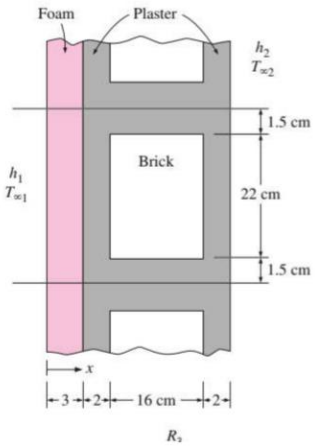
Question 1 :Solve the same question while the thickness of the brick is increased to 32 cm

$$R_{pc1} = \frac{L_{pc1}}{K_{pc1} * A_{P1}} = \frac{0.32}{0.22 * 0.015} = 96.97\ °\mathbf{C}/\boldsymbol{W}$$

$$R_{Brick} = \frac{L_{Brick}}{K_{Brick} * A_{Brick}} = \frac{0.32}{0.72 * 0.22} = 2.02\ °\mathbf{C}/\boldsymbol{W}$$

$$R_{Total} = \frac{1}{R_{Brick}} + 2\ \frac{1}{R_{Pl}} = \frac{1}{2.02} + 2 * \frac{1}{96.97} = 0.5156\ °\mathbf{C}/\boldsymbol{W}$$



Part 3

- H1 = 10 W/m2
- H2 = 40 W/m2
- R_{Cov1} = 0.4 $°\mathbf{C}/\boldsymbol{W}$
- R_{Cov2} = 0.1 $°\mathbf{C}/\boldsymbol{W}$
- R_{Foam} = 4.6154 $°\mathbf{C}/\boldsymbol{W}$
- $R_{Plaster}$ = 0.6154 $°\mathbf{C}/\boldsymbol{W}$

R_{Total} = 0.4 +0.1 +0.6154 + 0.51562 +4.6154 = 4.24642 $°\mathrm{C}/W$

1.1 Determine the steady rate of heat transfer through this Composite wall:

$$\dot{Q} = \frac{T_{\infty 1} - T_{\infty 2}}{R_{Total}} = \ \dot{\boldsymbol{Q}} = \frac{\mathbf{30}}{\mathbf{4.264642}} = \mathbf{7.065\ W}$$

$$\dot{Q}_{wall} = \ \dot{Q}_{unit} * \frac{A_{wall}}{A_{unit}} = 7.065 * \frac{15}{0.25} = 423.9\ W$$

1.2 Simplified wall calculation Procedure and The total heat transfer :

Material Layer	Assumption Wood	Assumption Insulation
Outside Air	0.03	0.03
Wood	0.14	0.14
Plywood	0.11	0.11
Urethane Rigid Foam	-	3.528 *0.98*90/25=2.52*
Wood Stud	0.63	-
Gypsum	0.079	0.079
Inside Air	0.12	0.12

$$R'_{withWood} = 0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12 = 1.109\ m^2.°\frac{C}{W}$$

$$R'_{withIns} = 0.03 + 0.14 + 0.11 + 3.528 + 0.079 + 0.12 = 4.007\ m^2.°C/W$$

$$U_{tot} = \ U_{wood} \times \frac{A_{wood}}{A_{tot}} + U_{ins} \times \frac{A_{ins}}{A_{tot}} = 0.25 \times U_{wood} + 0.75 \times U_{ins}$$

$$U_{wood} = \frac{1}{R'_{wood}} = \frac{1}{1.109} = 0.902$$

$$U_{ins} = \frac{1}{R'_{ins}} = \frac{1}{4.007} = 0.25$$

$$U_{tot} = \ 0.25 \times U_{wood} + 0.75 \times U_{ins} = 0.25 * 0.902 + 0.75 * 0.25 = 0.413\frac{W}{m^{2°}C}$$

From the definition of U

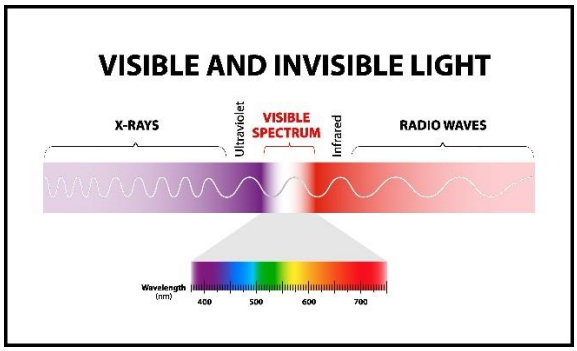
$$A = 50 * 2.5 * 0.8 = 100\ m^2,\ \Delta T = 22 - (-2) = 24°C$$

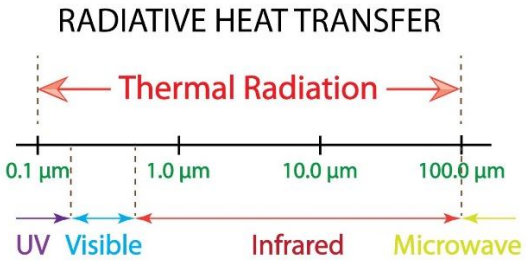
$$Q_{tot} = U_{tot} \times A_{tot} \times \Delta T = 0.413 * 100 * 24 = 991.2\ W$$

Question2: Summary about radiation and radiative heat transfer

Radiation is the third heat transfer method, it does not involve particles (mediums or materials) like convection and conduction. Although it is a very complex phenomena, it has a massive impact.

