Environmental Science, Problems Chapter 7

7.1

We have a solar absorber where water is circulating at a flow of $\Phi = 15$ cm^3/s. The area of the absorber is 5.0 m^2. One measures the incoming power to $Q_{\text{in}} = 390$ W/m^2. Calculate the temperature increase of the water after passing the absorber. $C_P = 4.18 \cdot 10^3$ J/kgK. You can assume that 1 cm^3 of water weighs 1 g.

Answer: 31°C or 31 K

7.2

There is a wind blowing with at velocity of $u = 12$ m/s. Calculate the energy of the wind per m^3.

Answer: 1.0 kJ/m^3

7.3

There is a strong wind blowing with the power of 1.0 kW/m^2. A windmill with a large rotator is used to produce electricity. Calculate the maximum power of the windmill per m^2.

Answer: 0.59 kW/m^2

7.4

There is a waterfall where the flow is 100 m^3/s and falling height of 55 m. Calculate the maximum power.

Answer: 55 MW

7.5

A wind is blowing over the Atlantic Ocean where the period of the waves is around 10 s. One finds that some large waves have a height of 12 m. Calculate the maximum power of the waves per meter.

Answer: 720 kW/m

7.6

A wind is blowing over the Atlantic Ocean where the period of the waves is T. One finds that some large waves have a height of H m. Later, one observes

waves with a maximum height of $2H$. Estimate how much the power has increased.

Answer: 4 times higher

7.7

Looking at nuclear power we try to estimate the energy we can obtain from 1.0 gram of ^{235}U. Use the Einstein mass relation $E = mc^2$.

Answer: 90 TJ

7.8

Looking at nuclear power we try to estimate the energy we can obtain from a proton with mass $1.67 \cdot 10^{-27}$ kg. Use the Einstein mass relation $E = mc^2$.

Answer: $1.5 \cdot 10^{-10}$ J $= 0.15$ nJ