4th Week homework

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Question 1

$R_{with\ wood} = 0.03+0.14+0.11+0.63+0.12+0.079=1.109\ m^2\ ^0c/w$

$R_{with\ insulation} = 0.03+0.14+0.11+3.528+0.12+0.079=4.007\ m^2\ ^0c/w$

$U_{wood} = 1/\ R'_{with\ wood} = 1/1.109 =0.9017\ w/m^2\ ^0c$

$U_{insulation} = 1/\ R'_{with\ insulation} =1/4.007=0.2496\ w/m^2\ ^0c$

$U_{total} = U_{wood} * A_{wood} / A_{total} + U_{insulation} * A_{insulation} / A_{total} = 0.25* 0.9017 + 0.75 *0.2496 = 0.4126\ w/m^2\ ^0c$

$R_{value} = 1/\ U_{total} = 1/0.4126 = 2.4237\ m^2\ ^0c/w$

$Q_{total} = U_{total} * A_{total} * \Delta T = 0.4126*50*25*(1-0.2)* 24= 990.24\ w$

Question 2

Everything in world emit some kind of energy which is called radiation and it doesn't need the presence of material and from this point of view it differs from conduction and convection.

Electromagnetic waves transform energy and are defined with wavelength and frequency as it comes in the following formula:

$C = ƛ.V$ or $V = C/ƛ$ or $ƛ = C/V$

V= frequency ƛ= wavelength $C = C_0/n$= speed

$C_0 = 2.9979*10^8$ m/s (speed of light in vaccum)

n= index of refraction of a medum which is 1 for air and most gases and 1.5 for glass

Photons or quanta are packets of energy carried by the electromagnetic waves and it is inversely proportional to wave length:

$E = hv = h*c/ƛ$ $h = 6.626069* 10^{-34}$j = plancks constant

We can divide electromagnetic radiation based on their wave length. and we can say the more the wave length the less energy they have.

10^{-9}- 10^{-7} : cosmic rays

10^{-5}- 10^{-2} : X rays

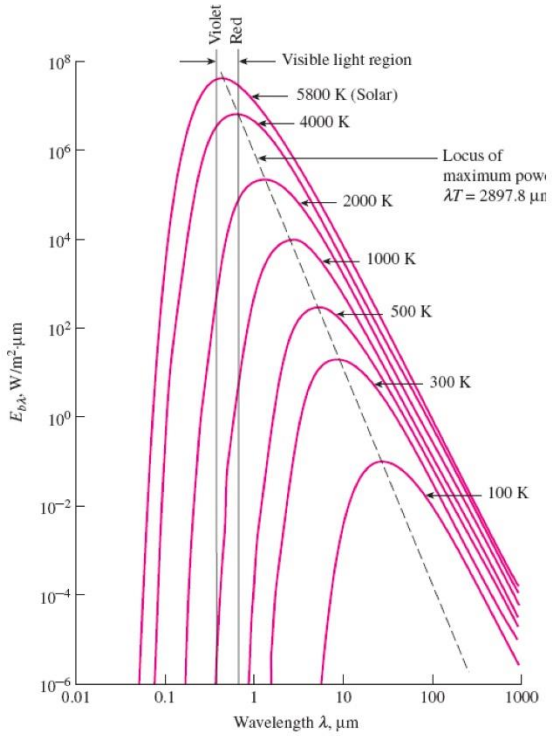
10^{-2}- 0.4 : Ultraviolet

0.4- 0.76 : visible

0.76- 10^2 : infrared

All objects emit waves and also absorb a percentage of the radiation which emit to them. A black body is called to a object which absorb all the radiation emitted to it and it is not necessarily black, and there can be a black object which is not a black body.

The following chart shows variation of blackbody power with wavelength for different temperature



The variation of the blackbody emissive power with wavelength for several temperatures.

The wavelength at which the peak occurs for a specified temperature is given by Wien's displacement law:

$$(\lambda T)_{\text{max power}} = 2897.8\ \mu\text{m} \cdot \text{K}$$