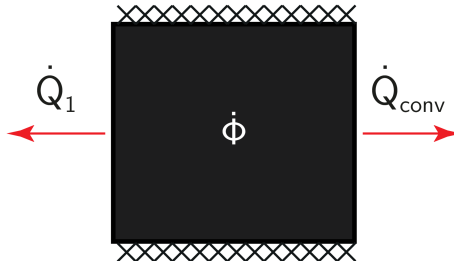


EB - Rad. - Outer 12

Set up the outer energy balance for the sphere that describes the change of its homogeneous temperature T_1 over the course of time. Use view factors and surface brightness whenever possible.



Energy balance:

$$\frac{\partial U}{\partial t} = \sum \dot{Q}_{\text{in}} - \sum \dot{Q}_{\text{out}}$$

$$\frac{dU}{dt} = \dot{\Phi} - \dot{Q}_{\text{conv}} - \dot{Q}_1$$

Change of internal energy over time:

$$\frac{dU}{dt} = m_1 c_1 \frac{dT_1}{dt}$$

Heat fluxes:

The heat generated within the body:

$$\dot{\Phi} = \dot{\Phi}''' V_1$$

Rate of heat loss by convection:

$$\dot{Q}_{\text{conv}} = \alpha_{\text{conv}} \frac{4A_1}{6} (T_1 - T_{\infty})$$

The surface brightness of body 1 will be determined in a separate task and can be stated as \dot{Q}_1 .

Substituting and rewriting:

$$\Rightarrow m_1 c_1 \frac{dT_1}{dt} = \dot{\Phi}''' V_1 - \alpha_{\text{conv}} \frac{2A_1}{3} (T_1 - T_{\infty}) - \dot{Q}_1$$