# Physics 301: Problems #5
## Sept. 20, 2019

1. A container of volume V containing an ideal gas is compressed by small amount $\Delta V \ll V$. The container is in thermal contact with the room environment at temperature T and thefore remains at temperature T.

   a) What is the change in entropy of the gas?

   b) What is the change in entropy of the environment?

2. Entropy of mixing The Sackur-Tetrode equation is $S = Nk \ln[\ ]$ where

$$[\ ] = e^{5/2} \frac{V}{N} \left( \frac{4\pi m U}{3Nh^2} \right)^{3/2}$$

   Rewrite this in terms of the temperature.

   Consider mix of two volumes V of Ar and He at temperature T, totaling N atoms with xN Ar and (1-x)N He atoms. Ignore the atomic mass difference. Combine the gases into a singe container of volume V. Find the entropy of mixture, and compare it to the entropy of N atoms of a single gas:

$$S^{Ar}_{N_A} + S^{He}_{N_B} = S^{Ar}_{N} + \Delta S_{mix}$$

3. You can check your answer, in the case that $x = 1/2$, $\Delta S_{mix} = Nk \ln 2$.

4. Sketch $\Delta S_{mix}$.