UNIVERSITY OF MINES AND TECHNOLOGY, TARKWA

SECOND SEMESTER EXAMINATIONS, MAY 2018

COURSE NO: PE 378
COURSE NAME: WELL TEST ANALYSIS
CLASS: **PE III** TIME: 3 HOURS

Name**:** _____Index Number: _____

There are four questions given. Read each question carefully and answer Q1 and any two other questions in all.

Q1. [40 marks]

Figures 1.1 and 1.2 are the data plots from a particular well test. Additional reservoir and fluid properties are given below.

P_i = 4412 psia; h = 69 ft; S_{wi} = 0.24; ϕ = 15 %;
μ = 1.8 cp q = 300 STB/D; B_o = 1.136 bbl/STB r_w = 0.25 ft;
$c_t = 17 \times 10^{-6}$ psi^{-1} B_{oi} = 1.126 bbl/STB

Estimate the following:

a. Beginning of the late time region
b. Reservoir permeability
c. Flow efficiency
d. If the oil price was $60/bbl and the recovery factor estimated was 71%, what is the gross revenue likely to be realized from producing the reservoir.

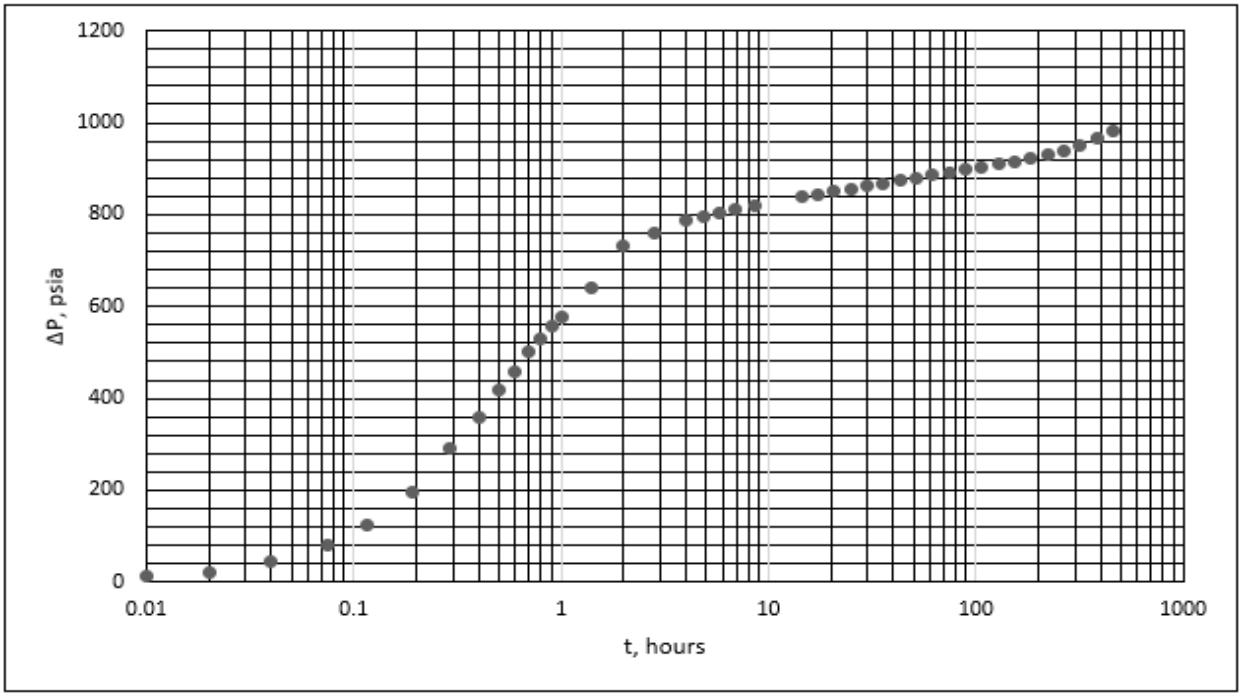
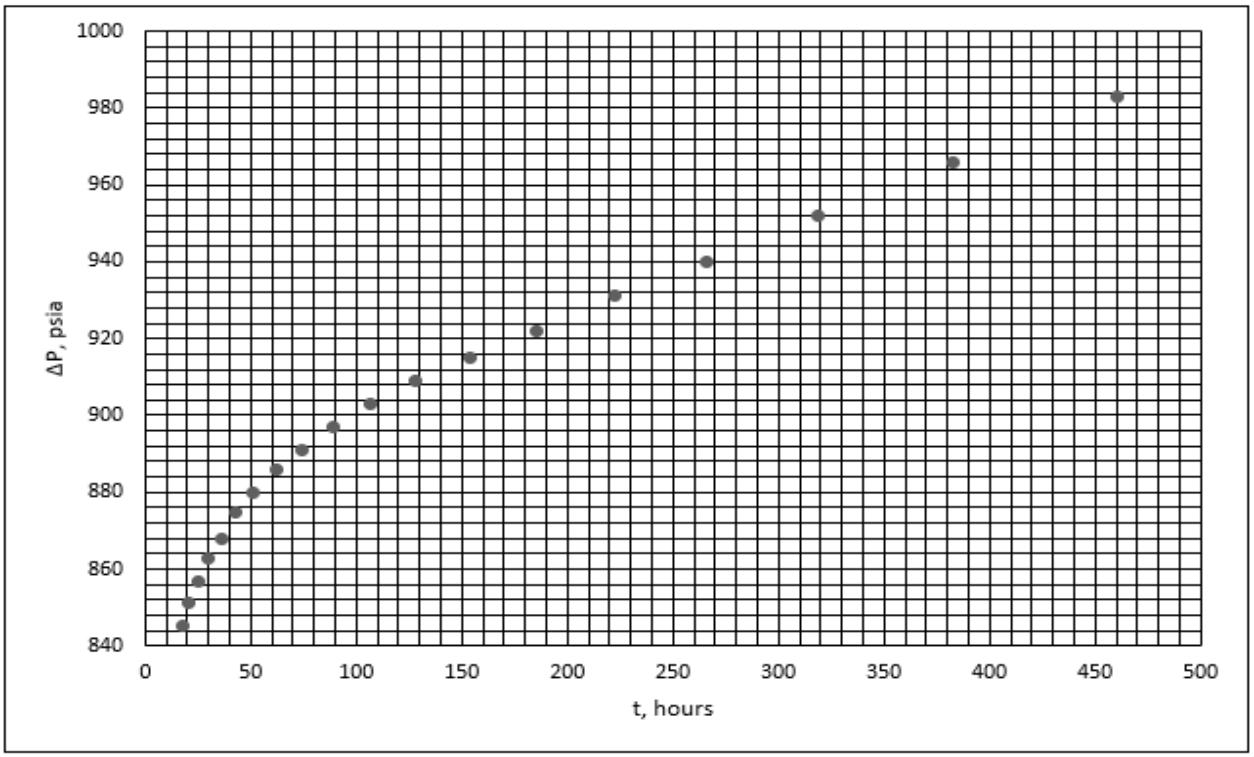


