HW #11

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5.24) $\left(\frac{\partial G}{\partial P}\right)_{T,N} = V$

$V_l = 3.42 \times 10^{-6}\ m^3 \qquad V_g = 5.31 \times 10^{-6}\ m^3$

$P_0 = 0$

$3.42 \times 10^{-6} \cdot P + 2.9 \times 10^3\ J = 5.31 \times 10^{-3}\ P$

$P = \frac{2.9 \times 10^3}{1.89 \times 10^{-6}}$

$= 15.3\ K\ bar$

6.5) (a) $Z = \sum_s e^{-E(s)/kT}$

$= e^{0.05/k \cdot 200K} + 1 + e^{-0.05/k \cdot 300K}$

$= 6.918 + 1 + 0.14455$

$= 8.063$

(b) $P(-0.05\ eV) = \frac{6.918}{8.063}$

$= 0.858$

$P(0\ eV) = \frac{1}{8.063}$

$= 0.124$

$P(0.05\ eV) = \frac{0.14455}{8.063}$

$= 0.0179$

(c) $Z = 1 + e^{-0.05/kT} + e^{-0.1/kT}$

$= 1.165$

$P(0\ eV) = \frac{1}{1.165} = 0.858$

$P(0.05\ eV) = \frac{0.14455}{1.165} = 0.124$

$P(0.10\ eV) = \frac{0.02089}{1.165} = 0.0179$

6.15) (a) $(3\ eV + 8\ eV + 6\ eV)/10 = \frac{17\ eV}{10} = 1.7\ eV$

(b) $P(s) = \frac{N(s)}{N}$

$P(0) = 0.4$

$P(1) = 0.3$

$P(4) = 0.2$

$P(6) = 0.1$

(c) $\bar{E} = 0 \cdot 0.4 + 1 \cdot 0.3 + 4 \cdot 0.2 + 6 \cdot 0.1$

$= 0.3 + 0.8 + 0.6$

$= 1.7$

6.20) (a)

$$1-x \;\overline{)\;1}\;\; 1 + x + x^2 + x^3 + \cdots$$

$$\frac{-(1-x)}{x}$$

$$\frac{-(x-x^2)}{x^2}$$

$$\frac{-(x^2-x^3)}{x^3}$$

$\vdots$ this converges for $|x|<1$

(b) $Z = 1 + e^{-\beta\varepsilon} + \left(e^{-\beta\varepsilon}\right)^2 + \cdots = \frac{1}{1-e^{-\beta\varepsilon}}$

(c) $\frac{\partial Z}{\partial \beta} = \frac{\partial}{\partial \beta}\left(\frac{1}{1-e^{-\beta\varepsilon}}\right) = -\frac{\frac{\partial}{\partial \beta}\left(1-e^{-\beta\varepsilon}\right)}{\left(1-e^{-\beta\varepsilon}\right)^2} = -\frac{\varepsilon e^{-\beta\varepsilon}}{\left(1-e^{-\beta\varepsilon}\right)^2}$

$\bar{E} = \frac{\varepsilon e^{-\beta\varepsilon}}{1-e^{-\beta\varepsilon}}$

(d) $U = N\bar{E} = \frac{N\varepsilon e^{-\beta\varepsilon}}{1-e^{-\beta\varepsilon}}$