This example shows how to calculate a cooling of an steel sphere of 10 cm ín diameter. When it is 615 degrees celcius. The cooling supposes to be done with the theory of heatradiation.

In below I set up the describing differential equation of the radiation problem. Equ(1) States how mush the heat energy decreases from the sphere. Equ(2) is the heat effect who get loss from the sphere. Equ (3) is the equation, with gives the heat effect from the sphere to the room, using the theory of radiation.
And then I set equ(2)=equ(3), and get T prime.

$A := 0.05^2 \cdot \pi \cdot 4$ The mantelarea of the sphere

$\varepsilon := 0.44$ Emission factor for the sphere

$Cs := 5.6699$ The radiation constant

$cp := 450$ Specific heatcapasity of iron

$m := 4.2$ The mass of the sphere

$T0 := 273.14$ The absolute temp, 0 degrees in Celsius

$T1 := T0 + 20$ Rooms temperature

(1) $\Delta Q = m \cdot cp \cdot \Delta T$

(2) $P = m \cdot cp \cdot \frac{\Delta T}{\Delta t}$

(3) $P = A \cdot \varepsilon \cdot Cs \cdot \left[\left(\frac{T1}{100} \right)^4 - \left(\frac{T}{100} \right)^4 \right]$

(4) $T' = \frac{A \cdot \varepsilon \cdot Cs}{m \cdot cp} \cdot \left[\left(\frac{T1}{100} \right)^4 - \left(\frac{T}{100} \right)^4 \right]$

Given

$$\frac{d}{dt} T(t) = \frac{A \cdot \varepsilon \cdot Cs \cdot 3600}{m \cdot cp} \cdot \left[\left(\frac{T1}{100} \right)^4 - \left(\frac{T(t)}{100} \right)^4 \right]$$

The diff, 3600 is to get the time in hours

$T(0) = 615 + T0$ Initalvalue add the absolute temp 273.14 K

$T := \mathrm{Odesolve}(t, 20)$ Solves the diff, about 20 hours

$T(t) := T(t) - T0$ Calculates the temprature to degrees Celius

Cooling by radiation of a steelsphere