PH4603 - Soft Condensed Matter Physics

Homework 4

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Problem 1

a) Show that the bulk modulus of an ideal gas is given by

$$K = nk_BT \tag{1}$$

Problem 3

Show that

$$\frac{\partial\langle q\rangle}{\partial \mathrm{pH}} = -\frac{e_0 \ln 10 \exp\Big[-\ln 10(\mathrm{pH}-\mathrm{pK})\Big]}{Z^2} \tag{2}$$

Let's start with

$$\langle q\rangle = \frac{1}{Z}(q_0 + (q_0+e_0)\exp[-\beta E]) \tag{3}$$

where Z and E both are dependent on pH.

$$\frac{\partial\langle q\rangle}{\partial \mathrm{pH}} = -\frac{Z'(\mathrm{pH})}{Z^2}(q_0+(q_0+e_0)\exp[-\beta E]) + \frac{1}{Z}(-\beta E'(\mathrm{pH})(q_0+e_0)\exp[-\beta E])$$