Figure 1.1

Figure 1.2



Q2. [30 marks]

2a

i. What is well test analysis?

ii. Mention any five reservoir parameters that can by estimated by well test analysis**.**

iii. Identify the types of well tests that have the following characteristic curves.

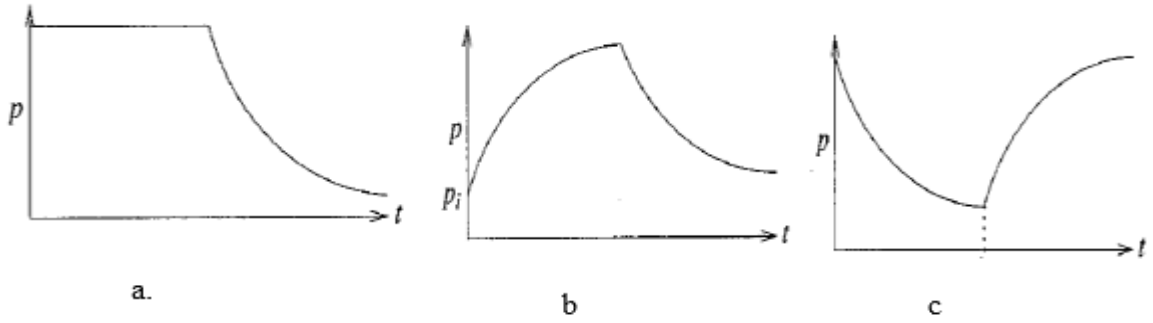


Figure 2

iv. Briefly discuss each of the test types labelled 'a' and 'c' in **figure 2** above.

2b.

An oil well is producing under a constant bottom-hole flowing pressure of 1800 psig. The current average reservoir pressure is 3500 psig. The well is developed in the center of a 40-acre square drilling pattern.

