

The background of the slide is a light gray gradient with several realistic water droplets of various sizes scattered across it. The droplets have highlights and shadows, giving them a three-dimensional appearance. The text is centered in the middle of the slide.

APPLICATIONS OF THERMODYNAMIC RELATIONS

CLAUSIUS – CLAPEYRON EQUATION

$$\left(\frac{\partial s}{\partial v}\right)_T = \left(\frac{\partial p}{\partial T}\right)_v$$

$$T \left(\frac{\partial s}{\partial v}\right)_T = T \left(\frac{\partial p}{\partial T}\right)_v$$

$$\{T \partial s = \partial Q\}$$

$$\Rightarrow \underline{\underline{\left(\frac{\partial Q}{\partial v}\right)_T}} = T \left(\frac{\partial p}{\partial T}\right)_v \quad - \textcircled{1}$$

$$\underline{\underline{\partial v = v_2 - v_1}}$$

$$\therefore \underline{\underline{\partial Q = L}}$$

$$\frac{L}{v_2 - v_1} = T \left(\frac{\partial P}{\partial T} \right)_v$$

$$\Rightarrow \boxed{\frac{\partial P}{\partial T} = \frac{L}{T(v_2 - v_1)}} \quad \text{--- } \textcircled{2}$$

Clausius
Clapeyron's Latent heat Eqⁿ

TDS EQUATIONS

T & V

$$dS = \left(\frac{\partial S}{\partial T} \right)_V dT + \left(\frac{\partial S}{\partial V} \right)_T dV$$

$$T dS = T \left(\frac{\partial S}{\partial T} \right)_V dT + T \left(\frac{\partial S}{\partial V} \right)_V dV$$

$$T \left(\frac{\partial S}{\partial T} \right)_V = C_V \text{ for reversible isochoric process}$$

Maxwell's
third
relation

$$\left(\frac{\partial S}{\partial V} \right)_T = \left(\frac{\partial P}{\partial T} \right)_V$$

$$\Rightarrow T dS = C_V dT + T \left(\frac{\partial P}{\partial T} \right)_V dV \quad \text{--- (1)}$$

$$dS = \left(\frac{\partial S}{\partial T} \right)_P dT + \left(\frac{\partial S}{\partial P} \right)_T dP$$

$$\Rightarrow T dS = T \left(\frac{\partial S}{\partial T} \right)_P dT + T \left(\frac{\partial S}{\partial P} \right)_T dP$$

$$\text{But } T \left(\frac{\partial S}{\partial T} \right)_P = C_P$$

$$\text{4th} \quad \left(\frac{\partial S}{\partial P} \right)_T = - \left(\frac{\partial V}{\partial T} \right)_P$$

$$\Rightarrow \boxed{T dS = C_P dT - T \left(\frac{\partial V}{\partial T} \right)_P dP} \quad - (2)$$

THE ENERGY EQUATIONS

$$dU = Tds - PdV$$

$$\frac{du}{dV} = T \frac{ds}{dV} - P$$

$$\left(\frac{\partial u}{\partial V}\right)_T = T \left(\frac{\partial s}{\partial V}\right)_T - P$$

$$\left(\frac{\partial s}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$$

First energy Eqⁿ

$$\Rightarrow \boxed{\left(\frac{\partial u}{\partial V}\right)_T = T \left(\frac{\partial P}{\partial T}\right)_V - P} \quad - (1)$$

$$du = T ds - P dv$$

$$\frac{du}{dP} = T \frac{ds}{dP} - P \frac{dv}{dP}$$

$$\left(\frac{\partial u}{\partial P}\right)_T = T \left(\frac{\partial s}{\partial P}\right)_T - P \left(\frac{\partial v}{\partial P}\right)_T$$

4th relation

$$\left(\frac{\partial s}{\partial P}\right)_T = - \left(\frac{\partial v}{\partial T}\right)_P$$

$$\Rightarrow \left(\frac{\partial u}{\partial P}\right)_T = -T \left(\frac{\partial v}{\partial T}\right)_P - P \left(\frac{\partial v}{\partial P}\right)_T \quad (2)$$

2nd Energy Eqⁿ

(a) For a perfect gas

$$PV = RT$$

$$\Rightarrow \frac{\partial P}{\partial T} = \frac{R}{V}$$

$$\left(\frac{\partial u}{\partial v}\right)_T = \frac{TR}{V} - P$$

$$= \frac{RT}{V} - \frac{RT}{V}$$

$$= 0$$

$$\boxed{\left(\frac{\partial u}{\partial v}\right)_T = 0}$$

(b)

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$

$$\left(P + \frac{a}{V^2}\right) = \frac{RT}{V - b}$$

$$P = \frac{RT}{V - b} - \frac{a}{V^2}$$

$$\Rightarrow \left(\frac{\partial P}{\partial T}\right)_V = \frac{R}{V - b}$$

$$\Rightarrow \left(\frac{\partial u}{\partial V}\right)_T = \frac{a}{V^2}$$

The image features a light gray background with a subtle, circular, textured pattern in the center. The corners are decorated with several realistic water droplets of various sizes, some overlapping. The droplets have highlights and shadows, giving them a three-dimensional appearance.

THANKYOU