Thermo I

Recitation #13

(05.16.23)

Final exam details

Overview of new material

Final exam

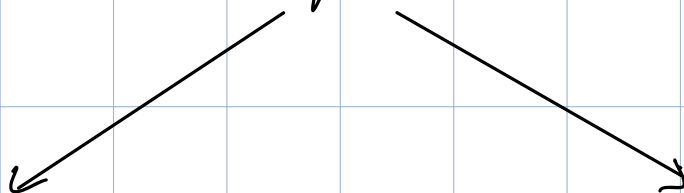→ 6 questions

→ 100 pts.

6 question

1 long question ← 30 pts → 1 long question ~ 40 mins

1 Short '' ← 10 pts → 1 Short '' ~ 13 mins

1 conceptual '' ← 10 pts → 1 coceptual '' ~ 13 mins (each)

$\underbrace{}$ based on Exam 1, 2, 3

$\underbrace{}$ new material

Time

New material → 1 long ques → Based on preos excel sheet

30 pts → Similar to H.w 8

No ΔH calc or ΔS calc.

at 298 k

3 root region

Pressure	Z values		Phase
0.001	0.999647643	$f_v < f_L$	Vapor
0.002654	0.999595554 or 2.26856E-0.5	$f_v = f_L$	Liquid and vapor equilibrium
1	0.00854669	$f_L < f_v$	Liquid
1.5	0.012819262	'	Liquid
3	0.025633899	''	Liquid
10	0.085375205	} one root region	Liquid
50	0.424965569		liquid
100	0.845661859		liquid
200	1.676882554		liquid

PV curve

$T(P, V)$ 298 K

Peng Robinson curve

Phase envolope (actual)

one root region

$f_L < f_v$

$f_L < f_v$

P_{sat}

$A_1 = A_2$

3 root region.

A_1

A_2

$f_v < f^L$

$f_v < f^L$

P

V

PT curve

P
(MPa) — 22.12
P_c

100

10

1.5

0.0025

0.001
MPa

Liquid

← P_c & T_c

saturation
$(L+v)$

Vapor

T

298K

3745°C
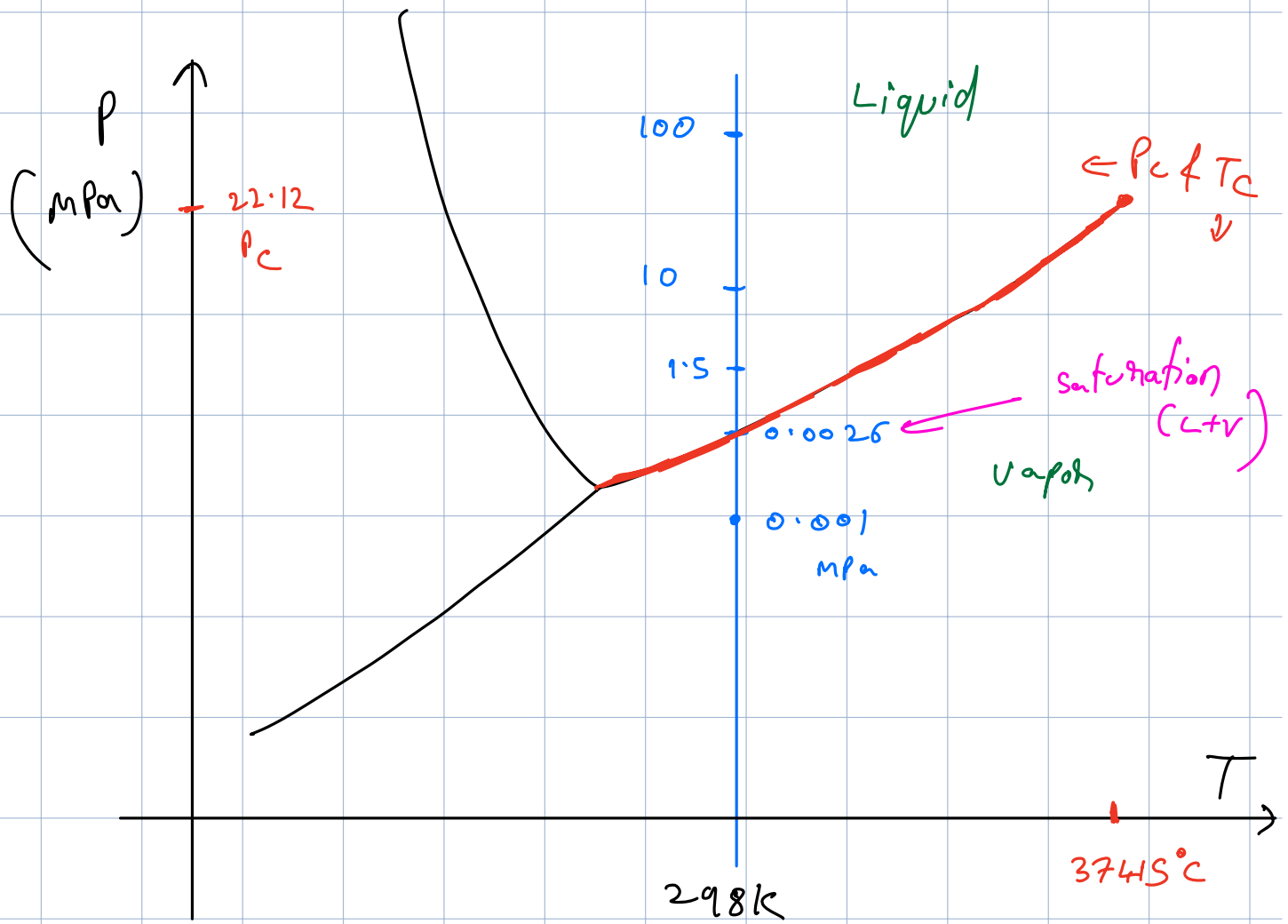
1 short question : Proving differential correlations

