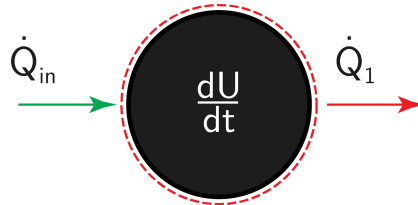


EB - Rad. - Outer 10

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:

$$\frac{\partial U}{\partial t} = \sum \dot{Q}_{in}^0 - \sum \dot{Q}_{out}$$

$$\frac{dU}{dt} = +\dot{Q}_{amb} - \dot{Q}_{conv} - \dot{Q}_1$$

Change of internal energy over time:

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

Heat fluxes:

Ambient radiation:

$$\dot{Q}_{amb} = \sigma A_1 T_\infty^4$$

Rate of heat loss by convection:

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

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

Substituting and rewriting:

$$\Rightarrow m_1 c_1 \frac{dT_1}{dt} = \sigma A_1 T_\infty^4 - \alpha_{conv} A_1 (T_1 - T_\infty) - \dot{Q}_1$$