

PHYS 301
Thermodynamics and Statistical Mechanics

Worksheet #5
Thursday February 19 2026

Question 1.

Suppose I have a box of volume $2V$ with a partition in the middle dividing the box into two sections, each with volume V . On the left, I put a N atoms of monoatomic ideal gas A . On the right, I put N atoms of a monoatomic ideal gas B . The whole box is at a single temperature T .

- (a) Now, I remove the central partition and let the two gases mix. Once equilibrium is reached and the two gases have perfectly mix, how much entropy has been generated by the mixing process?
- (b) After mixing, what is the change in the free energy? Did it increase or decrease?
- (c) Did the pressure change in the box after the two ideal gases mix? Note that the total pressure in the box is the sum of partial pressures of the two gases

$$P_{\text{tot}} = P_A + P_B. \tag{1}$$

- (d) Now, suppose that the two gases are the same, $A = B$. In this case, removing the central partition does not change anything and the entropy should stay constant. Show that this is indeed the case.