μ_o = 3 cp ϕ = 16% k = 50 md h = 30 ft

r_w = 0.3 ft B_o = 1.15 bbl/STB $c_t = 10 \times 10^{-6}$ psi^{-1} P_{sc} = 14.7 psia

Calculate the flow rate.

Q3 [30 marks]

3a.

i. Estimate the radius of drainage created during a 72-hour test on a well in a reservoir with $k/\mu = 172\, md/cp$ and $\phi c_t = 0.232\, x10^{-5}\, psi^{-1}$. At what condition is the concept of drainage radius meaningless?

ii. During the dual porosity behavior analysis, the porosity effects are described in terms of two parameters. Name these two parameters.

3b.

i. The pressure drop across the skin zone can be approximated by Darcy's flow equation. This pressure drop is expressed as

$$\Delta p_s = \begin{bmatrix} \Delta p \ in \ the \ skin \ zone \\ due \ to \ k_s \end{bmatrix} - \begin{bmatrix} \Delta p \ in \ the \ skin \ zone \\ due \ to \ k \end{bmatrix}$$

Show that the apparent wellbore radius is $r_{wa} = r_w e^{-s}$

ii. A 10-inch diameter oil well has a finite skin zone of 80 inches deep as shown in figure 3. The permeabilities in the skin zone and the virgin reservoir are also shown. Estimate the apparent wellbore radius.

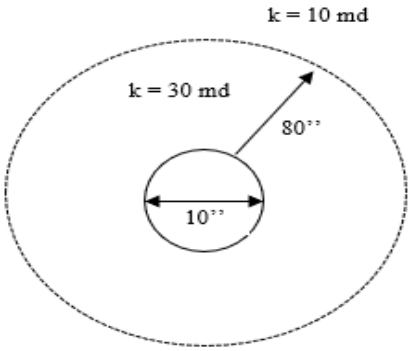


Figure 3

Q4. [30 marks]

The discovery well of an oil reservoir above the bubble point was tested at a constant rate of 385 STB/D and produced a cumulative volume of 2780 STB of oil. The well was then shut-in for a buildup test, and bottom-hole pressure was recorded for 72 hours as shown in Table 1. Other rock and fluid properties are given below**.**

r_w = 0.25 ft h = 36 ft ϕ = 13 % B = 1.67 bbl/STB μ = 0.75 cp
$c_t = 11 \times 10^{-6}$ psi^{-1}

a. Plot P_{ws} vs Horner time on semi-log graph.
b. Determine permeability, Flow Efficiency
c. Estimate the initial reservoir pressure

Table 1: Test Data

Δt	Pws(psi)
0	3519
0.15	3680
0.2	3723
0.3	3800
0.4	3866
0.5	3920
1	4103
2	4250
4	4320
6	4340
7	4344
8	4350
12	4364
16	4373
20	4379
24	4384
30	4393
40	4398
50	4402
60	4405
72	4407

Daniel Ocran (First Examiner)
Samuel Tawiah (Second Examiner)

$$t_{DA} = \frac{0.0002637kt}{\phi\mu c_t A}$$

$$p_i - p(r,t) = 141.2\frac{qB\mu}{kh}\left[p_D\left(t_{D,}r_{D,}C_{D,}geometry,\ \ldots\right) + s\right]$$

$$p_D(r_D, t_D) \cong \frac{1}{2}\left[ln\left(\frac{t_D}{r_D^2}\right) + 0.80907\right]$$

$$p_D = 2\pi t_{DA} + \frac{1}{2}ln\left(\frac{A}{r_w^2}\right) + \frac{1}{2}ln\left(\frac{2.2458}{C_A}\right); \qquad \Delta p = 141.2\frac{qB\mu}{kh}ln\left(\frac{r}{r_w}\right)$$

$$C_A = 5.456\frac{m}{m^*}exp\left[\frac{2.303(p_{1\,hr} - p_{Int})}{m}\right]; V_p = \phi hA = -\frac{0.23395qB}{c_t m^*}$$

$$\mathrm{s} = 1.1513\left[\frac{P_i - p_{wf}}{m} - log\left(\frac{k}{\phi\mu c_t r_w^2}\right) + 3.2275\right]$$

$$\bar{P} - P_{wf} = 141.2\frac{qB\mu}{kh}ln\left(\frac{4A}{1.781C_A r_w^2}\right)$$