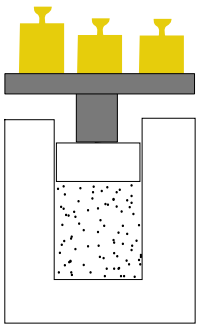
1 Midterm practice ph423 piston



Consider the pictured insulated piston, which is initially in thermal and mechanical equilibrium. The piston contains an unknown gas. You gradually add more mass to the top of the piston (perhaps by slowly pouring sand).

(a) Does the pressure on the fluid increase, decrease, or remain the same, or can you not tell? *Why?*

(b) Does the entropy of the fluid increase, decrease, or remain the same, or can you not tell? *Why?*

(c) Does the internal energy of the fluid increase, decrease, or remain the same, or can you not tell? *Why?*

2 Midterm practice ph423 sensecheck

Consider the following equations for internal energy and identify any problems that might indicate that they are erroneous. If the equation must be incorrect, please identify *why* it must be incorrect.

(a) $U = pS + \frac{3}{2}Nk_BT$

(b) $U = \frac{5}{2}pV$

(c) $U = \frac{3}{2}Nk_BT\ln(1+N)$

3 Midterm practice ph423 partial2

Consider the equations:

$$dw = (4x^3 - 9x^2y)dx - 3x^3dy \tag{1}$$
$$dy = 14xu\ dx + 7x^2du \tag{2}$$

Find

$$\left(\frac{\partial w}{\partial x}\right)_y$$

Find

$$\left(\frac{\partial w}{\partial x}\right)_u$$

4 Midterm practice ph423 helmholtz

Consider the variable F defined by

$$F = U - TS \tag{3}$$

where U is the internal energy, T is the temperature, and S is the entropy. Solve for the partial derivative $\left(\frac{\partial F}{\partial T}\right)_V$ where V is the volume.

Hint: The partial derivative is defined by the ratio of small changes in F and T that would take us to a new state without changing volume. Since the changes are small, we can assume the change happens via a quasi-static process. Therefore, we know that the thermodynamic identity will be valid, $dU = TdS - pdV$.