# Quiz 16

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(a) A container is divided into two chambers by a movable wall. The entire system is in contact with a heat bath at temperature T. One side of the container contains N particles of an ideal gas, while the other side contains N particles of a gas of "hard-spheres" described by $P(V - Nb) = Nk_B T$. In both cases, the internal energy is $U = cnRT$. We will try to find the volumes of the chambers at equilibrium in two ways.
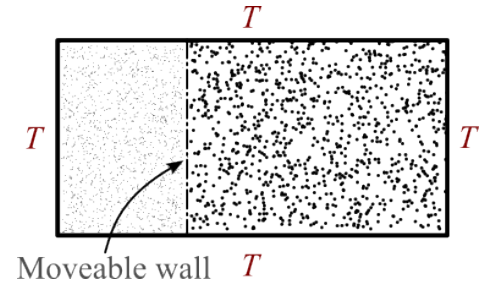
First, equalise the pressures on both sides to show that $V_1 = V_2 - Nb$, where V_1 is the volume of the chamber with the ideal gas, and V_2 the volume of the other chamber.   [4]

(b) In the last quiz, you found that for such a gas of "hard-spheres", $S = S_0 + C_V \log T + Nk_B \log(V - Nb)$. Use this to find the free energy of the *entire* system. Explain *clearly* how you get your answer.   [3]

(c) Next minimise the free energy with respect to one of the volumes (either V_1 or V_2) and show that you arrive at the same result as in part (a). [3]