[tex133] Thermodynamics of a classical ideal paramagnetic gas II

Consider the fixed amount $n = 1\text{mol}$ of a paramagnetic gas, specified by the equations of state $pV = RT$, $M = H/T$, and by the heat capacity $C_{VM} = 3R/2$.
(a) Characterize a general adiabatic process by a functional relation of the form $f(T, p, H) = \text{const}$. Start from the function $S(T, V, M)$ derived in [tex22].
(b) Show that the heat transfer is path-independent for isothermal processes. Derive an expression for the heat transfer ΔQ_T of a general isothermal process between (p_0, H_0) and p_1, H_1.
(c) Show that the heat transfer for isobaric processes does depend on the path taken. Derive an expression for the heat transfer ΔQ_p of the isobaric process $(T_0, H_0) \to (T_0, H_1) \to (T_1, H_1) \to (T_1, H_0) \to (T_0, H_0)$ along straight segments in the (T, H)-plane.
(d) Consider a process $(T, P_0, H_0) \to (T, P_1, P_1)$ with $p_0 > p_1$ that is both isothermal (no change in energy) and adiabatic (no heat transfer). In this process mechanical work $\Delta W_p(T, p_0, p_1)$ done by the system is matched by the same amount of magnetic work $\Delta W_H(T, H_0, H_1)$ done on the system. Find $\Delta W_p(T, p_0, p_1)$ and $\Delta W_p(T, p_0, p_1)$.

Solution: