Callen

2.2-1. Find the 3 equations of state for

$$U = \left(\frac{V_0 \theta}{R^2}\right) \frac{S^3}{NV}.$$

$$T = \frac{\partial U}{\partial S} = 3\left(\frac{V_0 \theta}{R^2}\right) \frac{S^2}{NV}$$

$$P = -\frac{\partial U}{\partial V} = \left(\frac{V_0 \theta}{R^2}\right)\left(\frac{S^3}{V^2}\right) \frac{\ln V}{N}$$

$$\mu = \frac{\partial U}{\partial N} = \left(\frac{V_0 \theta}{R^2}\right) \frac{S^3}{V} \ln N.$$

It's obvious that it's zeroth order homogeneous, since it's not a differential equation.