

AMSE205 Thermodynamics I

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Problem Set #3

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1. (a) Find the extreme values of the function

$$z = (x - 2)^2 + (y - 2)^2 + 4.$$

Find the constrained maximum of this function corresponding to the condition

$$x + y = 1$$

(b) by eliminating one variable and (c) by using a Lagrange undetermined multiplier method.

2. A rigid container is divided into two compartments of equal volume by a partition. One compartment contains 1 mole of ideal gas A at 1 atm, and the other compartment contains 1 mole of ideal gas B at 1 atm.

- (a) Calculate the entropy increase in the container if the partition between the two compartments is removed.
(b) If the first compartment had contained 2 moles of ideal gas A, what would have been the entropy increase due to gas mixing when the partition was removed?
(c) Calculate the corresponding entropy changes in each of the above two situations if both compartments had contained ideal gas A.

3. Consider a model in which the available energy levels are linearly spaced along the energy axis

$$\varepsilon_n = \left(n + \frac{1}{2} \right) \varepsilon_0, \quad (n = 0, 1, 2, \dots, 9)$$

The system contains ten particles. Consider two macrostates:

State I	{0, 0, 1, 2, 4, 2, 1, 0, 0, 0}
State II	{0, 1, 1, 2, 2, 2, 1, 1, 0, 0}

- (a) Which macrostate has the higher energy?
(b) Which macrostate has the higher entropy?
(c) Which macrostate is more likely to be observed?