

Thermodynamics – Weekly Problem, Th. 3**Publication: 25th Oct****Completion: 4th Nov**

- a) The working fluid of a heat engine consists of ideal gas, having heat capacity C_p . The engine has no friction and follows the cycle outlined below:
- Isothermal expansion when the working fluid is in contact with a hot reservoir at T_H between the states having pressures p_i and p_f ;
 - Isobaric cooling from T_H to T_L ;
 - Isothermal compression when the working fluid is placed in contact with a cold reservoir at T_L , which takes the cycle back to the original pressure, p_i ;
 - Isobaric heating from T_L to T_H .

Draw a fully labelled pV diagram for the cycle, carefully marking each place where heat either enters or leaves the cycle. [3 marks]

Show that the efficiency of this engine cycle is given by

$$\eta = \frac{T_H - T_L}{T_H + C_p(T_H - T_L)/(R \ln(p_i/p_f))}.$$

[5 marks]

- b) An Ericsson engine, which is totally internal reversible, follows the cycle describe above, but the with the process of regeneration taking place between the isobaric cooling and heating steps. Here, the heat rejected during the isobaric cooling goes through a regenerator, never leaving the confines of the engine, before being re-input during the isobaric heating. This means that no additional nett heat energy from an external source is required to be added during the isobaric heating i.e.) the only heat input during the cycle is in the isothermal heating. Determine how the engine's efficiency changes in this case. Comment on your result. [2 marks]