

key

PETE 324

Exam A

February 16, 2004

50 minutes, closed book except for 1 cheat sheet, calculator, and straight edge.

Turn in you cheat sheet with your exam.

Show your work. Include the units. Use symbols instead of values when necessary.

1. (15 points) Write the diffusivity equation for 1 dimension, in the radial (r) direction, and indicate the units of each of the variables.

CR

$$\frac{d^2 p}{dr^2} + \frac{1}{r} \frac{dp}{dr} = \frac{0.12 c_p}{0.00633 k} \frac{dp}{dt}$$

psi
ft
fraction
cp
psi⁻¹
md
days

① Term k included.

2. (15 points) Attached is the PVT data for the SPE1 test case. Calculate c_o at 4,015 psi, assuming that

- (a) the oil is saturated.
- (b) the oil is undersaturated.

$$c_o = -\frac{1}{B_o} \frac{dB_o}{dp} + \frac{B_g}{B_o} \frac{dB_g}{dp}$$

(a)

$$c_o = -\frac{1}{1.6950} \frac{(1.8270 - 1.6950)}{(5014.7 - 4014.7)} + \frac{0.000811 \frac{RB}{scf}}{1.6950} \frac{(1618.0 - 1270.0) \frac{scf}{RB}}{(5014.7 - 4014.7)}$$

$$= (-77.9 + 166.5) \times 10^{-6} = 88.6 \times 10^{-6} \text{ psi}^{-1}$$

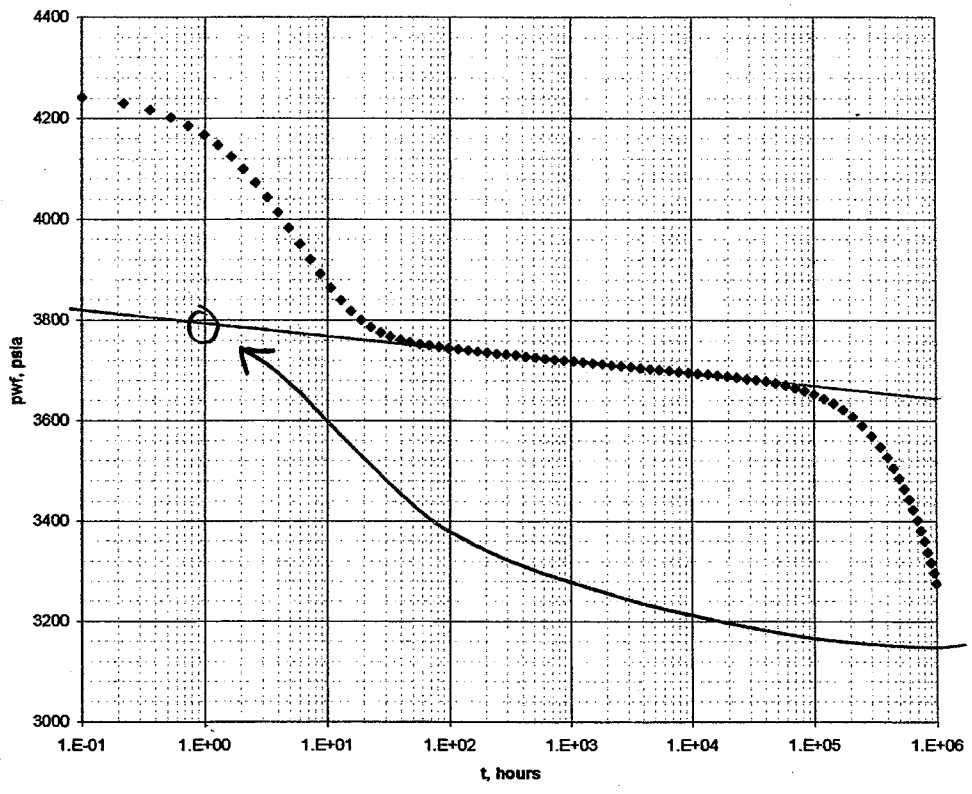
(b)

$$c_o = -\frac{1}{1.695} \frac{(1.5790 - 1.6950)}{(9014.7 - 4014.7)} = 13.68 \times 10^{-6} \text{ psi}^{-1}$$

