Question

	Wood	Insulation
Outside air	0.03	0.03
Wood Bevel (13 x 200mm)	0.14	0.14
Plywood (13mm)	0.11	0.11
Urethane Rigif Foam (90mm)	---	$0.98 \times \frac{90}{25} = 3.528$
Wood Studs (90mm)	0.63	—
Gypsum board (13mm)	0.079	0.079
Inside surface	0.12	0.12

$R_{with\ wood} = (0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12) = 1.109\ m\ C/W$

$R_{with\ insulation} = (0.03 + 0.14 + 0.11 + 3.528 + 0.079 + 0.12) = 4{,}007\ °C/W$

$U_{wood} = 1/R'_{with\ wood} = 1/1.109 = 0.9017$

$U_{insulation} = \frac{1}{R'_{with\ insulation}} = \frac{1}{4{,}007} = 0.2496$

$U_{total} = U_{wood} \times \frac{A_{wood}}{A_{total}} + U_{insulation} \times \frac{A_{insulation}}{A_{total}} = 0.9017 \times 25\% + 0.2496 \times 75\% = 0.4126$

$R_{value} = \frac{1}{U_{total}} = \frac{1}{0.4126} = 2.425$

$Q_{total} = U_{total} \times U_{total} \times \Delta T = 0.4126 \times 50 \times 25 \times (1 - 20\%) \times 22 - (-2) = 990{,}24\ W$

Radiation is the transfer of energy in the Electromagnetic waves or particles through space - and in this context, Electromagnetic waves which happens in the air, the light from the lightbulbs, Sun's UV rays, etc. The thermal radiation is the emission of electromagnetic waves or electromagnetic radiation and they are generated by every type of objects that have a temperature higher than 0°C or – 273,15 °C. So the thermal radiation is related on the temperature and so the heat of the object and everything around us constantly emits thermal radiation.

Radiation transfer occurs in solids, in liquids and gases and differs from conduction and convection because it doesn't require the presence of a material to take place. In fact to have a heat transfer in the case of the conduction and convection there will be the presence of two objects, instead in the radiation it's not necessary to have two object to have the phenomenon but the radiation transfer works when there is a hot object, so thermal radiation can occur in vacuum. However, the main factor that contributes to the amount of heat transferred thru radiation is its travel distance to the object being radiated. The type of electromagnetic radiation that is pertinent to heat transfer is the thermal radiation emitted as a result of energy transitions of molecules, atoms, and electrons of a substance.

Temperature is a measure of the strength of these activities at the microscopic level, and the rate of thermal radiation emission increases with increasing temperature. Thermal radiation is an electromagnetic wave that are rapidly moving fields of accelerated charges or charging electric currents give rise to electric and magnetic field. These waves transport energy and they are characterized by their wavelength (λ) and frequency (ν). These two properties are related by a law: $\lambda = c / \nu$ C is the speed of propagation of a wave in that medium. The speed of light in a vacuum is equal to 2,9979*108 m/s. Heat transfer from a body with a high temperature to a body with a lower temperature, when bodies are not in direct physical contact with each other or when they are separated in space, is called heat radiation

The frequency and the wavelength are inverse proportional so if lower is the value of frequency, higher is the value of wavelength and vice versa.

The infrared is the type of radiation that causes heat and almost of the bodies at room temperature emit infrared. Different bodies emit different amount of radiation per unit surface area and the ideal type of body that emits the maximum amount of radiation by surface at a given temperature is called black body.

*Black Body: a surface that absorbs all incident radiation and reflects none is called a black surface or black body.

For example, if you're wearing all black through a sunny day, you're more like to feel hot than if you're wearing white or lighter colors because black color does not reflect any UV radiation at all. A black body is able to absorb all incident radiation, regardless of wavelength and direction so it's the perfect emitter and absorber of radiation. The propagation of the radiation is also uniform. It differs from the typical behavior of an object because in a real object the propagation isn't uniform, and it's not able to absorb all the incident radiation and it's not able to emit the maximum amount of radiation. The black body is used to serve as standard against which the radiative properties of real surfaces may be compared. The radiation energy emitted by a blackbody is calculated by: E (T) = σT 4 (W/m2) σ is the Stefan-Boltzmann constant, while T is temperature in K.

The Stefan–Boltzmann law of thermal radiation for a black body states that the rate of radiation energy from the surface per unit area is proportional to the fourth power of the temperature of the body $q = \sigma AT$ 4 with q rate of energy emission from the surface, A surface area of the radiator and σ the Stefan–Boltzmann constant. For liquid medium, most of the radiation is absorbed is a thin layer close to the solid surface and nothing is transmitted.The amount of energy is related mostly to the temperature that the body has. In the equation the temperature has the power so it's weight is very important to the calculation of the energy.

This is the graphic related to the variation of the blackbody emissive power with wavelength for several temperatures. We can see how the emitted radiation is a continuous function of wavelength. At any specified temperature, it increases with wavelength, reaches a peak, and then decreases with increasing wavelength. The temperature is fundamental because at any wavelength the amount of emitted radiation increases with increasing temperature.

2) Radiation Heat Transfer • Radiation is the transfer of energy in the of Electromagnetic waves - and in this context, we're talking about any electromagnetic waves which mostly everything: your seatmate, the air, the light from the lightbulbs, Sun's UV rays, etc. • Lower electromagnetic waves, the lesser it is visible in the eyes, the higher the electric waves, the more it is visible to the eyes. E.g.; Light in light bulb. • Unlike convection and conduction heat transfer, radiation heat transfer does not require any medium of matter for it to take place. For example, in space, the Ultraviolet rays of the Sun or the Solar radiation does not need gas, liquid or any solid matter of some sort for it to move/transfer.. The longer the travel of the radiation, the lesser is the Heat transferred. That's why it's much colder during winter on both North and South Pole than the other parts of the Earth, because the Sun's rays don't reach that location that much. It also occurs in solid, liquid and gas matter. • In the case of thermal radiation from a solid surface, the medium through which the radiation passes could be vacuum, gas, or liquid. • Reflective coatings can help reduce the heat transfer from radiation a little since they absorb fewer electro magnetic waves. • • If the medium is a vacuum, since there are no molecules or atoms, the radiation energy is not attenuated and, therefore, fully transmitted. Therefore, radiation heat transfer is more efficient in a vacuum. • It depends on how much surface area there is for it radiate out away from the surface. • $dQ\ dt \propto A$ The amout of heat taken away from the object does depend and is proportional to

the Surface Area of the Object. • $dQ\ dt \propto AT\ 4$ It depends on the Temperature. Not only does the object has some surface area, it will also keep up some temperature. Therefore, the $dQ\ dT$ will depend on the temperature $T\ 4$.