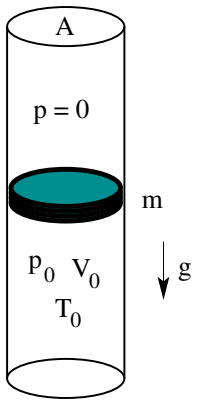
[tex141] Heavy piston

A cylinder of cross section A with insulating walls has two compartments separated by a disk of mass m. The axis of the cylinder is vertical. A uniform gravitational field g is present. The disk is initially held at a fixed position by an external agent. The upper compartment is evacuated and the lower compartment contains 1 mol of a monatomic, classical, ideal gas [$pV = RT$, $C_V = \frac{3}{2}R$] at temperature T_0, volume V_0, and pressure p_0. When the disk is released, it moves without (wall) friction and comes to rest at a lower position. Calculate the final values p_1, V_1, T_1 of pressure, volume, and temperature, respectively. The disk does not exchange heat. The only significant action of the gravitational field is on the disk.

Hint: Use energy conservation and Newton's third law. Assume thermal equilibrium for the inital and final states.



Solution: