[tex31] Joule coefficient of van der Waals gas

The cooling of a gas via free expansion is described by the Joule coefficient

$$\left(\frac{\partial T}{\partial V}\right)_U = \frac{1}{C_V}\left[p - T\left(\frac{\partial p}{\partial T}\right)_V\right].$$

(i) Determine the Joule coefficient for 1 mol of the ideal gas $[pV = RT, C_V = \alpha R]$ and for 1mol of the van der Waals gas $[(p + a/V^2)(V - b) = RT, C_V = \alpha R]$.
(ii) Calculate the temperature change $T_f - T_i$ when the van der Waals gas is freely expanded from V_i to $V_f > V_i$.

Solution: