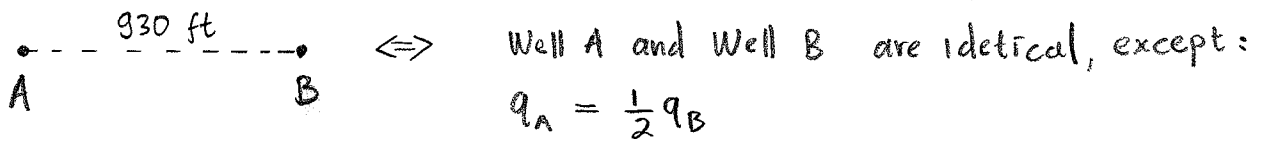


HOMEWORK - 5 SOLUTION PETE - 324



Data: Drainage area = infinite acting

$k = 4.7 \text{ md}$	$B_o = 1.05 \text{ RB/STB}$
$h = 110 \text{ ft}$	$q_A = 65 \text{ stb/d}$
$\phi = 0.17$	$S = 6.1$
$\mu = 1.3 \text{ cp}$	$P_i = 3000 \text{ psig}$
$C_t = 12 \times 10^{-6} \text{ psi}^{-1}$	$r_w = 0.25$

a. \rightarrow Pressure drop $(P_i - P_{wf})$ at $t = 10$ hours

Using Lee 1.7:

$$P_i - P_{wf} = -70.6 \frac{qB\mu}{kh} [E_i - 2S]$$

$$\Delta P_{A/A} = -70.6 \frac{(65 \text{ stb/d})(1.05 \text{ RB/stb})(1.3 \text{ cp})}{(4.7 \text{ md})(110 \text{ ft})} [E_i - 2(6.1)]$$

$$= -12.116 [E_i - 12.2]$$

$$\Delta P_{B/A} = -12.116 \times \frac{130 \text{ stb/d}}{65 \text{ stb/d}} [E_i]$$

$$= -24.232 [E_i]$$

Calculation of E_i :

(1) E_i function table p4 Lee's book:

$$E_i(-x), -x_A = \frac{-948 \phi \mu C_t r_w^2}{k t} = \frac{-948 (0.17)(1.3 \text{ cp})(12 \times 10^{-6} \text{ psi}^{-1})(0.25)^2}{(4.7 \text{ md})(10 \text{ hrs})}$$

$$= -3.3432 \times 10^{-6}$$

$$-x_B = -3.3432 \times 10^{-6} \times \frac{(930)^2}{(0.25)^2}$$

$$= -46.2647$$

$$\Delta P_{A/A} = -12.116 [Ei(-3.3432 \times 10^{-6}) - 12.2]$$

$$x_A < 0.02, Ei(x_A) = \ln(1.781 x_A)$$

$$Ei(-x_A) = \ln(1.781 * 3.3432 \cdot 10^{-6}) \\ = -12.03$$

$$\Delta P_{A/A} = -12.116 [-12.03 - 12.2]$$

$$\Delta P_{A/A} = 293.57 \text{ psi}$$

$$\Delta P_{B/A} = -24.232 [Ei(-x_B)]$$

$$x_B = 46.2647 > 10.9, Ei(-x_B) = 0$$

$$\Delta P_{B/A} = -24.232 [0]$$

$$= 0$$

$$\Delta P_A = \Delta P_{A/A} + \Delta P_{B/A} = 293.57 \text{ psi} + 0 \text{ psi} = 293.57 \text{ psi}$$

(2). From Earlougher's Figure :

$$t_{DRA} = \frac{0.000264 kt}{\phi \mu c_t r_w^2} = \frac{0.000264 (4.7)(10)}{(0.17)(12 \times 10^{-6})(1.3)(0.25^2)} \\ = 74859.73$$

from figure C.2, $P_D = 6 + s$

$$P_D = 6 + 6.1 = 12.1$$

$$\Delta P_{A/A} = 141.2 \frac{qB\mu}{kh} P_D = 141.2 \frac{(65)(1.05)(1.3)}{(4.7)(110)} 12.1$$

$$= 293.21 \text{ psi}$$

$$t_{DRB} = 74859.73 \times \frac{r_w^2}{r_e^2} = 74859.73 \times \frac{0.25^2}{930^2} = 5.409 \times 10^{-3}$$

t_{DRB} is very small, so we can P_D will be neglected.

$$\Delta P_{B/A} = 0 \text{ psi}$$

$$\Delta P_A = \Delta P_{A/A} + \Delta P_{B/A} = 293.21 \text{ psi} + 0 \text{ psi} = 293.21 \text{ psi}$$

(3) Function. xls work book :

$$t_{DRA} = 74859.73, P_D = 6.016 \text{ (From xls workbook)}$$

$$t_{DRB} = 5.409 \times 10^{-3}, P_D = 8.28 \times 10^{-23} = 0$$

$$\begin{aligned} \Delta P_{A/A} &= 141.2 \frac{984}{Fh} (P_D + S) = 141.2 \frac{(65)(1.05)(1.3)}{(4.7)(110)} (6.016 + 6.1) \\ &= 293.6 \text{ psi} \end{aligned}$$

$$\Delta P_{B/A} = 141.2 \frac{984}{Fh} (P_D) = 0$$

$$\Delta P_A = \Delta P_{A/A} + \Delta P_{B/A} = 293.6 \text{ psi} + 0 \text{ psi} = 293.6 \text{ psi}$$

