1. Fluid move on a surface carries heat away which result in Convective heat transfer. At heating the density change on the surface will cause the fluid to rise and be replaced by cooler fluid that also will heat and rise. The heat transfer through convection was first described by Newton and the relation is known as the Newton's Law of Cooling.

The equation for convection is: $\mathbf{Q_{conv}=hA_s (T_s-T_\infty)}$

Q_{conv}= heat transferred per unit time (W)

A_s= heat transfer area of the surface (m^2)

h= convective heat transfer coefficient of the process ($W/m^2 °c$)

T_s-T_∞= temperature difference between the surface and the bulk fluid (°c)

R_{glass} =L/ kA (Glass thermal conductivity is about k= 1W/mK) Area is much larger than thickness of the glass, so increase the thickness of glass does not result in a significant increase of total resistance but increase a lot of cost.

2. I have made almost no mistake, but few of them didn't have time to submit.

3. A= 0.8*1.5= 1.2 m^2

R_{conv1}= $1/h_1A$= 1/(10*1.2)= 0.0833 °C/W

R_{glass}= $L_1/(K_1A)$= 0.006/(0.78*1.2)= 0.0064 °C/W

R_{air}= $L_2/(K_2A)$ = 0.013/(0.026*1.2)= 0.4167 °C/W

R_{conv2}= $1/h_2A$= 1/(40*1.2)= 0.0208 °C/W

$R_{total} = R_{conv1} + R_{glass} + R_{air} + R_{glass} + R_{conv2} = 0.5336$ °C/W

$Q = (T_{\infty1} - T_{\infty2}) / R_{total} = 30 / 0.5336 = 56.2$ W

$T_1 = T_{\infty1} - Q * R_{conv1} = 20 - 56.2 * 0.0833 = 15.3$ °C

In the heat transfer process of double-layer glass, when the thickness of the air layer is less than 5mm, heat conduction and convection heat transfer are dominant. When the thickness is greater than 5mm, the radiation heat exchange is the main.

The thermal conductivity changes very significantly when the thickness of the air layer is 0-20mm. The increase in the thickness of the air layer does not affect the thermal conductivity of the radiation, and its value is basically unchanged. That is why we have an optimal range for the air-gap's distance.