PROBLEM # 1

Calculate the capillary pressure (psia) in a reservoir at a point 20 feet above the Free Water Level (p_c=0) for an oil/water system, given that water is the wetting phase and oil is the non-wetting phase. ρ_{oil} = 40.4 lb_m/ft^3; ρ_{water} = 63.5 lb_m/ft^3.

THEORY

$$p_c = \Delta\rho g h\ (consistent\ units) = \frac{\Delta\rho}{144}\frac{g}{g_c}h\ (oilfield\ units)$$

SOLUTION

$$p_c = \frac{(63.5-40.4)\ lb_m/ft^3}{144\ in^2/ft^2} \cdot \frac{32.174\ ft/s^2}{32.174\ \frac{lbm \cdot ft}{lbf \cdot s^2}} \cdot 20\ ft$$

$$= 3.2\ psi$$

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PROBLEM # 2

Determine the water saturation at a point 7.5 feet above the Free Water Level (p_c=0) for an oil/water system given the following laboratory and reservoir data:

	Lab	Reservoir	Other Data
Fluid System	Air-Water	Oil-Water	ρ_{oil} = 40.4 lb_m/ft^3
θ (degrees)	0	0	$\rho_{formation\ water}$ = 63.5 lb_m/ft^3
σ (dynes/cm)	70	24	
k / ϕ (md)	120	150	

Laboratory capillary pressure data:

Water Saturation (fraction)	p_c (psia)
1.00	0.00
0.90	0.055
0.60	0.25
0.40	0.60
0.37	1.02
0.29	1.67
0.22	2.45
0.12	9.24

THEORY

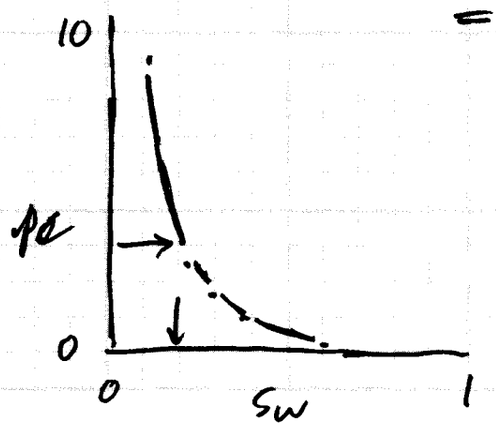
$$J(S_w) = \frac{p_c}{\sigma \cos\theta}\sqrt{\frac{k}{\phi}},\ J(S_w)\|_{Lab} = J(S_w)\|_{Res},\ p_c = \Delta\rho g h$$

SOLUTION

$$p_c = \frac{\Delta\rho}{144}\frac{g}{g_c}h = \frac{23.1\ lb_m/ft^3}{144\ in^2/ft^2}\frac{g}{g_c}\frac{lb_f}{lb_m}\ 7.5\ ft = 1.203\ psi$$

$$J_{Lab} = J_{res} \Rightarrow p_{c\,lab} = (1.203\ psi)\frac{70\cos 0}{24\cos\theta}\frac{\sqrt{150}}{\sqrt{120}}$$

$$= 3.923\ psi \Rightarrow 0.12 < S_w < 0.22$$



$S_w \approx 0.2$

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PROBLEM # 3

Determine the radius of the largest pore from the above laboratory capillary pressure measurement if the displacement pressure was 0.02 psia.

THEORY

$$p_c = \frac{2\sigma\cos\theta}{r}$$

SOLUTION

$$r = \frac{2\sigma\cos\theta}{p_c} = \frac{(2)(70\ \text{dynes/cm})(14.696\ \text{psi/atm})}{(0.02)\text{psi}\ (1.01325\times10^6\ \text{dynes/cm}^2\text{/atm})}$$

$$= 0.10\ \text{cm}$$

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