National Exams December 2011

98-Pet-A5, Petroleum Production Operations

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.

2. Any non-communicating calculator is permitted. This is an OPEN BOOK exam.

3. A complete paper consists of answering all questions four in total the exam is out of 100 marks. All questions are of equal value.

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(Duration 3 hrs)

Problem-1 (25 points)

Based on the data obtained from a recent isochronal test, the following IPR relationship was developed.

$$q_L = 0.02\left[P_R^2 - P_{wf}^2\right]^{0.8}$$

Stabilized Test Data:

P_{WF}, psig	Q_L, STBL/Day
2800	1420

a-) (10 points) The well is producing 100% oil at the current reservoir condition. Determine the oil production rate, STBO/D, when the flowing bottomhole pressure is 1800 psig.

b) (15 points) If in the later stage of the reservoir life, the average reservoir pressure goes down to 2400 psi, determine the oil production rate from this reservoir when the flowing bottomhole pressure is 1800 psi Note that 40% water production is anticipated at this stage of the reservoir life.

Problem-2 (25 points)

Following data are pertinent to current reservoir condition:

Bubble Point Pressure:	4600	psig
Average Reservoir Pressure :	4500	psig
Wellbore Radius:	0.5	ft
Drainage Radius:	3000	ft
Water Cut, fw :	0	
Skin Factor, S' =	8	

Stabilized Test Data:

P_{WF}, psig	Q_L, STBL/Day
4000	500

a-) (10 points) Determine the oil production rate under current reservoir condition when the flowing bottomhole pressure is 2000 psig.

b-) (15 points) After performing a hydraulic fracturing job, well started producing 25% water ($f_w = 0.25$). A production test was conducted after the frac job and the following data were obtained:

P_{WF}, psig	Q_L, STBL/Day
3662	2000

Determine the anticipated Oil Production Rate (STBO/D) after the Frac Job at the flowing bottomhole pressure of 2000 psi. Is this a successful frac job? Explain!

Suppose that the IPR curve for a well is given by the following relationship:

$$q_L = 1407\left[1 - 0.2\frac{P_{wf}}{\bar{P}_r} - 0.8\left(\frac{P_{wf}}{\bar{P}_r}\right)^2\right]$$

The other relevant data are given as follows:

Wellhead pressure = 400 psig.
Average Reservoir Pressure = 4000 psig
Bubble Point Pressure = 4100 psi
Well Depth = 5000 ft
Tubing ID = 2.441 in.
GLR = 300 SCF/STBL
$f_w = 0.5$

a-) (10 points) The desired oil production rate is 400 STBO/Day. Determine if the well will flow at the desired oil production rate.

b-) (15 points) If you would like to increase the oil production rate up to 600 STBO/Day. Determine if the GLR=300 SCF/STBL is sufficient for this well to produce at the desired rate. If not, how much additional gas needs to be injected into the tubing? (Note that the water cut (fw) and wellhead pressure are the same as in part a)

4.(25 points)

The following table summarizes the results obtained when designing the unloading valves for a gas lifted well.

Valve Number	Depth of Valve ft	Tubing Pressure (psi) Pt	Casing Opening Pressure (psi) Pvo
1	1700	490	970
2	2600	600	968
3	3300	680	962
4	3850	750	953
5	4300	800	942

a-) (10 points) The ratio between the port area (Ap) and the bellow area(Ab) R=Ap/Ab equals to 0.1534 for all the valves, calculate the bellow's nitrogen pressure, Pb, for valve number 3.

b-) (10 points) Calculate the valve closing pressure, Pvc, at depth for valve number 3.

c-) (5 points) Assuming the casing gas pressure gradient is constant and equal to 20 psi/1000 ft calculate the surface opening pressure, Pso, and the surface closing pressure, Psc, for valve number 3.

Figure-1 Sketch of Casing Operated Gas Lift Valve