Week 4

Submitted by: Nancy Morsy Ismail Aly Saleh

Task 1:

Answer:

	Wood	Insulation
Outside air	0.03	0.03
Wood bevel (13x200mm)	0.14	0.14
Plywood (13mm)	0.11	0.11
Urethane Rigif Foam (90mm)	No	$\frac{0.98 \times 90}{25} = 3.528$
Wood Studs (90mm)	0.63	No
Gypsum board (13mm)	0.079	0.079
Inside surface	0.12	0.12

$$R_{with\,wood} = (0.03 + 0.14 + 0.11 + 0.63 + 0.079 + 0.12) = 1.109\ m^2\,^\circ C/W$$

$$R_{with\,insulation} = (0.03 + 0.14 + 0.11 + 3.528 + 0.079 + 0.12) = 4.007\ m^2\,^\circ C/W$$

$$U_{wood} = \frac{1}{R'_{with\,wood}} = \frac{1}{1.109} = 0.9017\ W/m^2\,^\circ C$$

$$U_{insulation} = \frac{1}{R'_{with\,insulation}} = \frac{1}{4.007} = 0.2496\ W/m^2\,^\circ C$$

$$U_{total} = \frac{U_{wood} \times A_{wood}}{A_{total}} + \frac{U_{insulation} \times A_{insulation}}{A_{total}}$$

$$\frac{25}{100} \times 0.9017 + \frac{75}{100} \times 0.2496 = 0.4126\ W/m^2\,^\circ C$$

$$R_{value} = \frac{1}{U_{total}} = \frac{1}{0.4126} = 2.4237\ m^2\,^\circ C/W$$

$$Q_{total} = U_{total} \times U_{total} \times \Delta T = 0.4126 \times 50 \times 25 \times \left(1 - \frac{20}{100}\right) \times 22 - (-2) = 990.24\ W$$

Task 2:

Summary about radiation and radiative heat transfer:

Radiation:

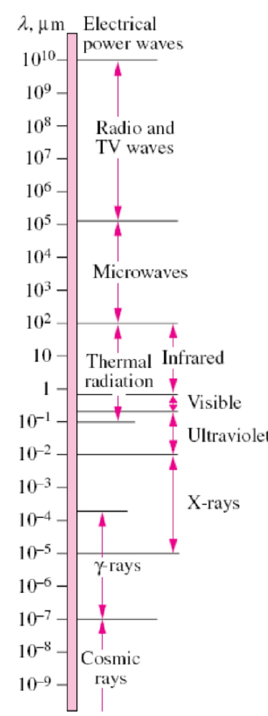
Is the emission of energy in form of waves through space. It occurs in solid as well as liquid and gases.Electromagnetic waves travel at the speed of light.

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.

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.

Electromagnetic waves transport energy with their frequency v or wavelength λ. These two properties in a medium are related by:

$$\lambda = \frac{c}{v}$$



The electromagnetic wave spectrum.

Thermal Radiation:

A type of electromagnetic radiation emittion from energy transitions of molecules, atoms and electrons of a body.

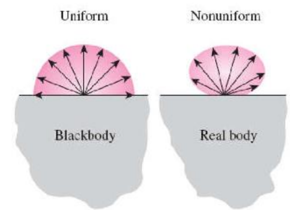
Visible light (or better, visible light for the human eye) is the electromagnetic radiation with a wavelength ranging from about 380 nm of violet to about 760 nm for red.

The ultraviolet radiation includes the low-wavelength end of the thermal radiation spectrum and lies between the wavelengths 0.01 and 0.40 m.

Ultraviolet rays are to be avoided since they can kill microorganisms and cause serious damage to humans and other living beings.

The type of electromagnetic radiation that is pertinent to heat transfer is the

Black Body Radiation:



Is an ideal body used as a standard to have a comparison with the radiative properties of other surfaces. It is a perfect emitter and absorber of radiation. The radiation energy emitted by a blackbody is:

$$E_b(T) = \sigma T^4$$

σ is the Stefan-Boltzmann constant, while T is temperature in K. We can see how 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.

- Different bodies may emit different amounts of radiation per unit surface area.
- A black body emits the maximum amount of radiation by a surface at a given temperature.
- It is an idealized body to serve as a standard against which the radiative properties of real surfaces may be compared.
- A black body is a perfect emitter and absorber of radiation.
- A blackbody absorbs all incident radiation, regardless of wavelength and direction.

-The graph represents the variety of the blackbody emissive power with wavelength for several temperatures.

-The axis of wavelength is on a logarithmic scale, while the axis of the emissive power is on a linear scale.

-The amount of emitted radiation increases with increasing temperature.

-The radiation emitted by the sun, which is considered to be a blackbody at 5800 K, reaches its peak in the visible light region of the spectrum.

-Surfaces at T < 800 K emit in the infrared region and are not visible to the eye unless they reflect light coming from other sources.