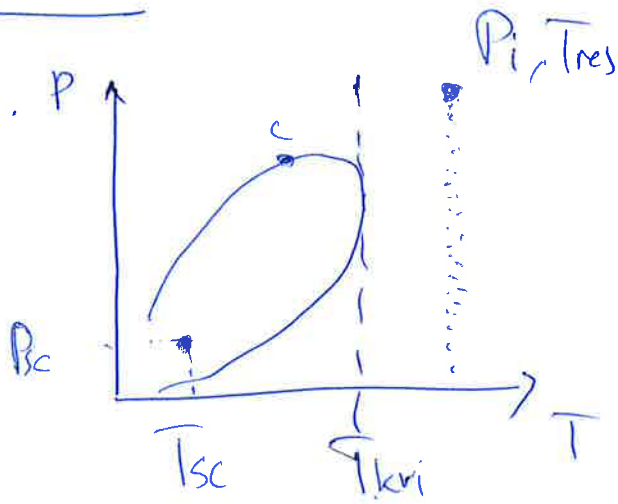
Problem 1

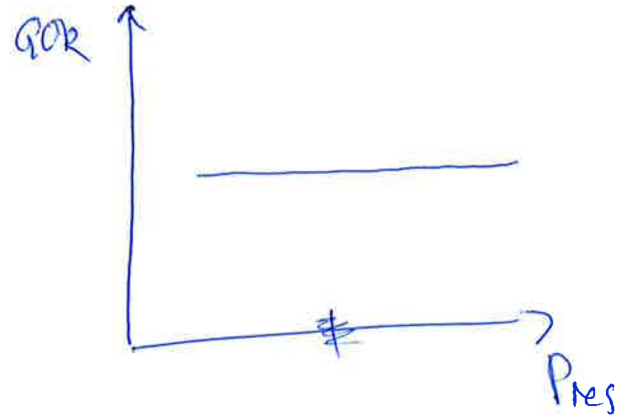
a) 1.



$T_{res} > T_{kri}$

sc inside the two-phase envelope

2)



GOR is constant

Composition of the reservoir fluid flowing into the well is constant.

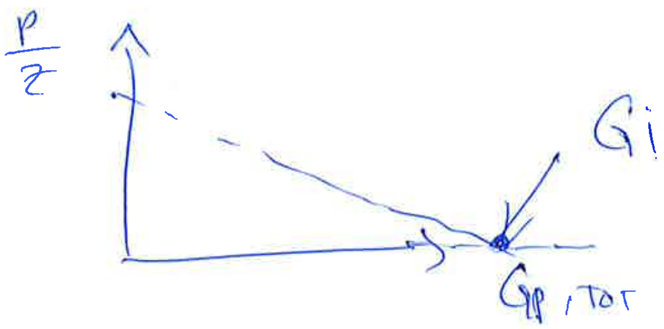
3) Derive GE-formula.

4) Derive $\frac{P}{Z} = f(G_p)$

$PV = ZnRT$

$n_{prod} = n_i - n_{left}$

5)



b) IGIP (Sm^3)
IOIP (Sm^3)

2-step separator system

$P_{res} = 50\,000$ kPa

$Z_i = 1.236$

$T_{res} = 100\,°C$

$S_{wr} = 0.10$

$\Phi = 0.25$

$\rho_{STO} = 750$ kg/m^3

$M_{STO} = 105$

$GOR_{sep} = 6500$ Sm^3/Sm^3

$GOR_{tank} = 500$ Sm^3/Sm^3

$V_b = 10\,000$ m^3

$$HCPV = V_b \cdot \Phi \cdot (1 - S_{wr}) = 10\,000\ m^3 \cdot 0.25 \cdot (1 - 0.10)$$

$$= 2250\ m^3$$

Number of moles gas in HCPV: $PV = ZnRT$

$$n_i = \frac{P_i \cdot V_i}{Z_i R T_i} = \frac{50\,000\ kPa \cdot 2250\ m^3}{1.236 \cdot 8.3145 \cdot (100 + 273.15)\ K}$$

$$n_i = 29\,336.9\ kg\,mol$$

Total GOR for the separation process:

$$GOR_{TOT} = GOR_{sep} + GOR_{tank} = 6500 + 500$$

$$= 7000\ Sm^3/Sm^3$$

One must determine mole fraction of gas and liquid for the total separation process.

Basis in 1 Sm³ oil:

~~An~~ Number of moles in 1 Sm³ STO:

$$n_{STO} = \frac{m_{STO}}{M_{STO}} = \frac{\rho_{STO} \cdot V_{STO}}{M_{STO}} = \frac{\rho_{STO} \cdot 1\ Sm^3}{M_{STO}}$$

$$n_{STO} = \frac{750\ kg/m^3 \cdot 1\ Sm^3}{105\ kg/kgmol} = 7.143\ kg\ mol$$

$$GOR = \frac{V_{g,sc}}{V_{STO,sc}} \Rightarrow V_{g,sc} = GOR \cdot V_{STO}$$

$$= 7000\ Sm^3/Sm^3 \cdot 1\ Sm^3\ (STO)$$

$$= 7000\ Sm^3$$

$$V_{g,sc} = n_g \cdot V_m \Rightarrow n_g = \frac{V_{g,sc}}{V_m} = \frac{7000\ Sm^3}{23.6447\ Sm^3/kg\ mol}$$

$$= 296.0\ kg\ mol$$

Calculate mol fractions:

$$L = \frac{n_{STO}}{n_g + n_{STO}} = \frac{7.143\ kg\ mol}{(296.0 + 7.143)\ kgmol} = 0.0236$$

$$V = \frac{n_g}{n_g + n_{STO}} = \frac{296.0\ kgmol}{(296.0 + 7.143)\ kgmol} = 0.9764$$

Out of n_i 97.64 % becomes gas
2.36 % becomes oil

$$\underline{\underline{IGIP}} = \overbrace{n_i \cdot 0.9764}^{n_g} \cdot V_m$$

$$= 29336.9 \text{ kgmol} \cdot 0.9764 \cdot 23.6447 \text{ Sm}^3/\text{kgmol}$$

$$= \underline{\underline{677291.8 \text{ Sm}^3}}$$

$$\underline{\underline{IOIP}} = \frac{IGIP}{GOR_{TOT}} = \frac{677291.8 \text{ Sm}^3}{7000 \text{ Sm}^3/\text{Sm}^3} = \underline{\underline{96.76 \text{ Sm}^3}}$$

c) 1. $B_g = \frac{\text{volume gas at res. conditions}}{\text{volume gas at SC}}$ m^3/Sm^3

2. Calculate B_g at $P_{res} = 50000$ kPa

$$B_g = \frac{V_{g,res}}{V_{g,SC}} = \frac{HCPV}{IGIP,sc} = \frac{2250 \text{ m}^3}{677291.8 \text{ Sm}^3}$$

$$\underline{\underline{B_g = 0.00332 \text{ m}^3/\text{Sm}^3}}$$

3.