Advanced Physical Chemistry II

HW

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October 30, 2019

17 The Boltzmann Factor and Partition Functions

6,10,15,19,24,29,32,41

17-6 From Problem 17-5, we have

$$\langle E\rangle = -\frac{\hbar\gamma B_z}{2}\tanh\frac{\hbar\gamma B_z}{2k_{\mathrm{B}}T} \tag{17.1}$$

Since

$$\tanh x \to 1 \text{ as } x\to\infty \qquad \tanh x \to 0 \text{ as } x\to 0 \tag{17.2}$$

we have

$$\langle E\rangle \to -\frac{\hbar\gamma B_z}{2} \text{ as } T\to 0 \qquad \langle E\rangle \to 0 \text{ as } T\to\infty \tag{17.3}$$

17-10

$$\langle E\rangle = k_{\mathrm{B}}T^2\left(\frac{\partial \ln Q}{\partial T}\right)_{N,V} = k_{\mathrm{B}}T^2\frac{N}{T} = Nk_{\mathrm{B}}T \tag{17.4}$$

while the 3-D $\langle E\rangle$ is $\frac{3}{2}Nk_{\mathrm{B}}T$, because each dimension contributes $\frac{1}{2}Nk_{\mathrm{B}}T$.