

i) Zurekenen:  $dV \Rightarrow dP$

$$P = P(V, S) \Rightarrow dP = \left(\frac{\partial P}{\partial V}\right)_S dV + \left(\frac{\partial P}{\partial S}\right)_V dS \Rightarrow [dP]_S = \left(\frac{\partial P}{\partial V}\right)_S dV$$

$$\left(\frac{\partial P}{\partial V}\right)_S = - \frac{\left(\frac{\partial S}{\partial V}\right)_P}{\left(\frac{\partial S}{\partial P}\right)_V} = - \frac{\left(\frac{\partial S}{\partial T}\right)_P \left(\frac{\partial T}{\partial V}\right)_P}{\left(\frac{\partial S}{\partial T}\right)_V \left(\frac{\partial T}{\partial P}\right)_V} = - \frac{C_P}{C_V} \frac{1}{\left(\frac{\partial V}{\partial T}\right)_P} \frac{\left(\frac{\partial V}{\partial P}\right)_T}{\left(\frac{\partial T}{\partial P}\right)_V} = - \frac{C_P}{C_V} \frac{1}{\alpha V K_T} = - \left[ \frac{C_P}{C_V} \frac{1}{\alpha V K_T} \right]$$

$$[dP]_S = - \left[ \frac{C_P}{C_V} \frac{1}{\alpha V K_T} \right] dV$$

$dV > 0 \Rightarrow dP < 0$

$dV < 0 \Rightarrow dP > 0$

bolumna handtsen prena triktigings da, pens-diferentriak prena handtsen da  
erapings den prena prena-handtsen da. (Sistemaren erantzena)  $dP > 0$   
bolumna triktigings prena handtsen da, pens-diferentriak prena triktigings da  
erapings den prena prena-beheratsen da. (Sistemaren erantzena)  $dP < 0$

erantzena

ii) Zeharku  $dV \Rightarrow dT \Rightarrow dP$

$$T = T(V, S) \Rightarrow dT = \left(\frac{\partial T}{\partial V}\right)_S dV + \left(\frac{\partial T}{\partial S}\right)_V dS \Rightarrow [dT]_S = \left(\frac{\partial T}{\partial V}\right)_S dV$$

$$\left(\frac{\partial T}{\partial V}\right)_S = - \frac{\left(\frac{\partial S}{\partial V}\right)_T}{\left(\frac{\partial S}{\partial T}\right)_V} = - \frac{\left(\frac{\partial P}{\partial T}\right)_V}{\frac{1}{T} \left(\frac{\partial S}{\partial T}\right)_V} = - \frac{\left(\frac{\partial P}{\partial T}\right)_V}{\frac{1}{T} C_V} = - \left[ \frac{T}{C_V} \alpha \right]$$

$$[dT]_S = - \left[ \frac{T}{C_V} \alpha \right] dV$$

$dV > 0; \alpha > 0 \Rightarrow dT < 0$

$\alpha < 0 \Rightarrow dT > 0$

$dV < 0; \alpha > 0 \Rightarrow dT > 0$

$\alpha < 0 \Rightarrow dT < 0$

interak bera galdin erapins da  $\delta Q < 0$   
interak erantzen bera handtsen  $\delta Q > 0$   
interak bera handtsen da  $\delta Q > 0$   
interak erantzen bera galdin  $\delta Q < 0$

$(\alpha > 0, \delta Q > 0)$  erantzena

$(\alpha < 0, \delta Q < 0)$  erantzena

interak bera handtsen da  $\delta Q > 0$   
interak erantzen bera galdin  $\delta Q < 0$   
interak bera galdin da  $\delta Q < 0$   
interak erantzen bera handtsen  $\delta Q > 0$

$(\alpha > 0, \delta Q < 0)$  erantzena

$(\alpha < 0, \delta Q > 0)$  erantzena