Midterm # 3 solutions

1pr − 8
2u − 7
3d − 2
4 − 7

Problem #1.

For the Maxwell velocity distibution find $\langle b V_z^2 \rangle$ where b is the constant.

* We found in class (see Lecture 12 p. 8) that $\langle V_x^2 \rangle = \frac{kT}{m}$, We do not have any field and all directions x, y, z are equivalent.

$$\langle b V_z^2 \rangle = b \langle V_z^2 \rangle = b \langle V_x^2 \rangle = b \frac{kT}{m}$$

Problem #3.

μ_{A1} - chemical potential of solvent in 1st compartment

μ_{A2} - chemical potential of solvent in 2nd compartment.

$$\mu_{A1} = \mu_{A0}(T, P_1) - \frac{N_B}{N_A} kT$$

chemical potential of pure solvent at pressure P_1.

$$\mu_{A2} = \mu_{A0}(T, P_2) - \frac{N_C}{N_A} \cdot kT$$

Equilibrium corresponds the condition $\mu_{A1} = \mu_{A2}$.

$$\mu_{A0}(T, P_1) - \frac{N_B}{N_A} kT = \mu_{A0}(T, P_2) - \frac{N_C}{N_A} kT = \mu_{0A}(P, T_1) + \left(\frac{\partial \mu}{\partial P}\right)_T \cdot \times (P_2 - P_1) - \frac{N_C}{N_A} \cdot kT.$$

$$\left(\frac{\partial \mu}{\partial P}\right)_T = \frac{1}{N_A} \cdot \left(\frac{\partial G}{\partial P}\right)_T = \frac{V}{N_A}$$ - volume per molecule of solvent.

$$(P_2 - P_1) = \frac{N_A}{V} \cdot \left(\frac{N_C}{N_A} kT - \frac{N_b}{N_A} kT\right) = kT \cdot (n_c - n_b)$$

n_c, n_b - concentrations of solute molecules in 2nd and 1st compartments.

Midterm # 3

2.

$$P\left(\tfrac{3}{2}\right) = \frac{\exp\left(-\mu_B g \cdot B \cdot \frac{3}{2}\right)}{\sum_{S_z=-\frac{5}{2}}^{S_z=5/2} \exp\left(-\mu_B g B S_z\right)}$$

4.

A – homogeneous liquid. (one phase with composition $Au_{40}Ge_{60}$.

B - mixture of solid and liquid phases.
solid phase – pure Ge.
Liquid phase $Au_{62}Ge_{38}$

C – heterogeneous mixture of two solid phases.
1 phase – pure Ge
2 phase – $Au_{98}Ge_2$. – almost pure gold.