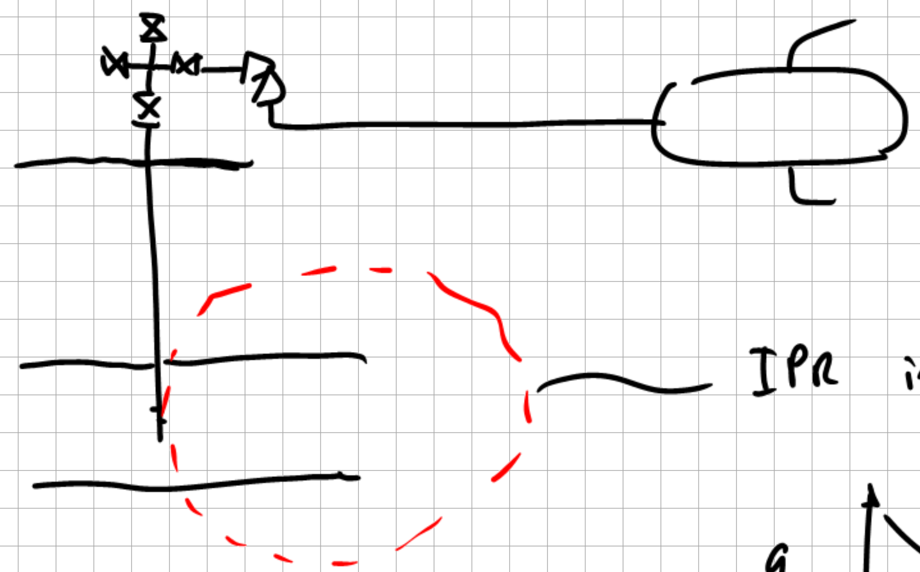
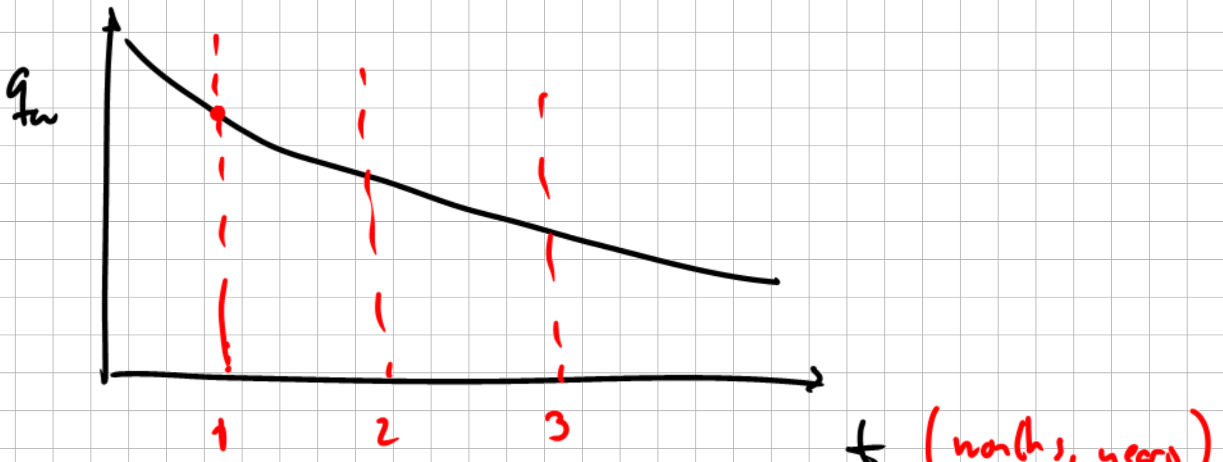
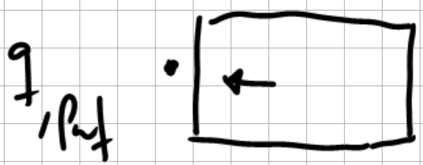


