1. (20 Points) Consider the combustion of one mole of H$_2$ with 1/2 mole of O$_2$ under standard conditions. Note that the enthalpy of formation for one mole of water when hydrogen and oxygen gas combine (H$_2$ + 1/2 O$_2$ → H$_2$O) is $\Delta H = -286$ kJ.

(a) How much of the heat energy produced comes from a decrease in the internal energy of the system?
(b) How much comes from work done by the collapsing atmosphere? (treat the volume of the liquid water as negligible?)

\[ \Delta H = \Delta U + P \Delta V \]

\[ \Delta H = \Delta H_{\text{combustion}} = -286 \text{ kJ} \]

\[ P \Delta V = nRT = (1 \text{ mol})(8.314 \text{ J/mol k})(298 \text{ k}) = 3.7 \text{ kJ} \approx 4 \text{ kJ} \]

\[ \Delta U = \Delta H - P \Delta V = 286 \text{ kJ} - 4 \text{ kJ} = 282 \text{ kJ} \]

(a) 282 kJ
(b) 4 kJ