NAME :

Quiz 19

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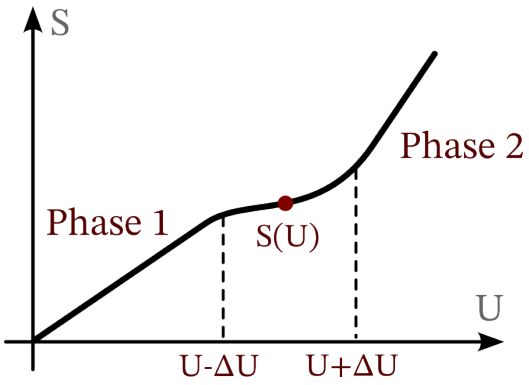
(a) A certain model for a physical system is found to have an entropy whose dependence on the internal energy (all other parameters held constant) is given by the figure below.



Argue that in such a case, the physical system can actually increase its entropy by dividing itself into an inhomogeneous mixture of both phases unless [2]

$$S(U-\Delta U)+S(U+\Delta U)\leq 2S(U). \tag{1}$$

(b) Show that in the limit $\Delta U \to 0$, this implies [3]

$$\left(\frac{\partial^2 S}{\partial U^2}\right)_{V,N} \leq 0. \tag{2}$$

(c) Show that the "stability condition" given above implies that the heat capacity of a stable system must be positive, i.e. that $C_V > 0$. [5]