→ Pressure drop at $t = 5000$ hrs

(1) using Ei function :

$$\Delta P_{A/A} = 368.93 \text{ psi}$$

$$\Delta P_{B/A} = 46.02 \text{ psi}$$

$$\Delta P_A = 414.95 \text{ psi}$$

(2) using Earlougher Figure C.2

$$\Delta P_{A/A} = 370.75 \text{ psi}$$

$$\Delta P_{B/A} = 44.1 \text{ psi}$$

$$\Delta P_A = 414.85 \text{ psi}$$

(3) using xls. work book

$$\Delta P_{A/A} = 368.9 \text{ psi}$$

$$\Delta P_{B/A} = 45.87 \text{ psi}$$

$$\Delta P_A = 414.77 \text{ psi}$$

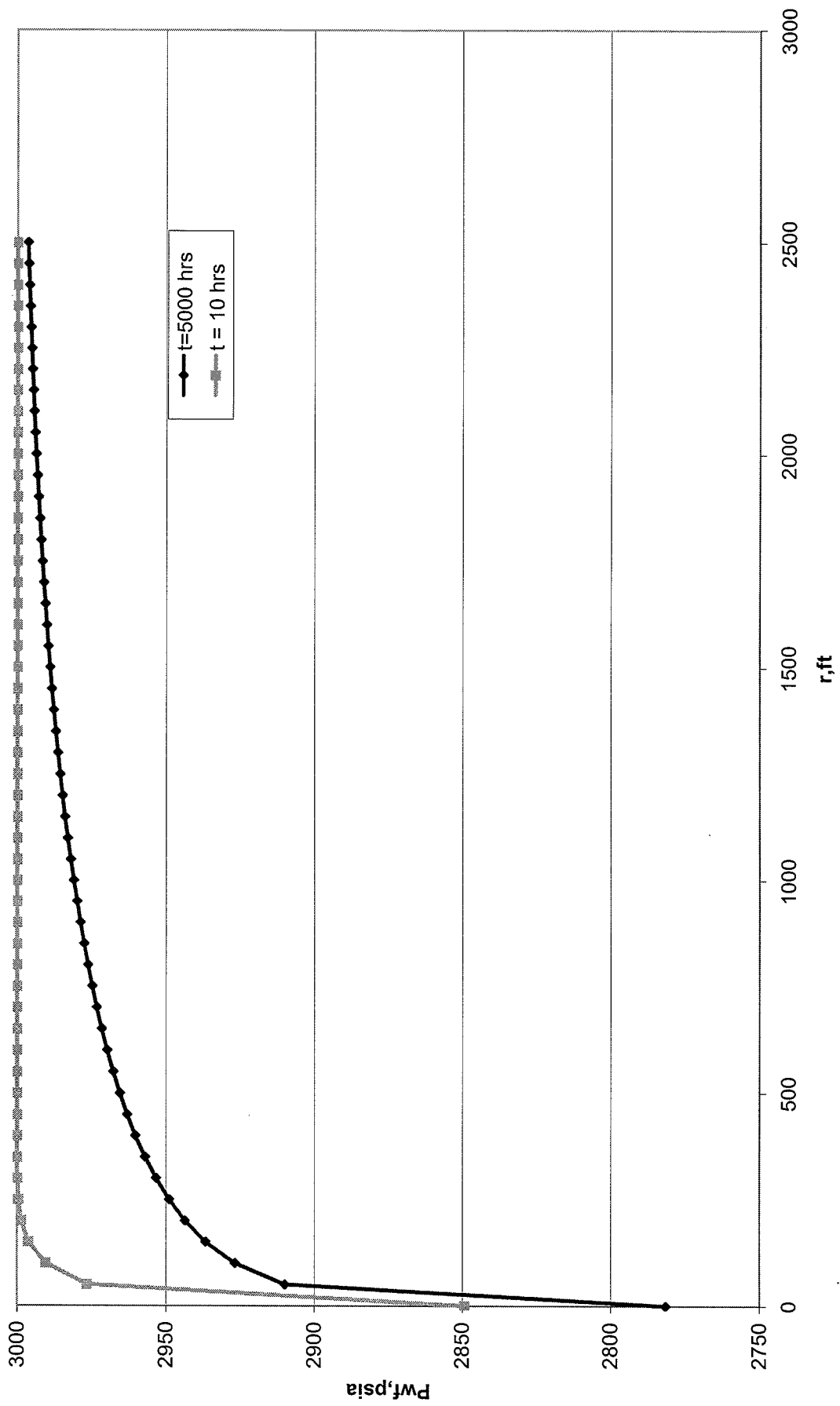
Calculations

This spreadsheet contains the modules for special functions

Exponential Integral Solution

tD	X	Ei	pD
2.7	-0.092593	1.893E+00	9.464E-01
7.40E+04	-3.38E-06	1.202E+01	6.010E+00
3.75E+07	-6.67E-09	1.825E+01	9.124E+00

Pressure Profile



Pressure Profile

