Radiation for Heat transfer rate

Consider a lump of charcoal in space at a temperature T

The power required to keep this lump of matter @ this temperature is the radiative heat transfer rate, $\dot{q}$. this depends on 3 things

- the surface area of the charcoal A.
- the surface temperature of the charcoal T_s
- a constant of nature, σ, the stefan-Boltzmann constant
  $\sigma = 5.67 \times 10^{-8} \frac{W}{m^2 K^4}$

the units of the constant telegraph the equation

$$\dot{q} = \sigma A T_s^4$$

Place the lump of charcoal in a room at temp T_{surr} and not only can the charcoal emit heat but it can also absorb it. Detailed balance demands that both appear in the same way:

$$\dot{q} = \sigma A (T_s^4 - T_{surr}^4)$$

finally if you change the surface of the charcoal, paint it, coat it w/ ice, wrap it in tin foil you will change the efficiency with which the heat can leave. the Emissivity ϵ covers this & $0 \le \epsilon \le 1$

$$\dot{q} = \epsilon \sigma A (T_s^4 - T_{surr}^4)$$

lowest values of ϵ happen for shiny metal (tin foil $\epsilon \sim 0.05$)

and increase from there

clean, or polished metal

$\epsilon \sim 0.15$

rusty metal

$\epsilon \sim 0.5 \pm 0.15$

glass ~ 0.9

water, skin

~ 0.93

special paint (high ϵ)

$\epsilon \sim 0.96$