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3. (20 points) A "drawdown" flow test is conducted with a well flowing at constant rate. The plot of p_{wf} vs. t is attached. Calculate k and s from this plot, given the following data:

$p_i = 4,091$ psia	$\mu = 0.80$ cp	$h = 120$ ft
$q = 121$ stb/d	$\phi = 0.19$	$r_w = 0.25$ ft
$B = 1.10$ rb/stb	$c_t = 24.3 \times 10^{-6}$ psi ⁻¹	$S_w = 0.23$



$P_{1hr} = 3792$ psia

calculate slope of SLSL

$$m = \frac{\Delta p}{\log t_2 - \log t_1} = \frac{(3696 - 3720) \text{ psi}}{1 \text{ cycle}} = 24 \text{ psi/cycle}$$

$$k = 162.6 \frac{q B \mu}{m h} = 162.6 \frac{(121 \text{ stb/d}) + (1.10 \text{ rb/stb}) + 0.8 \text{ cp}}{24 \text{ psi/cycle} + 120 \text{ ft}}$$

$$k = \boxed{6.01 \text{ md}}$$

$$s = 1.1515 \left[\frac{(p_i - P_{1hr})}{m} - \log \left(\frac{k}{\phi \mu c_t r_w^2} \right) + 3.23 \right]$$

$$s = 1.1515 \left[\frac{(4091 - 3792)}{24} - \log \left(\frac{6.01}{0.19 + 0.80 \times 24.3 \times 10^{-6} \times (0.25)^2} \right) + 3.23 \right] = \boxed{9.526}$$

4. (15 points) The following data is a portion of the p_{wf} vs. t data for a well test. We want to make a "derivative" plot for the log-log type curve. Calculate the value of the "derivative" at $t = 424.78$ hours.

<u>t, hours</u>	<u>p_{wf}, psia</u>
294.83	3731.6
353.90	3729.7
424.78	3727.7
509.84	3725.8

$$\frac{d\Delta P}{d \ln t} = \frac{-(3727.7 - 3729.7)}{\ln\left(\frac{424.78}{353.90}\right)} = \frac{2.0}{0.18}$$

$$= \boxed{10.96 \text{ psi}} \times$$

RAW 5. (15 points) Suppose you observe a log-log plot of drawdown test data. You notice that the derivative value is constant at 25 psi for a period of time. From this information, calculate permeability, k . [Use the data from problem no. 3].

$$\frac{d(P_i - P_{wf})}{d(\ln t)} = 25 \text{ psi}$$

$$\frac{dP}{d \ln t_D} = \frac{1}{2} = \frac{d \left[\frac{kh(P_i - P_{wf})}{141.2 q B m} \right]}{d \ln t_D}$$

But,

$$d(\ln t_D) = d \ln t$$

so,

$$\frac{kh \Delta P}{141.2 q B m} = \frac{1}{2} = \frac{k(120)(25)}{141.2(121)(1.10)(0.80)}$$

$$k = 2.506 \text{ md}$$

RAW 6. (20 points) An input data sheet from Gassim is attached (this is not the data used for problem no. 3).

- (a) Calculate the rate of pressure change (psi/day) of the very, very early rate of pressure change during the WBS period
 (b) Calculate the skin factor, s .

$$(a) \quad \frac{dP}{dt} = \frac{-qB}{V_p c_t} = \frac{-(561.5)(1.1)}{[\pi(0.25^2 - 0.001^2)(150)(16.2)] [(15.0 + 0.2 \times 3) \times 10^{-6}]}$$

$$= \frac{-617.65}{[477.12][15.6 \times 10^{-6}]} = -82,983 \text{ psi/day}$$

$$(b) \quad s = \left(\frac{k}{k_s} - 1 \right) \ln \frac{r_s}{r_w}$$

$$= \left(\frac{4}{0.2} - 1 \right) \ln \left(\frac{1.8477}{0.25} \right) = 38.0$$