TASK 1

	Wood	Insulation
Outside air	0,03	0,03
Wood Bevel (13x200mm)	0.14	0,14
Polywood (13mm)	0,11	0,11
Urethane Rigif foam insulat.(90mm)	-	3,52
Wood studs (90mm)	0,63	-
Gypsum board (13mm)	0,079	0,079
Inside surface	0,12	0,12

R'wood = 1.109 m2 °C / W

R' insulation = 4 m2 °C / W

$1 / R_{tot} = (1 / R_{wood}) + (1 / R_{ins})$ $R' = R \times A$

$R = (R'/A')\ (A_{tot} / R'_{tot})$ => $A_{tot} / R'_{tot} = A_{wood}/R'_{wood} + A_{ins}/R'_{ins}$

$U = 1 / R'$

$U_{tot} \times A_{tot} = (U_{wood} \times A_{wood}) + (U_{ins} \times A_{ins})$

$U_{tot} = U_{wood} \times (A_{wood}/A_{tot}) + U_{ins} \times (A_{ins}/A_{tot}) = 0{,}412\ W / m^2\ °C$

$R_{value} = 1 / U_{tot} = 2{,}423\ m^2\ °C / W$

$Q^{dot}_{tot} = U_{tot} \times A_{tot} \times \text{delta}T = 990{,}24\ W$

TASK 2

Irradiation is a method of transmitting heat that does not include a medium. In fact, conduction and convection occur macroscopically within a body by means of microscopic interactions between the various particles that constitute it; in the absence of matter, conduction and convection are not possible. Radiation can also occur through the void (however, the presence of two bodies is necessary, for a heat exchange).

In the absorbent body, due to the action of thermal radiation, molecular agitation is increased, and therefore, macroscopically, we register an increase in temperature.

The heat exchanged by radiation is transmitted mainly from the body at a higher temperature to that at a lower temperature; in reality, energy propagates in both directions, but with less intensity from cold to warm. In fact, if a body emanates only and never absorbed electromagnetic energy, its temperature would reach absolute zero. Furthermore, a body with a temperature equal to absolute zero could not transmit heat by radiation.

The amount of heat transmitted by the radiation, however, is small if compared with that transmitted by conduction or convection: in fact, according to a law that goes under the name of Stefan-Boltzmann Law, it is proportional to T^4 , and therefore grows very rapidly with increasing temperature, while at low temperatures it is almost imperceptible. Indeed $E=\sigma T4$, where σ is precisely the Stefan-Boltzmann constant ($5.67\cdot10-8$ W m−2 K−4).

The radiation provides for two types of bodies: one emitter, the other absorbent. However, it must be kept in mind that the two phenomena are present simultaneously: each body both absorbs and emits a thermal radiation.

We define the black body as that body which, placed in thermodynamic equilibrium, completely absorbs all the electromagnetic radiation it receives, without reflecting even a part of it: in particular, therefore, it absorbs all the heat it receives by radiation.

In general, the body at higher temperature radiates more energy to the body at a lower temperature than that which it absorbs, until there is an equilibrium situation, in which they reach the same temperature. In this case the radiated and absorbed energy compensate.

Plank's law:

$$E_{b\lambda}(\lambda, T) = \frac{C_1}{\lambda^5[\exp(C_2/\lambda T) - 1]} \qquad (\mathrm{W/m^2 \cdot \mu m})$$

$$C_1 = 2\pi h c_0^2 = 3.74177 \times 10^8\ \mathrm{W \cdot \mu m^4/m^2}$$

$$C_2 = hc_0/k = 1.43878 \times 10^4\ \mathrm{\mu m \cdot K}$$

$k = 1.38065 \times 10^{-23}$ J/K *Boltzmann's constant*