

CHEM 3410: Physical Chemistry I — Fall 2009

Homework 1

Due in Class: September 9, 2009

Mathematical skills are very important to understand concepts in physical chemistry. Here are some math-related problems to help you remember some of the calculus you have seen before and introduce some you may not have seen.

I have prepared a series of podcasts available on the course blog to help you review the important mathematics concepts needed in physical chemistry. Episodes 1–3 will be helpful to complete this assignment. Please use these podcasts to help you complete this assignment and throughout the semester.

1. For each of the following functions, evaluate the derivative $\frac{dy}{dx}$:

(a) $y = 5x^4 - 3x^2 + \sin x$

(b) $y = e^{4x^2} + 5x^2 \cos(6x)$

2. For the following function, evaluate the partial derivatives indicated below:

$$F(w, x, y, z) = 3xy^2 + \frac{w^3 z^3}{32y} - \frac{xy^2 z^3}{w}$$

(a) $\left(\frac{\partial F}{\partial x}\right)_{w,y,z}$

(b) $\left(\frac{\partial F}{\partial w}\right)_{x,y,z}$

(c) $\left[\frac{\partial}{\partial z} \left(\frac{\partial F}{\partial x}\right)_{w,y,z}\right]_{w,x,y}$

(d) $\left[\frac{\partial}{\partial x} \left(\frac{\partial F}{\partial z}\right)_{w,x,y}\right]_{w,y,z}$

Notice anything interesting about the solutions to parts (c) and (d)?

3. We will derive the following relationship in a few weeks:

$$\left(\frac{\partial U}{\partial V}\right)_T = T \left(\frac{\partial P}{\partial T}\right)_V - P$$

Using the above relationship, evaluate $\left(\frac{\partial U}{\partial V}\right)_T$ for an ideal gas. Remember from Chem I that $PV = nRT$