Homework #1 Jan 8, 2016

Problems (HH= Hook & Hall)

#1 HH 2.1

#2 HH2.2

#3 HH 2.6

Homework #2 Jan 15, 2016

#1 HH 2.3

#2 HH 2.5

3 Show that Eq(2.55) can be rewritten as Eq (2.56) by using the chain rule for partial derivatives. (Hint: It is useful to think of some function F(V,T,P)= constant that relates V T and P (not necessarily the ideal gas law, but that does serve as an example). When we compute its change, we get

$dF=0 = F_P\, dP + F_V\, dV + F_T\, dT$

where $F_P = (\partial F/ \partial P)_{T,V}$ etc. From this we can prove the required identity. Start with $(\partial V/ \partial T)_P = - F_T/F_V$. We may similarly write the two derivatives in 2.56 and multiply out to prove the result.

#4 Derive the Gruneisen expression (2.64) by plugging in (2.62) into (2.61) and taking the derivative of (2.63). Why does the first term in (2.63) not contribute to β?

#5 HH 2.7

#6 Calculate the heat capacity in 2-dimensions, assuming a Debye model. Assume you have one transverse mode and one longitudinal mode, having different velocities. Verify that the high T value is $2N\, k_B$ while the low T value is proportional to $(T/T_D)^2$

#7 Using Mathematica/Matlab/.. compute the heat capacity in 3-dimensions numerically as a function of (T/T_D) starting from the integral formula (2.52) in HH. From this result, and assuming that the equation of state is a modified Gas law
$p\, V= N\, k\, T_D$, (a fair approximation), as well as $\gamma \sim 0.2$,
calculate numerically the thermal expansion coefficient