# Environmental Science, Problems Chapter 3

## 3.1

Calculate the albedo $a$, if the mean temperature of the Earth is 298 K, the value of $f$ is 0.61, $\sigma = 5.671 \cdot 10^{-8}$ W/m$^2$K$^4$, $S = 1367$ W/m$^2$ and use the equation

$$(1-a)\,\frac{S}{4} = f\sigma T^4.$$

**Answer: a = 0.20**

## 3.2

Calculate the incoming solar intensity $S$, if the mean temperature of the Earth is 288 K, the value of $f$ is 0.61, $\sigma = 5.671 \cdot 10^{-8}$ W/m$^2$K$^4$, $a = 0.30$ and use the equation

$$(1-a)\,\frac{S}{4} = f\sigma T^4$$

**Answer: 1.4 kW/m$^2$**

## 3.3

Calculate the mean temperature $T_2$ of the Earth if the $f$-value changes from 0.61 when the temperature is $T_1 = 288$ K to $f = 0.65$ at $T_2$. We have $\sigma = 5.671 \cdot 10^{-8}$ W/m$^2$K$^4$ and $a = 0.30$. Apply the equation

$$f\sigma T^4 = constant.$$

**Answer: 280 K**

## 3.4

Light with intensity 10 W/m$^2$ is absorbed in a gas. The light travels 85 cm in the gas and the absorption coefficient is $\mu = 0.23$ m$^{-1}$. How large is the intensity $I$, after the light has traveled the 85 cm. Apply the equation

$$I = I_0 e^{-\mu x}$$

to calculate $I$.
**Answer: 8.2 W/m$^2$**

## 3.5

Light with intensity 10 W/m$^2$ is absorbed in a gas. The light travels a distance in the gas and the absorption coefficient is $\mu$. The intensity is 6.2 W/m$^2$ after it has passed 15 cm through the gas. Apply the equation

$$I = I_0 e^{-\mu x}$$

to calculate $\mu$.
**Answer: 3.2 m$^{-1}$**

## 3.6

Radiative forcing is given by

$$\Delta I = \Delta t \sigma T^4.$$

The transmission decreases from 0.61 to 0.60. Find the reduction of the radiative forcing when $T = 287.9$ K and $\sigma = 5.671 \cdot 10^{-8}$ W/m$^2$K$^4$.
**Answer: 0.39 W/m$^2$**

## 3.7

Radiative forcing can be given by

$$\Delta T = G\Delta I$$

where $G$ is the gain factor. Calculate the gain factor if $\Delta I$ is 18 W/m$^2$ and $\Delta T$ is 4.5 K.
**Answer: 0.25 K/Wm$^2$**