Entropy changes in statistical mechanics

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- Explain in your own words what the difference is between the extensive variables that I have labelled $\alpha^{(j)}$ and the variables I have labelled $B^{(k)}$ in the video.

- What derivative we trying to work out in this video? Use the space below to explain why and any details you think are relevant.

- Given that $\frac{S}{k_B} = \Psi + \sum_k \lambda_k \langle B^{(k)} \rangle$ write an expression for the derivative that we would like to calculate.

- Explain in your own words why: $\frac{\partial \Phi}{\partial \alpha^{(j)}} \mathrm{d}\alpha^{(j)} = \mathrm{d}\Phi$

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- Give an expression that allows one to calculate Ψ.

- Hence, give an expression for the derivative $\frac{\partial \Psi}{\partial \alpha^{(j)}}$

- What is $\frac{e^{-\sum_k \lambda_k B_i^{(k)}}}{e^{\Psi}}$ equal to?

- Use this result to explain in your own words why: $\frac{\partial \Psi}{\partial \alpha^{(j)}} = -\sum_k \frac{\partial \lambda_k}{\partial \alpha^{(j)}} \langle B^{(k)} \rangle - \sum_k \lambda_k \left\langle \frac{\partial B^{(k)}}{\partial \alpha^{(j)}} \right\rangle$

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- Give the final result for the change in infinitesimal change in entropy that accompanies an infinitesimal change in the fixed extensive thermodynamic variable $\alpha^{(j)}$