IPR inflow performance relationship

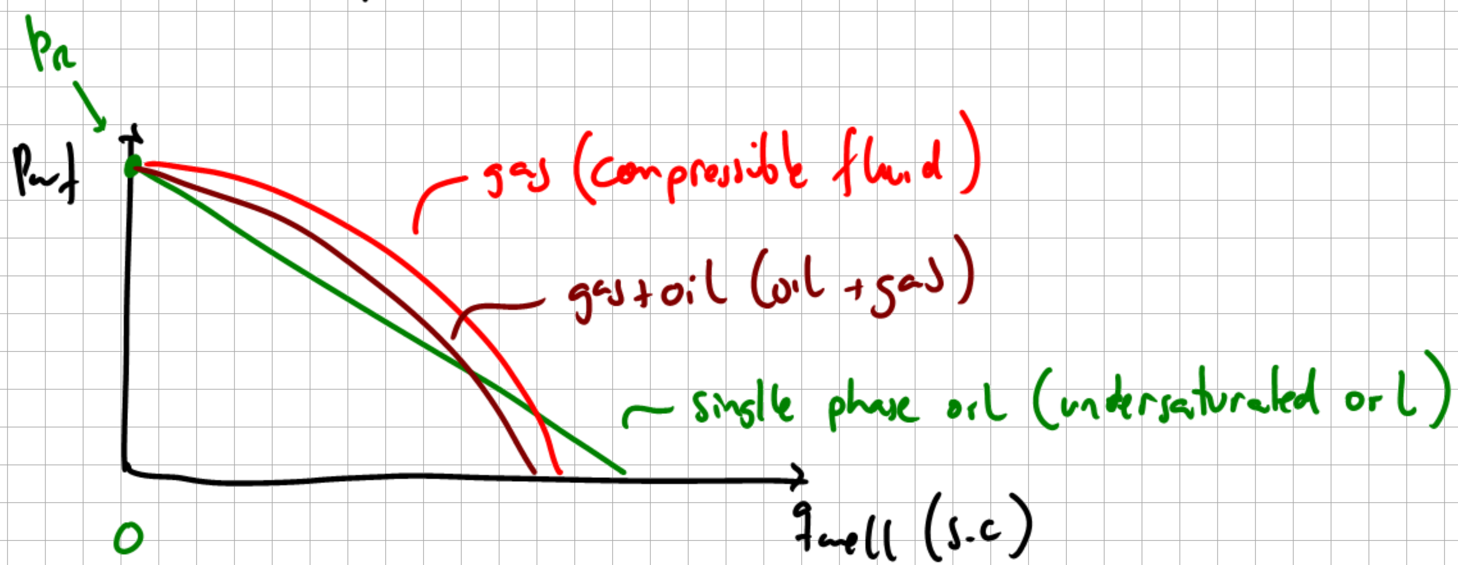




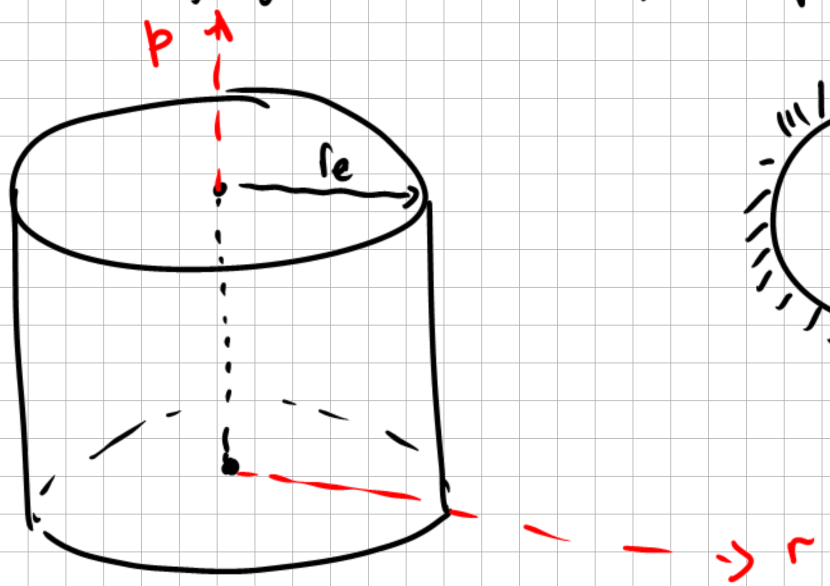
$q = f(P_{wf}, t)$

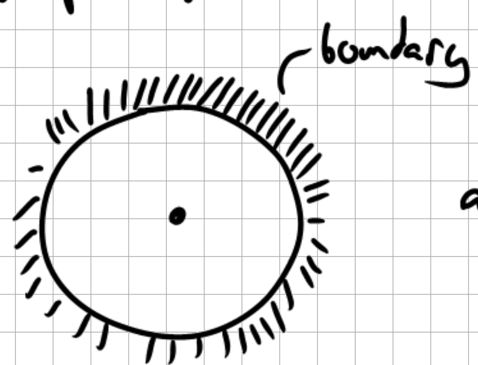
↳ instead of using t, i use P_R

at a given point in time:



