

Homework #14

Since I didn't get to the Carnot cycle in time, here are a few remarks:

#5: Efficiency is defined as the fraction of the total heat energy input that is delivered as work.

#6: The efficiency e of a Carnot engine is given by equation 20-3 in the book, in terms of the temperature of the heat source (T_H) and of the waste heat (T_L), $e = 1 - (T_L / T_H)$. The Carnot cycle is the most efficient engine possible (as we'll discuss in class Friday).

#7: The coefficient of performance of a Carnot refrigerator (or air conditioner, the same thing) is the ratio of the heat energy extracted to the work needed. This is greater than one, because it doesn't take that much energy to move heat around—it's the reverse of the Carnot engine, where a lot of heat is moved but not much extracted as work. Reversing this, not much work is needed to move heat from a cold place to a hot place. The coefficient of performance (COP) is heat extracted/work needed = Q_L / W , and for a Carnot refrigerator $\text{COP} = T_L / (T_H - T_L)$.

For question #1, by the way, assume the concert hall is initially at 0°C, and ignore the fact that the people would die long before the time given.