Should arrive at an answer in 3-4 steps

governing equations :
$$\rightarrow dU = -Pdv + Tds$$
$$\rightarrow d\xi = vdp - SdT$$
$$\rightarrow dA = -Pdv - SdT$$
$$\rightarrow dH = Tds + vdp$$

Basic identities :
$$\rightarrow \left(\frac{\partial x}{\partial y}\right)_x = 0$$
$$\left(\frac{\partial x}{\partial x}\right)_y = 1$$

Cyclic triple product :

$$\rightarrow \left(\frac{\partial x}{\partial y}\right)_F \left(\frac{\partial y}{\partial F}\right)_x \left(\frac{\partial F}{\partial x}\right)_y = -1$$

chain rule!

$$\rightarrow \quad \left(\frac{\partial x}{\partial y}\right)_z = \left(\frac{\partial x}{\partial F} \cdot \frac{\partial F}{\partial y}\right)_z$$

$$\left(\frac{\partial x}{\partial y}\right)_z = \left(\frac{\partial x}{\partial F}\right)_z \cdot \left(\frac{\partial F}{\partial y}\right)_z$$

Maxwell eq/s $\rightarrow$ Refer recitation # 10 notes.

More identities $\rightarrow$

$$\left.\frac{\partial S}{\partial T}\right|_V = \frac{C_V}{T} \quad \& \quad \left.\frac{\partial S}{\partial T}\right|_P = \frac{C_P}{T}$$

$$\left.\frac{\partial H}{\partial T}\right|_P = C_P \quad \& \quad \left.\frac{\partial H}{\partial P}\right|_T = V - T\left.\frac{\partial V}{\partial T}\right|_P$$

$$\left(\frac{\partial P}{\partial v}\right)_S$$

$\Rightarrow$ $dU = T\,dS - P\,dv$

int. w.r.t P & apply the triple prod.

$$\left(\frac{\partial v}{\partial P}\right)_S = P \left(\frac{\partial S}{\partial P}\right)_v \left(\frac{\partial V}{\partial S}\right)_P$$

$\underbrace{\qquad\qquad}_{1}$

$\rightarrow \left(\frac{\partial S}{\partial T}\right)_v \cdot \left(\frac{\partial T}{\partial P}\right)_v$ (chain rule)

$\rightarrow \dfrac{C_v}{T} \left(\frac{\partial T}{\partial P}\right)_v$

1 conceptual quest 10 pts

→ where do vap & liq coexist?

↪ one root region?

↪ PV dia / PT dia

→ True or false

→ what is an EoS?

→ why is PR EoS better than IG EoS?

→ intermolecular potential func } not

   virial eq of state   } on

                                   exam!

Thank you everyone !! &

Good Luck
for your exam & the journey ahead.