Petroleum Engineering 311
Test 13

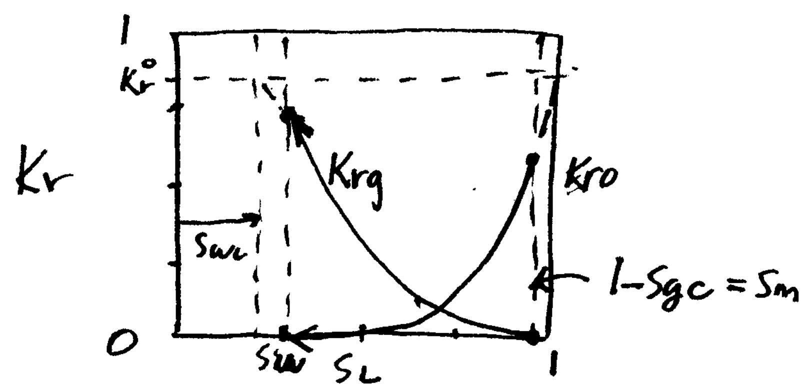
April 11, 2003

1. Calculate $k_{ro}]_{dr}$ and $k_{rg}]_{dr}$ for a water-wet rock for the values of S_g shown below if $S_w = 0.25$, $S_{iw} = 0.2$, $S_m = 0.95$, $k_r^o = 0.85$, and $\lambda = 2$. See equations at the bottom. Note that $k_{rw}]_{dr}$ is a small constant.

S_o	S_g	$k_{rg}]_{dr}$	$k_{ro}]_{dr}$	$S_g + S_m - 1$	$S_o + S_w - S_{iw}$ (S_L)
0.7	0.05	0.0	0.569	0.0	0.75
0.4	0.35	0.093	0.066	0.3	0.45
0.0	0.75	0.737	0.0	0.7	0.05

$S_o = 1 - S_w - S_g$

2. Sketch the graph of $k_{ro}]_{dr}$ and $k_{rg}]_{dr}$, calculated above, vs liquid saturation. Clearly label the axes of your graph and endpoints. Show the direction of the saturation change.



For the mobile water phase:

$$k_{rw}\Big]_{dr} = \frac{k_w}{k} = \left(\frac{S_w - S_{iw}}{1 - S_{iw}}\right)^{\frac{2+3\lambda}{\lambda}} \quad (17)$$

For the oil phase:

$$k_{ro}\Big]_{dr} = \frac{k_o}{k} = k_r^o \left(\frac{S_o}{1 - S_{iw}}\right)^2 \left[\left(\frac{S_o + S_w - S_{iw}}{1 - S_{iw}}\right)^{\frac{2+\lambda}{\lambda}} - \left(\frac{S_w - S_{iw}}{1 - S_{iw}}\right)^{\frac{2+\lambda}{\lambda}}\right] \quad (18)$$

For the gas phase:

$$k_{rg}\Big]_{dr} = \frac{k_g}{k} = \begin{cases} k_r^o \left(\frac{S_g + S_m - 1}{S_m - S_{iw}}\right)^2 \left[1 - \left(\frac{S_o + S_w - S_{iw}}{1 - S_{iw}}\right)^{\frac{2+\lambda}{\lambda}}\right]; & (S_g + S_m > 1) \\ 0; & (\text{elsewhere}) \end{cases} \quad (19)$$