces of the refrigerator are 6°C and 17°C, respectively, determine the average thermal conductivity of the refrigerator walls. Also, determine the annual cost of operating this refrigerator if the unit cost of electricity is $0.08/kWh.




R: 0,112 W/ mK e $ 105,1/ ano

3) Consider a medium in which the heat conduction equation is given in its simplest form as

$$\frac{\partial^2 T}{\partial x^2} = \frac{1}{\alpha}\frac{\partial T}{\partial t}$$

(*a*) Is heat transfer steady or transient?
(*b*) Is heat transfer one-, two-, or three-dimensional?
(*c*) Is there heat generation in the medium?
(*d*) Is the thermal conductivity of the medium constant or variable?

4) Consider a long solid cylinder of radius $r_0 = 4$ cm and thermal conductivity $k = 25$ W/m · °C. Heat is generated in the cylinder uniformly at a rate of $\dot{g}_0 = 35$ W/cm$^3$. The side surface of the cylinder is maintained at a constant temperature of $T_s = 80$°C. The variation of temperature in the cylinder is given by

$$T(r) = \frac{\dot{g} r_0^2}{k}\left[1 - \left(\frac{r}{r_0}\right)^2\right] + T_s$$

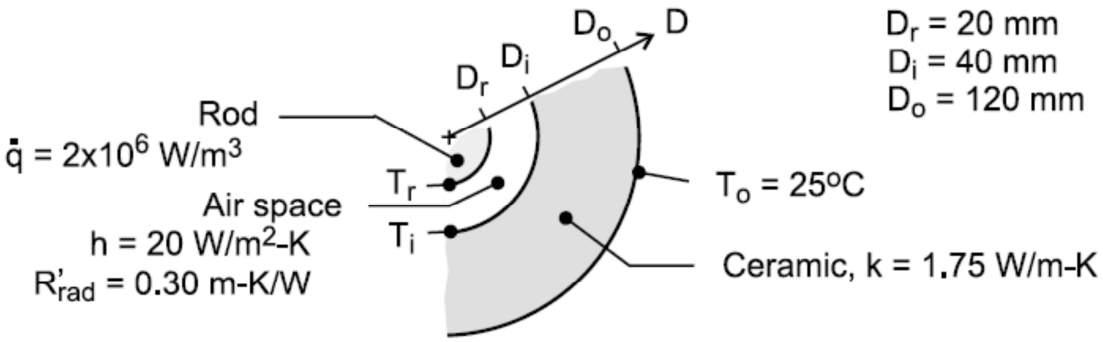
Based on this relation, determine (*a*) if the heat conduction is steady or transient, (*b*) if it is one-, two-, or three-dimensional, and (*c*) the value of heat flux on the side surface of the cylinder at $r = r_0$.

C) 280 W/cm$^2$

5) Corrente elétrica flui através de uma barra longa gerando energia elétrica a uma taxa volumétrica uniforme $\dot{q} = 2.10^6$ W/m³. A barra é concêntrica com um cilindro oco de cerâmica, criando um invólucro que é preenchido com ar. A resistência térmica por unidade de comprimento devido a radiação entre as superfícies do invólucro é Rrad = 0.3 m.K/W e o coeficiente associado à convecção livre é de 20 W/m²K.

a) Construa um circuito térmico que possa ser utilizado para calcular a temperatura da superfície da barra Tr.

b) Calcule a temperatura da barra para as condições prescritas. **R: 239 °C**

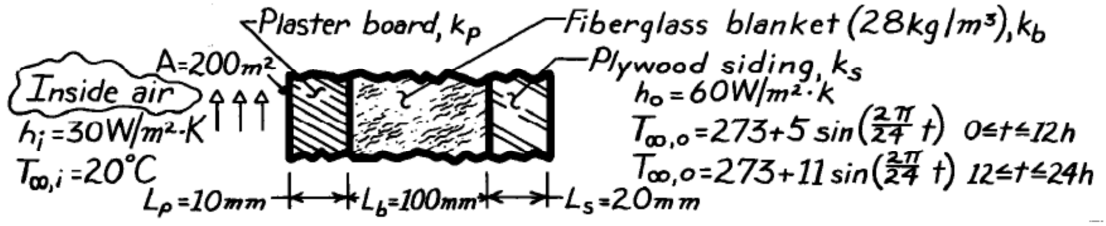



6) Uma casa tem uma parede formada por três materiais como indica a figura. Considerando as condições interna e externas mostradas, estime a perda de calor diária através da parede (kW.h). Despreze a energia armazenada na parede.

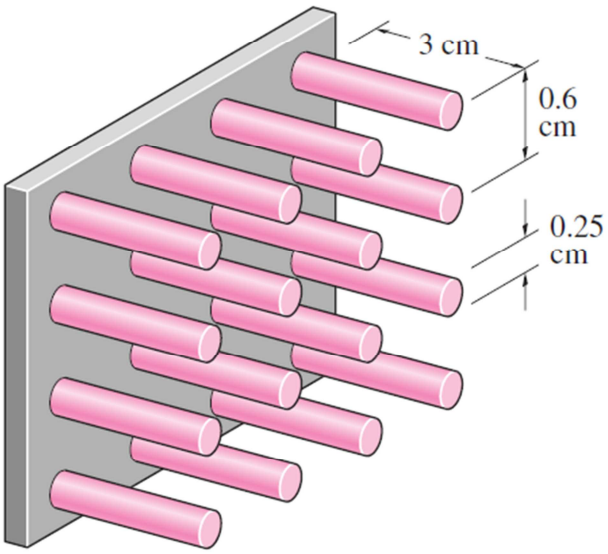
Dados:

K plaster = 0.17 W/mK
K fiberglass = 0.038 W/mK
K Plywood = 0.12 W/mK

**R: 36,18 kW.h**



7) A hot surface at 100°C is to be cooled by attaching 3-cm-long, 0.25-cm-diameter aluminum pin fins ($k$ = 237 W/m · °C) to it, with a center-to-center distance of 0.6 cm. The temperature of the surrounding medium is 30°C, and the heat transfer coefficient on the surfaces is 35 W/m$^2$ · °C. Determine the rate of heat transfer from the surface for a 1-m × 1-m section of the plate. Also determine the overall effectiveness of the fins.




R: 0,942