

Environmental Science, Solutions Chapter 6

6.1

It will last

$$t = \frac{95 \cdot 10^9}{0.06 \cdot 6.3 \cdot 10^7 \cdot 365} \text{ years} = 68.9 \text{ years} \approx 70 \text{ years.}$$

Answer: 70 years

6.2

Using $Q = cm\Delta T$ we get

$$c = \frac{Q}{m\Delta T} = \frac{172 \cdot 10^3}{1 \cdot (60 - 20)} \text{ J/kgK} \approx 4.3 \cdot 10^3 \text{ J/kgK}$$

Answer: 4.3 kJ/kg·K

6.3

Using $\eta \leq 1 - \frac{T_C}{T_H}$ we get

$$\eta \leq 1 - \frac{T_C}{T_H} = 1 - \frac{273 + 20}{273 + 60} = 0.120 = 12\%.$$

Answer: $\leq 12\%$

6.4

Using $\eta \leq 1 - \frac{T_C}{T_H}$ we obtain

$$0.15 \leq 1 - \frac{273 + 20}{T_H} \Rightarrow 1 - 0.15 = \frac{293}{T_H} \Rightarrow T_H = \frac{293}{0.85} \text{ K} \approx 345 \text{ K} = 72 \text{ }^\circ\text{C}.$$

Answer: 72 °C

6.5

Using $\text{COP} = \frac{1}{\frac{T_C}{T_H} - 1}$ we obtain

$$\text{COP} = \left(\frac{T_C}{T_H} - 1 \right)^{-1} = \left(\frac{273 + 30}{273 - 7} - 1 \right)^{-1} = \left(\frac{303}{266} - 1 \right)^{-1} = 7.2 \approx 7.$$

Answer: 7