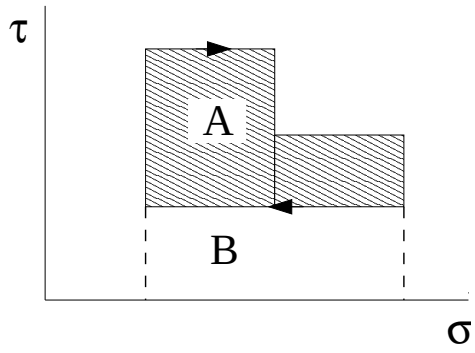
Physics 410 - 2003

Thermal Physics

Problem Set 14

1. An engine is represented by the cyclic transformation shown in the $\sigma - \tau$ diagram. Here, A denotes the area of the shaded region and B the area of the region below it. Show that this engine is not as efficient as a Carnot engine operating between the highest and lowest available temperatures (6 pt). Show that an arbitrary reversible engine cannot be more efficient than a Carnot engine operating between the highest and the lowest available temperatures (7 pt).



2. Chapter 8, p. 259, problem 10 (6 pt). Expansion into vacuum is irreversible, pressure is equal to zero.

3. Chapter 9, p. 272, problem 1 (6 pt)

You need to have 20 points out of 25 (5 points are extra credit).

The problems are from Kittel & Kroemer, *Thermal Physics*, 2nd edition, (Freeman, NY 1980).