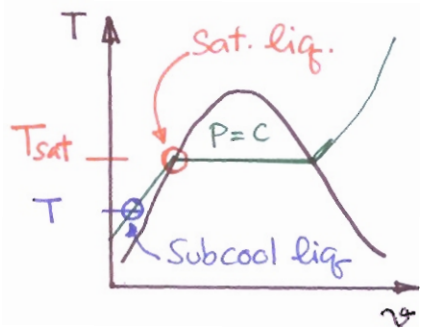
Source: Cengel, Y.A., and Boles, M.A., THERMODYNAMICS :An Engineering Approach, 5th Edition in SI unit, McGraw-Hill, 2006.
Prepared by: Assoc.Prof.Sommai Priprem,PhD.

Home Work no.1

1. What is the difference between saturated liquid and subcooled liquid?

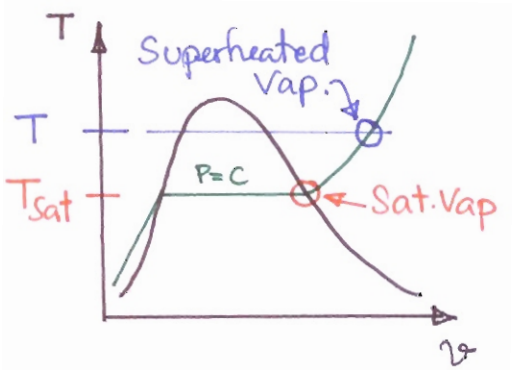
Saturated liquid คือของเหลวที่กำลังเดือด อุณหภูมิของมันคืออุณหภูมิจุดเดือด *(saturation temperature)* ณ ความดันนั้น

ส่วน *subcool liquid* นั้นจะมีอุณหภูมิต่ำกว่าจุดเดือดที่ความดันนั้นๆ



2. What is the difference between saturated vapor and superheated vapor?

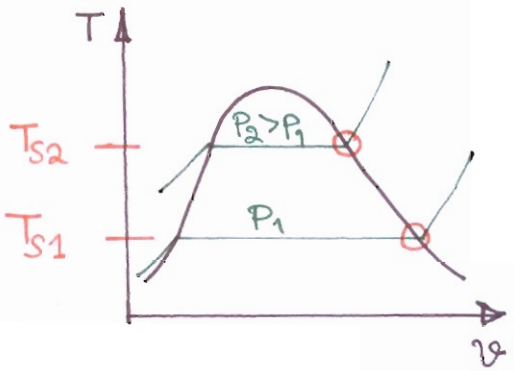
Saturated vapor คือไอที่เกิดจากของเหลวที่กำลังเดือด อุณหภูมิของมันเท่ากับอุณหภูมิจุดเดือด *(saturation temperature)* $(T = T_{sat})$ ณ ความดันนั้น ส่วน *superheated vapor* จะมีอุณหภูมิสูงกว่าจุดเดือดที่ความดันนั้นๆ $(T>T_{sat})$



3. Is it true that water boils at higher temperature at higher pressure? Explain.

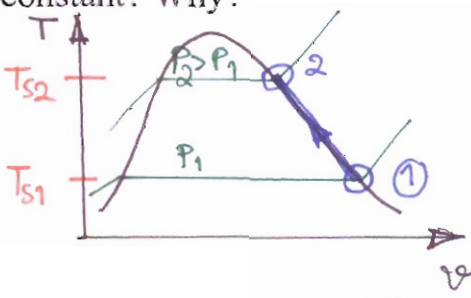
จริง.....

เพราะเมื่อความดันเพิ่มขึ้นจะส่งผลให้ การเปลี่ยนแปลงสถานะจากของเหลวเป็นไออยากขึ้น มันจึงต้องมีระดับพลังงานสูงขึ้นกว่าเดิม โมเลกุลจึงจะสามารถหลุดออกมาได้ นั่นคือ อุณหภูมิอิ่มตัว(หรือจุดเดือด) สูงขึ้นด้วย



4. If the pressure of a substance is increased during a boiling process, will the temperature also increase or will it remain constant? Why?

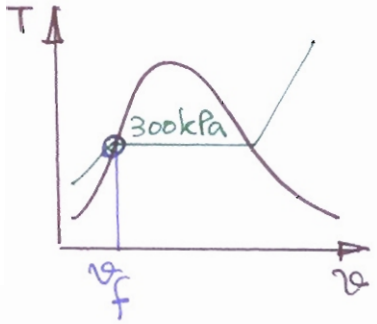
ในระหว่างที่ต้มของเหลว หากความดันเปลี่ยนไปจุดเดือดก็จะเปลี่ยนไปด้วย ดังนั้นหากความดันเพิ่มขึ้นก็จะส่งผลให้อุณหภูมิจุดเดือดเพิ่มขึ้นไปด้วย



Sommai

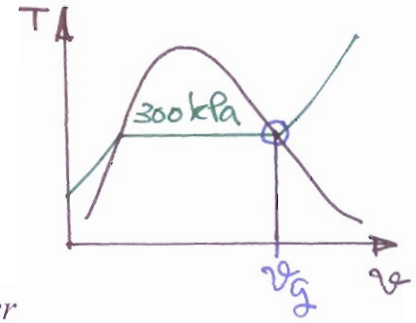
5. What is the specific volume of saturated liquid water 300 kPa.

