INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR
End-Autumn Semester 2017-18

Date of Examination: 27-11-2017; Session: AN; Duration: 3 hrs; Full Marks: 60
Subject No. : M140039 Subject: Oil and Gas Well Testing & Enhanced Oil Recovery
Department : Mining Engineering
Specific charts, graph paper, log book etc., required: 3x5 cycles *Semi-log graph papers* should be provided.
Special Instructions (if any):

a. Answer ALL questions.
b. Any missing data may be assumed and stated.

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1. a) A 120-hr build up test was conducted on a well. Analysis of the buildup test shows the formation permeability to be 100md. Calculate the radius of investigation. Other rock and fluid properties are: $\mu = 8cp$ $c_t = 9.28x10^{-6}\ psi^{-1}$; $\varphi = 0.25$.

b) A well is perforated in the bottom 15ft of the total formation thickness of 30ft. Vertical and horizontal permeabilities are believed to be equal. A pressure build up test was run on the well, and the results and basic properties are: $\phi = 0.28$; $\mu_o = 0.9cp$; $c_t = 1.7x10^{-5}\ psi^{-1}$; $r_w = 0.4$ ft; m= 70psi/cycle; k = 89md; $p_{wf} = 1{,}600psi$ and $p_{1hr} = 3000psi$.
Calculate: (i) Total skin; (ii) Skin due to formation damage; (iii) skin due to incompletely perforation.

c) With suitable equations explain the flow tests and pressure buildup test methods for gas well testing for gas reservoirs with pressure in the range 2000<p<3000 psi.

2+2+6 = 10

2. A drawdown test in which the rate decreased continuously throughout the test was run in a well with the following characteristics: $\phi = 0.18$, $\mu = 1.2$ cp, $c_t = 16 \times 10^{-6}\ psi^{-1}$, $r_w = 0.3$ ft, h = 80 ft, $B_o = 1.12$ RB/STB, $\rho = 55$ lb/cu ft, and liquid gas interface is in well.
The test data are given in the Table below:

t (hours)	P_{wf} (psi)	q (STB/D)	t (hours)	P_{wf} (psi)	q (STB/D)
0.	5000	200	3.64	4797	121
0.114	4927	145	4.37	4798	119
0.136	4917	143	5.24	4798	118
0.164	4905	142	6.29	4798	117
0.197	4893	141	7.54	4799	116
0.236	4881	140	9.05	4799	114
0.283	4868	138	10.9	4800	113
0.340	4856	137	13.0	4801	112
0.408	4844	136	15.6	4801	110
0.490	4833	135	18.8	4802	109
0.587	4823	133	22.5	4803	108
0.705	4815	132	27.0	4803	107
0.846	4809	131	32.4	4804	105
1.02	4804	129	38.9	4805	104
1.22	4801	128	46.7	4806	103
1.46	4799	127	56.1	4807	102
1.75	4798	126	67.3	4807	100
2.11	4797	124	80.7	4808	99
2.53	4797	122	96.9	4809	98
3.03	4797	121			

From the above data estimate k and s.

5+5 = 10

3. Estimate the formation permeability and skin factor from the following data available from a gas well pressure build-up test. T = 199^{0}F; h = 34ft; μ_i = 0.023 cp; S_w = 0.33(water is immobile); c_{gi} = 0.000315 psi^{-1}; φ = 0.22; z_i = 0.87; and r_w =0.3ft. The well produced 6,068 Mcf/D before the test. A plot of p_{ws} vs. $\log(t_p+\Delta t)/\Delta t$ gave a middle-time line with a slope of 66psi/cycle. Analysis of the build-up curve showed that static drainage-area pressure, p, was 3,171 psia. Pressure on the middle-time line at Δt =1hour, $p_{1\ hr.}$ was 2,745 psia; flowing pressure, at shut-in, p_{wf}, was 2,486 psia.

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4. a) Using Nelson-McNiel technique derives the equation for air requirements in In-situ Combustion process for a five spot pattern using the above technique per acre of pattern.
b) With the help of stoichiometric formula calculate the air requirement in MMSCF/Acre-ft. for an in-situ combination process, when m = 3.4, n = 1.5, E_o = 0.85 and F = 1.27.

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5. *a) With ternary phase diagram explain the conditions necessary for a dry gas miscible drive and for a condensing gas drive process.*
b) With a neat diagram explain in-situ combustion process.

5+5 = 10

6. a) With the help of a schematic diagram, explain a typical micellar-polymer flooding process. Mention the compositions for mobility buffer, slug and pre-flush in the above process.
b) With a neat diagram explain 'Critical Micelle Concentration' for an anionic surfactant-water system.
b) Explain Type II (-) and Type II (+) in a surfactant-brine-oil phase behavior with help of ternary diagrams.

3+3+4 = 10

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