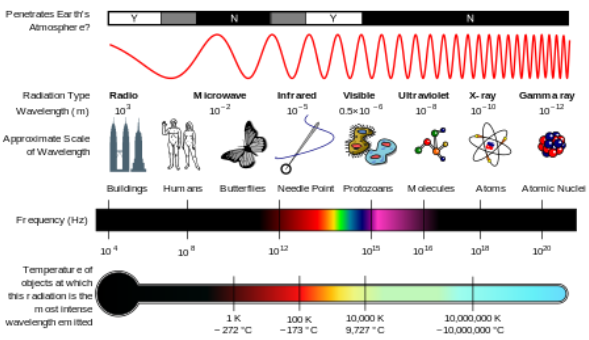
The energy of radiation (Heat transfer) travels occurs invisibly using infrared or electromagnetic waves. Radiation occurs more effectively in vacuum. Emission and transfer of heat via electromagnetic waves. The visible portion of the electro-magnetic spectrum is light around us, most of the spectrum is invisible, which consists of invisible light, Ultraviolet and infrared rays.



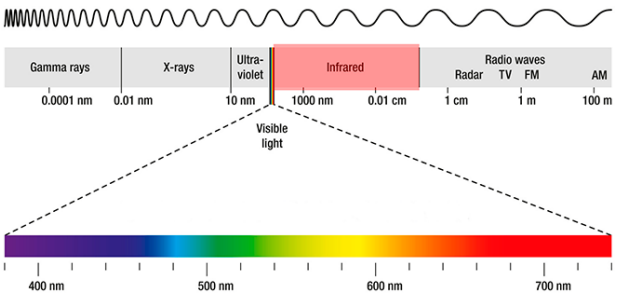


Radiation doesn't need matter to transfer heat, which is why outer space is cold, because there is no matter to transfer the heat coming from the sun. That is how we get the heat and light from the sun, via the waves.

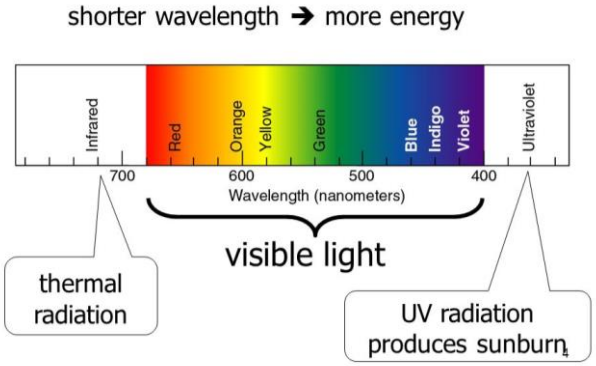
Everything around us emits heat, the sun, light and us, which allows radiative heat transfer. Light is the visible part of the spectrum, the invisible is called infrared and ultraviolet. The intensity of the heat absorbed or transferred depends of the color of the receiving body, on the other hand, transparent materials do not absorb heat. When heat waves travel to the receiving body, it can be reflected, refracted or absorbed and if transparent it will pass though until it touched another body (how the car if left in the sun the wheel is hot but the glass is not)



Light waves are radiant energy waves or visible heat waves. The visibility of the heat waves depends on the radiating body (like how steel glows when heated).



Each color has its own wavelength on the spectrum and it is measured in micro-meters, which is 10^{8} µm and µ is 10^{-6}. Light (visible and invisible) has range anything less than 0.4 µm is called ultraviolet, which is invisible and harmful we have the ozone layer to protect is from it where is absorbs 12% of it. Infrared falls between 0.76 and 100 µm. good heat emitters are good heat absorbers, which will take us to the Black Body Radiation. Black Body Radiation is the perfect emitter and absorbers, that emits in a uniform manner and absorbs all radiation (maximum temperature), no matter the wavelength, the longer the wavelength the weaker its impact, the shorter the wavelength the stronger it is.



Radiative Heat Transfer is the heat transfer that does not need depend on objects (heat source and heat receiver) contact, how we feel the sun without touching it. Radiation het is transferred through empty space or vacuum (thermal radiation). Radiation is where electro magnetic waves carry the heat energy, when the molecules of the objects warp up they vibrate which causes the electric charges. Every object including us radiate heat and it radiates back, when both bodies are the same temperature it is called equilibrium, where I am the same temperature as my surroundings. .