TPG 4145

Note Title 1/9/2017

Class Thought Problems

① H_2O

② C_3 (Propane)

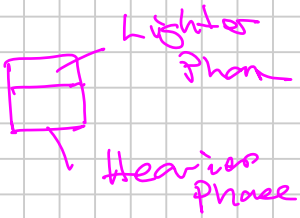
③ Air & Humidity

} p-T phase diagrams
- Gas (Vapor)
- Liquid
- Solid

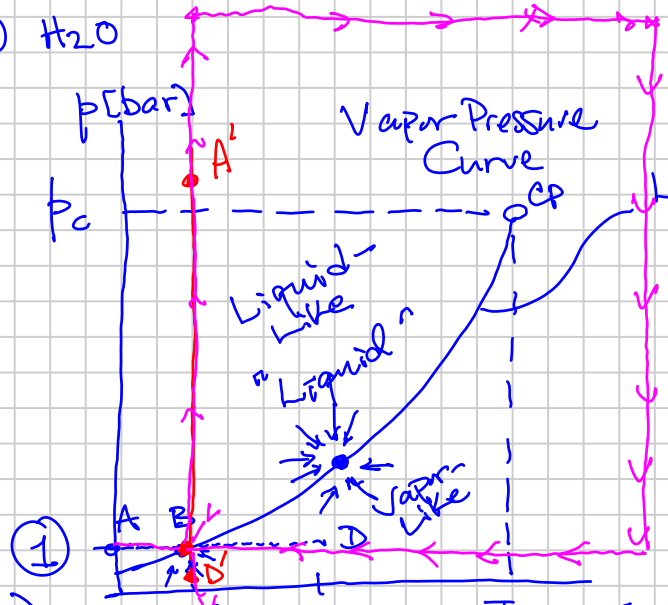
→ Vapor Pressure Curve (single compound)

→ Mixtures

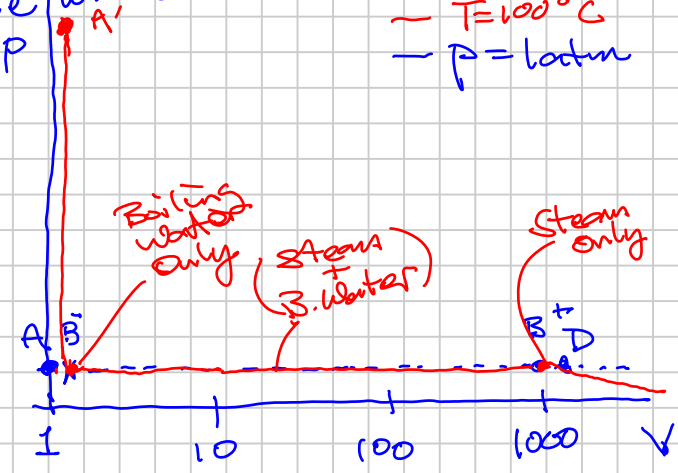
(p-V) behavior



① H_2O



Line where H_2O is in two phases
- T = 100°C
- p = 1 atm



② Normal Pressure

Normal Boiling Point

Unit? ~~K~~

$$pV = RT$$

$p_1 = 1$ $\quad V_1 = 1000$ $\quad T_1 = 100°C$

$$V_2 = V_1 \cdot \frac{T_2}{T_1}$$

$$1000 \cdot \frac{(250+273)}{(100+273)}$$

$$= 1400 \ m^3$$

Note Title 1/10/2017

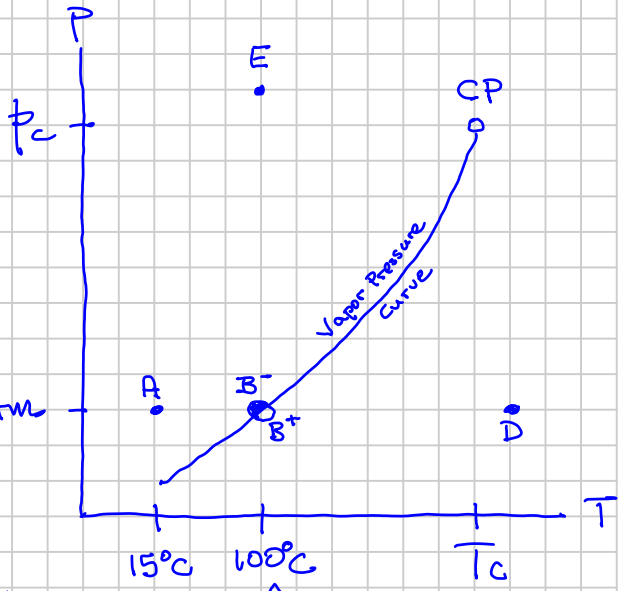
H_2O Phase & Volumetric Behavior

VAPOR PRESSURE CURVE: $p_v(T)$

A: 60°F (15.56°C)
1 atm (14.69 psia)

B: 100°C (212°F)
1 atm (14.69 psia)

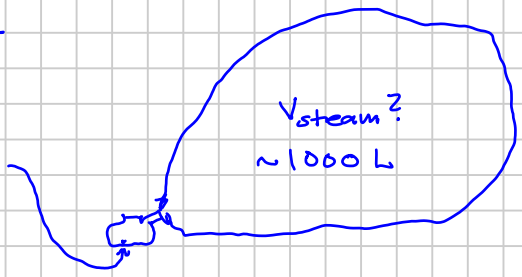
"Normal" Pressure ⇒ 1 atm



A: Water out of the faucet 1 L

B⁻: Water Kettle (heater/cooker)
just starts to boil — 1 bubble
"Bubblepoint" → ~1 L

B⁺: All liquid water in kettle has boiled "off" to steam, except one drop of liquid (called "dew") - "Dewpoint"



Phase Definitions:

Vapor	V	Increasing Density
Liquid (s)	L	
Solid	S	

Well defined phases only if >1 phases present, e.g. 50-50, @ bubblepoint, @ dewpoint

Vapor-like	$\tilde{V}$
Liquid-like	$\tilde{L}$
Solid-Like	$\tilde{S}$

Only one phase exists — subjective phase definition based on properties (ρ, μ_y ...)

For a pure compound (e.g. H_2O), well-defined phases (V & L) ONLY exist along the vapor pressure curve.

All (p,T) conditions away from the vapor pressure curve are single phase and phase labeling is a somewhat arbitrary (subjective) "definition" – e.g. "Vapor-Like" ($\tilde{V}$), "Liquid-Like" ($\tilde{L}$)

"Standard" pseudo-phase definition for pure compounds (i.e. a consistent, recommended definition) uses an extension of the $p_v(T)$ to $T > T_c$, i.e., $\tilde{p}_v(T)$ defined by the "critical isochor", the collection of (p,T) conditions with density equal to the density at the critical point:

$$\rho(T > T_c, \tilde{p}_v) = \rho_c(T_c, p_c)$$