Petroleum Engineering 311
Test 9

March 3, 2003

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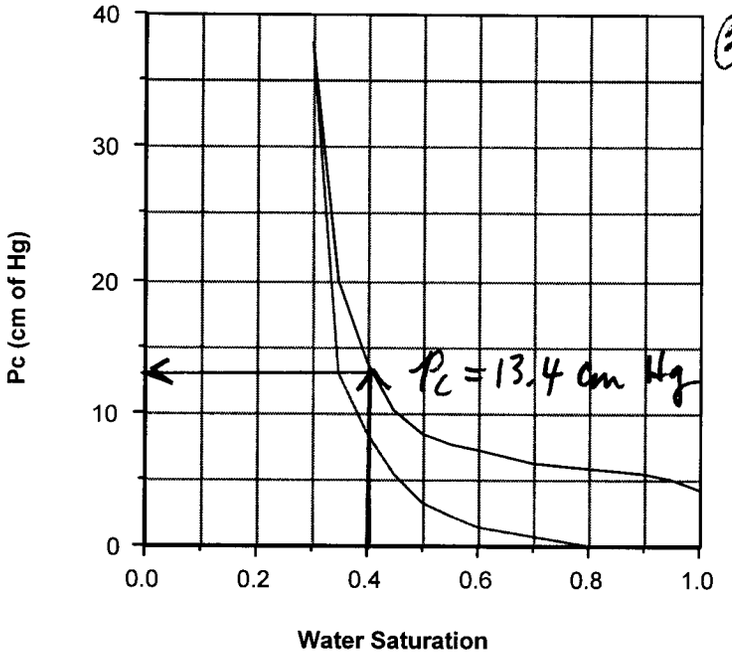
A well penetrates an oil bearing sand at -4010 ft subsea which has the following average properties:

porosity	0.117	permeability	2.62 md
oil-water interfacial tension	36 dynes/cm	contact angle	0 degrees
oil density	55.5 lb_m/ft^3	water density	65.5 lb_m/ft^3
acceleration due to gravity	32.174 ft/s^2	water saturation	0.4

A core sample having a porosity of 0.128 and a permeability of 5.5 md was used in a laboratory air-water displacement test (interfacial tension of 72 dynes/cm and a contact angle of 0 degrees) to determine the capillary pressure data shown below



① From graph, $P_{c\,lab} = 13.4$ cm

② $J_{res} = J_{lab}$

$$\frac{\Delta\rho g h}{144 g_c} = P_{c\,lab}\frac{\sigma\cos\theta_{res}}{\sigma\cos\theta_{lab}}\frac{\sqrt{\frac{k}{\phi}}_{lab}}{\sqrt{\frac{k}{\phi}}_{res}}$$

$$= \left(\frac{13.4\text{ cm}}{76\text{ cm}}\right)(14.696\text{ psi})\left(\frac{36}{72}\right)\frac{\sqrt{\frac{5.5}{0.128}}}{\sqrt{\frac{2.62}{0.117}}}$$

$$= 1.795\text{ psi}$$

$$\Rightarrow h = \frac{1.795\text{ psi}\,|\,144\text{ in}^2/\text{ft}^2\,|\,g_c\,|\,\text{lbm}/\text{lbf}}{10\text{ lbm/ft}^3\,|\,g\,|}$$

$$= 25.8\text{ ft}$$

Estimate the depth of the free-water level.

HINT: 1. Use $J(S_w) = \dfrac{p_c}{\sigma\cos\theta}\sqrt{\dfrac{k}{\phi}}$ to relate height above free water level in the reservoir to the laboratory capillary pressure curve. You'll need this: 1 atm = 76 cm Hg = 14.696 psia.

2. Read Lab p_c from drainage curve above and calculate subsea depth to free water level.

③ $-4010 - 25.8 = -4036$ ft subsea