Elementary Physics of Energy

Homework 6
Due Date: May 19, 2011

1. What collector area is needed for the system shown in Figure 4.6 to provide the necessary space heating for a home having 2000 ft^2 of floor area? Assume an average daily insolation of 1000 Btu/ft^2 and an efficiency of 20%. Also assume that the house requires 50 million Btu per thousand square foot of floor area for the 180 day heating season.

2. A car wash needs 1500 gallons of water a day heated from 50^0F to 100^0F. How large a solar collector would be needed to do this? The incident solar energy is 1100 Btu/ft^2 and the collector efficiency is 25%.

3. A passive solar home has energy stored in a concrete floor with area 1000 ft^2. How thick should this floor be to store 2×10^5 Btu with a temperature swing of 30^0F?

4. In what part of the electromagnetic spectrum does solar radiation have maximum intensity? Approximately what range of wavelengths is this? Now express this range in units of frequency (i.e. Hertz) and energy (Joules).

5. The valence electron in a Sodium atom transitions from an excited state back to the ground state, in the process it emits a photon with wavelength 589 nanometers. What is the difference in energy between the excited and ground states?

6. Using Stefan's law (given in lecture), calculate the power per unit area emitted by the Sun given that its temperature is 5800 K. Take $\epsilon = 1$ and $\sigma = 5.67 \times 10^{-8}$ $\frac{W}{m^2 \cdot K^4}$. What would the temperature be if the power per unit area was half this value?