Solution:
Substance: water
State: Saturated liquid
Then, $v = v_f$ at 300 kPa
Table A-5, at 300 kPa
$v_f = 0.001073\ m^3/kg$
the specific volume, $v = 0.001073$ *answer*



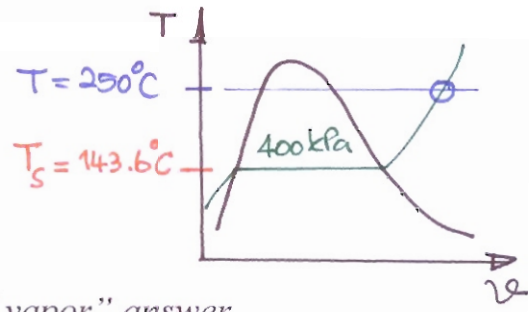
6. What is the specific volume of saturated vapor water 300 kPa.

Solution:
Substance: water
State: Saturated vapor
Then, $v = v_g$ at 300 kPa
Table A-5, at 300 kPa
$v_g = 0.6573\ m^3/kg$
the specific volume, $v = 0.6573$ *answer*



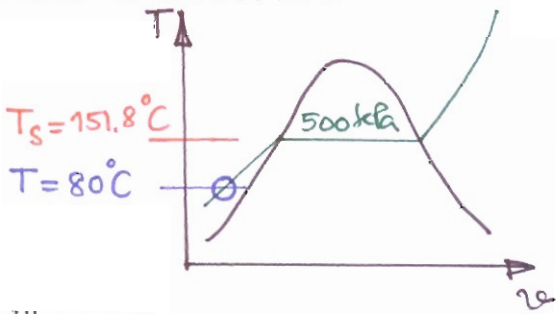
7. What is the phase and enthalpy of water at 250 °C and 400 kPa.

Solution:
Substance: water
State: 250 °C and 400 kPa.
Check: Table A-5, at 400 kPa ,
$T_{sat} = 143.63$ °C
Because T>Tsat,
therefore the phase is 'superheated vapor" *answer*
To find h, use table A-6 at 400 kPa and 250 °C
$h = 2{,}964.2$ *kJ/kg* *answer*



8. What is the phase and enthalpy of water at 80 °C and 500 kPa.

Solution:
Substance: water
State: 80 °C and 500 kPa.
Check: Table A-5, at 500 kPa ,
$T_{sat} = 151.86$ °C
Because T<Tsat,
therefore the phase is 'subcool liquid" *answer*
To find h, use table A-6 at 500 kPa and 80 °C.
$h = 2{,}964.2$ *kJ/kg* *answer*



9. What is the phase and enthalpy of water at 200 kPa and 0.7 quality.

Solution:
Substance: water
State: 200 kPa and x = 0.7
Because $0.0<x<1.0$
Therefore, the phase is 'mixture" answer
from: $h = h_f + xh_{fg}$

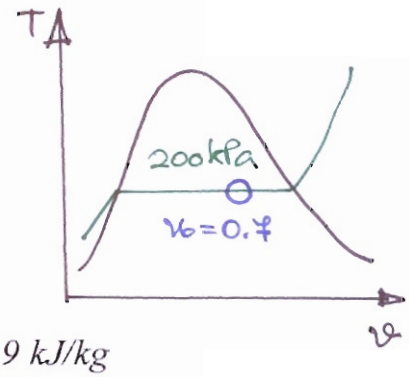


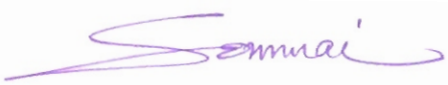
table A-4 at 200 kPa
$h_f = 504.70$ kJ/kg and $h_{fg} = 2201.9$ kJ/kg
therefore, $h = (504.70 \text{ kJ/kg}) + (0.7)(2201.9 \text{ kJ/kg})$
$h = 2{,}046.03$ kJ/kg answer

10. What is the temperature of water at 5 MPa and 2,000 kJ/kg specific internal energy. Also determine its quality.

Solution:
Substance: water
State: 5 MPa and $u = 2{,}000$ kJ/kg
table A-4 at 5 MPa

$u_f = 1{,}147.81$ kJ/kg,
$u_{fg} = 1{,}449.3$ kJ/kg and
$u_g = 2{,}597.1$ kJ/kg

Because $u_f < u < u_g$
Therefore, the phase is 'mixture" answer
from: $u = u_f + xu_{fg}$
$x = (u - u_f)/u_{fg}$
$= (2{,}000 \text{ kJ/kg} - 1{,}147.81 \text{ kJ/})/(1{,}449.3 \text{ kJ/kg})$
$= 0.5880$ answer



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