Released: Monday, June 6
Due: Saturday, June 11 at 12 pm CST

Problem 1:	/	20
Problem 2:	/	20
Problem 3:	/	20
Problem 4:	/	40
Total:	/	100

Equations you may find useful:

$$1 = \int_{-\infty}^{\infty} dx \, \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right)$$

$$\sigma^2 = \int_{-\infty}^{\infty} dx \, \frac{(x-\mu)^2}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right)$$

$$S = k_\mathrm{B} \ln \Omega$$

$$\beta = \frac{1}{k_\mathrm{B}T} = \frac{1}{k_\mathrm{B}} \left(\frac{\partial S}{\partial E}\right)_{N,V}$$

$$Q(\beta) = \sum_\nu e^{-\beta E(\nu)} \quad \text{[Canonical]}$$

$${}_M C_N = \frac{M!}{N!(M-N)!}$$

$$\frac{1}{1-x} = 1 + x + x^2 + \ldots$$

$$\mu = \int_{-\infty}^{\infty} dx \, \frac{x}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right)$$

$$P(\nu) = \frac{e^{-\beta E(\nu)}}{Q(\beta)} \quad \text{[Canonical]}$$

$$-\beta A = \ln Q \quad \text{[Canonical]}$$

$$C_V = \left(\frac{\partial \langle E \rangle}{\partial T}\right)_{N,V}$$

$$\ln n! \approx n \ln n - n$$

$$dE = TdS - pdV + \mu dN$$

$$A = E - TS$$

$$(1-f)\ln(1-f) = -f + \frac{f^2}{2} + \frac{f^3}{6} + \ldots$$

Instructions: This take-home exam must be completed without collaborating with others. You may use course notes (official posted notes or notes you took), your problem set solutions, the official posted problem set solutions, and the videos of lectures. You may not use textbooks or the internet (aside from accessing the course content).

In an in-class setting, I would allocate two to three hours for this exam, meaning I think you could solve the majority of the problems in that time if you had studied carefully and worked diligently without interruption. You may wish to take the exam in that fashion or you may choose to intersperse your studying with your problem solving, treating the exam more like a non-collaborative problem set. If you choose the latter, I expect the exam to fill a similar amount of time as the problem sets did.

Office hours will be held this week at the ordinary time, but I only intend to address exam-related questions by providing clarifications.

This course has ended, so the exams and solutions have been removed. If you have a good reason to want access, please email Todd.