Physics 112 - Intro to Statistical and Thermal Physics - Spring 2023
Spoiler Set 02

Problem 2.1 - Partial Derivatives

(a) $d\mathcal{R} = \frac{\partial \mathcal{R}}{\partial P} dP + \frac{\partial \mathcal{R}}{\partial V} dV + \frac{\partial \mathcal{R}}{\partial T} dT.$

(b) Remember that we are keeping the pressure P constant!

Spoilers! For part (c) you should have found

$$\left(\frac{\partial V}{\partial P}\right)_T = -\frac{(\partial \mathcal{R}/\partial P)_{T,V}}{(\partial \mathcal{R}/\partial V)_{T,P}}, \qquad \left(\frac{\partial P}{\partial T}\right)_V = -\frac{(\partial \mathcal{R}/\partial T)_{P,V}}{(\partial \mathcal{R}/\partial P)_{T,V}}.$$

Problem 2.2 - Heat Capacities and Calorimetry

(d) Remember, since S is a state variable we can use our result from part (a) and our process from part (c).

Problem 2.3 - Thermodynamic Processes and Cycles

(b) Your denominator should consist of a sum of two positive terms. To show the inequality, try "ignoring" one of the terms. Recall that, if $a, b > 0$ then $1/a + b < 1/a$.

(d) Start by using the equation for the internal energy of the van der Waals gas to express dU in terms of the differentials dT and dV. Then use the first law to get another expression for dU. Remember that we are strictly dealing with an isentropic process...

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