27

KENYATTA UNIVERSITY

EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN PETROLEUM ENGINEERING

EPL 406: WELL LOG ANALYSIS AND WELL TESTING

1ST SEMESTER 2023/2024 TIME:2 Hours

INSTRUCTIONS:

The examination consists of **TWO** sections **(A** and **B).**

Answer **SECTION A (COMPULSORY)** and **ANY TWO QUESTIONS** from **SECTION B.**

Section A - Compulsory (30 marks)

QUESTION 1

(a) What are the undesirable effects of near wellbore skin? (3marks)

(b) State **FOUR** important benefits of pressure drawfowntest. (4marks)

(c) Describe well productivity test analysis to estimate AOF. (5 marks)

(d) State **FOUR**challenges of productivity test. (4marks)

(e) Sketch the flowing wellbore pressure versus time profile for a well completed in a reservoir subject to **full infinite-acting** external boundaries. (3 marks)

(f) How does an infinite-acting flow period manifest? (3 marks)

(g) List 3 undesirable effect of wellbore skin (3 marks)

(h) If completion wellbore radius of a well is 0.33ft and there is skin of 2.2, what is the effective wellbore radius of the well? (3 marks)

(i) What action would you recommend for the well in Question 1 (h) above? (2 marks)

Section B- Answer any Two Questions (Each question 20 marks)

QUESTION 2

A pressure drawdown analysis gave a slope of 60psi/cycle and p_{1hr} = 3350psi and initial reservoir pressure is = 4200psi. The test was conducted at a constant rate of 1500stb/day. Other pertinent information available is: formation volume factor = 1.55rb/stb, oil viscosity = 2cp, pay thickness = 20ft, wellbore radius = 0.333ft, porosity = 20%, permeability = 100md, total compressibility = $35x10^{-5}$/psi. Find

i. Fluid transmissibility (4marks)

ii. Wellbore skin (4marks)

iii. Apparent wellbore radius (4marks)

iv. How much oil is in communication with the wellbore if the slope of flowing wellbor pressure versus flow time plot is - 100psi/hour? (8marks)

QUESTION 3

(a) A well produced oil at the rate of 624b/d for 3hours. The rate was changed to 1800b/d for 2hours. This was followed by water injection at 2500b/d for 6hours. Oil production resumed thereafter at 20000b/d and is sustained to date. Other pertinent information available is: formation volume factor = 1.25rb/stb, oil viscosity = 3.15cp, pay thickness = 30ft, wellbore radius = 0.33ft, porosity = 10%, permeability = 80md, total compressibility = $20x10^{-5}$/psi. Calculate the pressure drop in the well after

(i) 4hours (6marks)

(ii) 36hours (6marks)

(b) Draw the rate and pressure profiles for the history. (8marks)

QUESTION 4

(a) The porosity of a well consolidated sand is known to be 26%. Formation water resistivity has been measured as 0.064 Ohm-meters. From electric logs, Rt = 8 Ohm-meters. Estimate water saturation for this sand using

(i) Archie equation. (4 marks)

(ii) Humble equation. (4marks)

(b) Sketch the full log combination to show, without doubt, the presence of

(i) only oil (4marks)

(ii) only gas (4marks)

(iii) only water (4marks)

QUESTION 5

What are the use of the following logs:

a. Sp/Resistivity (4 marks)

b. Neutron (4 marks)

c. Density (4 marks)

d. Porosity (4 marks)

e. SP/Resistiveity/Gamma ray/Density/Neutron (4 marks)

LIST OF SOME FORMULAS FOR EPL 406

$$p_D = -\frac{1}{2}Ei\left(-\frac{r_D^2}{4t_D}\right)+s \qquad p_D = \frac{kh\Delta p}{141.2q\mu B} \qquad r_D = \frac{r}{r_w}$$

$$t_D = \frac{0.000264kt}{\phi\mu c_t r_w^2}$$

$$p_{wf} = p_i + \frac{70.6q\mu B}{kh} Ei\left(-\frac{946\phi\mu c_t r_w^2}{kt}\right)+\frac{141.1q\mu Bs}{kh}$$

$$p_i - p_{wf} = \Delta p = -\frac{70.6q\mu B}{kh}\left[Ei\left(-\frac{946\phi\mu c_t r_w^2}{kt}\right) - 2s\right]$$

$$\mathrm{x}=\frac{948\phi\mu\, c_t\, r^2}{\mathrm{k\,t}} \qquad p = p_i - \frac{141.2q\mu B}{kh}\left[\frac{2t_{Dw}}{r_{eD}^2}+\ln r_{eD}-\frac{3}{4}\right]$$

$$r_{eD}=\frac{r_e}{r_w} \qquad p_D = \ln r_{eD} \qquad E_i(-x) = \ln(1.781x)$$

$$r_d = 0.032\sqrt{\frac{k\Delta t}{\phi\mu c_t}} \qquad s = \left(\frac{k}{k_s}-1\right)\ln\frac{r_s}{r_w} \qquad \Delta p_s = \frac{141.2q\mu B}{kh}s$$

$$s = 1.151\left[\frac{(p_{1hr}-p_{wf})}{m} - \log\frac{k}{\phi\mu c_t r_w^2} + 3.23\right]$$

$$\Delta p_T = -\frac{70.6q1\mu B}{kh}\left[Ei\left(-\frac{946\mu\phi c_t r_w^2}{kt}\right) - 2s\right] - \frac{70.6(q2-q1)\mu B}{kh}\left[Ei\left(-\frac{946\mu\phi c_t r_w^2}{k(t-t1)}\right) - 2s\right] - \frac{70.6(q3-q2)\mu B}{kh}\left[Ei\left(-\frac{946\mu\phi c_t r_w^2}{k(t-t2)}\right) - 2s\right]$$

$$p_{ws} = p_i - \frac{162.6q\mu B_o}{kh}\log\left(\frac{t_p+\Delta t}{\Delta t}\right) \qquad m = 162.6\frac{q\mu B_o}{kh}$$

$$p_{wf} = p_i - m\left[\log t + \log\frac{k}{\phi\mu c_t r_w^2} - 3.23 + 0.87s\right]$$

$$J = \frac{q}{\Delta p} = \frac{q}{p - p_{wf}} = \frac{0.0078kh}{\mu B(p_D + s)}$$