10.40 Thermodynamics **Fall 2003**
Problem Set 4

Problem 7.1 Text

Solution:

$$\underline{A}_{NN} = (\partial^2 \underline{A}/\partial N^2)_{T,\underline{V}} = (\partial\mu/\partial N)_{T,\underline{V}}$$
$$= -(\partial \underline{V}/\partial N)_{T,\mu}/(\partial \underline{V}/\partial\mu)_{T,N}$$
$$= -V(\partial\mu/\partial \underline{V})_{T,N}$$
$$\mu = f(T, P)$$
$$d\mu = -S\,dT + V\,dP$$
$$(\partial\mu/\partial \underline{V})_{T,N} = V(\partial P/\partial \underline{V})_{T,N} = V\underline{A}_{\underline{V}\,\underline{V}}$$

substituting,

$$\underline{A}_{NN} = -V^2(\partial P/\partial \underline{V})_{T,N} = V^2\underline{A}_{\underline{V}\,\underline{V}}$$

Thus, when $\underline{A}_{\underline{V}\,\underline{V}} \to 0$, $\underline{A}_{NN} \to 0$