Chemistry 553

Problem set 1

Due: 14 January 2011

1. Dill and Bromberg, 2nd ed, P(problem) 2.1

2. Sum the series:
$$S(m) = \sum_{i=0}^{\infty} k^m p^k \tag{1}$$
   for $m = 2, m = 3$.

3. P4.5

4. P4.6

5. P4.13

6. Derive
$$\ln N! \simeq N \ln N - N + \ln(\sqrt{2\pi N}) \tag{2}$$
   starting from the expression for the gamma function
$$\Gamma(N+1) = N! = \int_0^{\infty} dx\, e^{-x} x^N = \int_0^{\infty} dx\, e^{Ng(x)} \qquad g(x) = \ln x - x/N \tag{3}$$

   The integrand is sharply peaked about x^*. Derive x^*, and expand $g(x)$ about the maximum to quadratic order,
$$g(x) = g(x^*) - \frac{1}{2N^2}(x - x^*)^2 \tag{4}$$

   Substitute $g(x)$ into the gamma-function integral and perform the integration. The approximation for $\ln N!$ should result.