Task 1

$$R_{total} = 0.4 + 4.61 + 0.36 + 0.97 + 0.36 + 0.1$$

$$R_{total} \approx 6.8 \frac{C^\circ}{\mathrm{W}}$$

$$\dot{Q}' = \frac{T_{\infty 1} - T_{\infty 2}}{R_{total}}$$

$$\dot{Q} = \frac{20 - (-10)}{6.8}$$

$$\dot{Q} \approx 4.41\ \mathrm{W}$$

The final amount of the partial heat transfer is for 0.25 m2 area. So, the total heat transfer would be:

$$\dot{Q} = 4.41 \times \frac{3 \times 5}{0.25}$$

$$\dot{Q} \approx 264.6\ \mathrm{W}$$

Task 2

$$R_{conv\,1} = \frac{1}{h_1 \times A} = \frac{1}{10 \times [(0.015+0.22+0.015) \times 1]} = 0.4 \frac{C^\circ}{\mathrm{W}}$$

$$R_{left.plaster} = \frac{L_{plaster}}{k_{plaster} \times A} = \frac{1}{0.22 \times [(0.015+0.22+0.015) \times 1]} = 0.36 \frac{C^\circ}{\mathrm{W}}$$

$$R_{foam} = \frac{L_{foam}}{k_{foam} \times A} = \frac{0.03}{0.026 \times [(0.015+0.22+0.015) \times 1]} = 4.61 \frac{C^\circ}{\mathrm{W}}$$

$$\frac{1}{R_{parallel.layers}} = \frac{1}{R_{Plaster.up}} + \frac{1}{R_{brick}} + \frac{1}{R_{plaster.down}}$$

$$\frac{1}{R_{parallel.layers}} = \frac{1}{\frac{L_{plaster.up}}{k_{plaster} \times A}} + \frac{1}{\frac{L_{brick}}{k_{brick} \times A}} + \frac{1}{\frac{L_{plaster.down}}{k_{plaster} \times A}}$$

$$\frac{1}{R_{parallel.layers}} = \frac{1}{\frac{0.32}{0.22 \times 0.015}} + \frac{1}{\frac{0.32}{0.72 \times 0.22}} + \frac{1}{\frac{0.32}{0.22 \times 0.015}}$$

$$\frac{1}{R_{parallel.layers}} = \frac{1}{96.97} + \frac{1}{2.02} + \frac{1}{96.97} = 0.01+0.495+0.01 = 0.515$$

$$R_{parallel.layers} \approx 1.94 \frac{C^\circ}{\mathrm{W}}$$

$$R_{conv\,2} = \frac{1}{h_2 \times A} = \frac{1}{40 \times [(0.015+0.22+0.015) \times 1]} = 0.1 \frac{C^\circ}{\mathrm{W}}$$

Total R:

$$R_{total} = 0.4 + 4.61 + 0.36 + 1.94 + 0.36 + 0.1$$

$$R_{total} \approx 7.8 \frac{C^\circ}{\mathrm{W}}$$

The heat transfer rate:

$$\dot{Q}' = \frac{T_{\infty 1} - T_{\infty 2}}{R_{total}}$$

$$\dot{Q} = \frac{20 - (-10)}{7.8}$$

$$\dot{Q} \approx 3.85\ \mathrm{W}$$

The final amount of the partial heat transfer is for 0.25 m2 area. So, the total heat transfer would be:

$$\dot{Q} = 3.85 \times \frac{3 \times 5}{0.25}$$

$$\dot{Q} \approx 231\ \mathrm{W}$$