vertical well, cylindrical reservoir, single phase fluid





at $t=0$

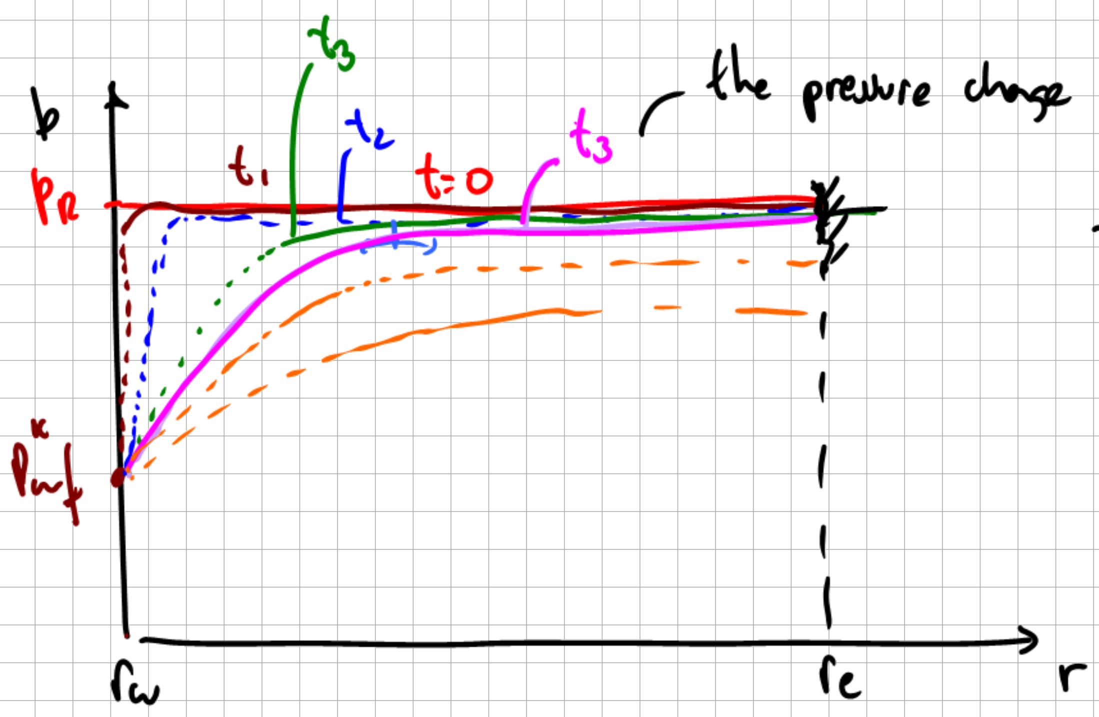
$q=0$

$P(r_w) = P_R$

at $t>0$

$q \neq 0$

$P(r_w) = P_{wf}^*$



the pressure change reaches the boundary

$t=0 \rightarrow t=t_3$ infinite acting

t is important for IPR (no boundary effects)

$t_3 \rightarrow$ steady state $p(r_e) = \text{const}$

pseudo steady state $q(r_e)=0$ (pss)

$$t_{pss} = 281.3 \frac{\phi \cdot \mu \cdot C_t \cdot A}{k}$$

ϕ [-]

μ [cp] $\quad$ 1cp = 1E-3 Pa s

C_t [1/bar] $\quad C_t = C_f + C_{fluid}$ → gas, → oil

→ $S_w C_w + S_o C_o + S_g C_g$

A [m²]

k [md]

Formation compressibility, c_f	[1/bar]	4.35E-05		
Oil compressibility at res conditions, C_o	[1/bar]	2.18E-04		
Gas compressibility at res conditions, C_g	[1/bar]	7.25E-03		
Total compressibility, assuming oil-filled pore, C_t	[1/bar]	2.61E-04		
Total compressibility, assuming gas-filled pore, C_t	[1/bar]	7.30E-03		
Oil viscosity at res conditions, μ_o	[cp]	0.5		
Gas viscosity at res conditions, μ_g	[cp]	1.20E-02		
Porosity, ϕ	[-]	0.3		
Outer radius of reservoir, r_e	[m]	600		
Top area of reservoir, A	[m2]	1130973.4		
		FLUID:	Gas	Oil
		k	t_{pss}	t_{pss}
		[md]	[hr]	[hr]
		0.01	835552.28	1245853.30
		0.1	83555.23	124585.33
		1	8355.52	12458.53
		10	835.55	1245.85
		1000	8.36	12.46
		10000	0.84	1.25

- if t_{pss} is short most of the production will occur in pss (ss) therefore t is not necessary to compute IPR
- if t_{pss} is large, most of the production will occur in IA, therefore it is important to consider time in IPR

IPRs are obtained
- empirical (field data) → "easier to use" → field data is needed
- Derived analytically (semi-analytically) from conservation equations.

Conservation of mass + Darcy flow in a radial reservoir;
single-phase fluid

$$\frac{\partial^2 p}{\partial r^2} + \frac{1}{r}\frac{\partial p}{\partial r} = \alpha \frac{\partial p}{\partial t}$$

$$\alpha = \frac{\mu \phi C}{k}$$

- need a lot of parameters about the reservoir
- Allow for well design and to estimate future performance
- always need adjustment with field data