**Deriving the function for thermal energy change over time**

**Radiation into empty space:**

From the Stefan-Boltzmann law we know that the rate of energy change due to thermal radiation is given by:

Where e is energy, t is time, A is surface area, ε is emissivity, σ is the Stefan-boltzmann constant and T is temperature.

We also know that the thermal energy responsible for T is:

Where m is mass and C is the specific heat capacity of the material. It turns out that C actually depends upon T, but for simplicity we will assume it is constant.

Combining the above we get:

For simplicity let us assume that

so this simplifies to:

this rearranges to

If we integrate both sides by t:

so

To find the value of c, we need to give the value of e for a particular value of t. For instance, we can know that at time t = 0, the energy of the object was its starting energy, e0.

Combining the above we get:

This can be rearranged to give e as a function of t:

Finally, we reinsert the values for z: