I have a question about problem 4.1 on Problem set 1. Why is it not possible to solve for the final pressure and temperature using the condition that E1 = -E2 and the equations for internal energy and adiabatic work? The published solution seems to say that it cannot be solved.

Some things worth considering:

1. The solutions state that the problem cannot be solved considering a reversible path.

2. E1=-E2 is incorrect. The correct expression is dE1=-dE2

3. What do you mean by adiabatic work? You mean work performed while no heat transfer occurs.

4. There is no heat transfer occurring at any wall in the system (internal or external). If one writes the first law for this system, one finds that P1=P2 **at any given point in the reversible path**.... Since the initial pressures are not the same (otherwise there would not be a problem at all :-)), we conclude that there is no possible reversible path.

5. The change from the initial to the final state must be accompanied by dissipation (friction losses with the wall, turbulence in the gas, etc.) This dissipation will turn into heat, which, since it cannot be transferred elsewhere, will increment the internal energy of the systems, increasing their temperature. The problem is that we don't know a priori the heat evolution within the two subsystems. **The problem could be solved, though, if we had a model for the dissipative losses and the dynamics of the system, (i.e. Fluid flow with a moving wall, turbulence, etc..).**

Fun Fact: It may be interesting to note that, from the concepts of irreversible
thermodynamics, which basically deal with the generation of entropy, one
can derive the energy, mass and momentum equations that are used in fluid
mechanics. (The same can also be derived using Stat Mech!!!!)

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