

Exam AES1340

Applied Reservoir Engineering

re-examination 16 June 2011


Name:
Student number:

Use separate sheets to write your answers and clear derivation with name and student number indicated at the top. Also present them in the logical order from answer 1 to answer 7. An answer without derivation or explanation will receive a lower score than a complete answer.

Question 1: *lecture 1a*

- ✓ a) What are the main differences between reserves and contingent resources?
- ✗ b) Consider an oil field of 50 mln bls. You booked 10 mln bls proven reserves at the start of the project to be produced from one well. From a pressure analysis test in this well there are strong indications of a sealing fault within the assumed reservoir. What are the likely consequences for the reserves booking and your outlook on activities and future reserves bookings?

Question 2: *lecture 1b*

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- ✓ a) Write down the Havlene MBE formulation and describe the key terms.
 - ✗ b) You develop a reservoir by pressure depletion through 5 wells. You expected pressure to decline significantly but they stay close to the initial value. What is the most likely cause?
 - ✗ c) What would be the consequence for your facilities with respect to gas handling, water handling and oil handling? Explain.

Question 3: *lecture 1b*

- ✗ a) What is the most important analysis for a gas reservoir?
 - ✓ b) After you initiated gas production and the pressure has declined about 10%, how do you determine the initial gas in place and what is the key aspect which influences the outcome?
 - ✗ c) What are the two key aspects that determine your recovery factor?
- P depletion
w. prod
or gas prod.*

- ✓ a) Sketch the expected streamlines in the above well lay out.
- ✓ b) Explain what is happening between the left and right side of the reservoir.
- ✓ c) What can you do to improve recovery while you have no additional slots available?

Question 7: *lec 3b*

- < a) Sketch the principle of gas coning
- ✓ b) Mention 3 ways to avoid/reduce gas coning
- ✗ c) What would you expect the oil saturation to be inside the gas cone.

Question 8: *EOR*

- ✓ a) Derive the equation for the maximum Oil-Steam-Ratio in a steam injection project
- < b) Why is the real ratio smaller than the one under a).
- < c) How can you initially improve oil production rate in a steam drive project?

Question 9: *EOR*

- ✓ a) At 100 bar and standard temperature, is CO₂ a gas or a liquid?
- ✓ b) What is MMP and how do you determine it?
- ✓ c) What are key concerns in a CO₂ flood?

Question 10: *EOR*

- ✗ a) Write down the equation for the capillary number.
- ✓ b) Which parameter do we try to change to reduce residual oil?
- < c) Plot the key phase behavior in a ternary diagram of water, oil and surfactant that describes the Type II-, Type III and Type II+ system.
- ✓ d) What are the two key roles for alkaline in a Alkaline Surfactant Polymer flood?

Question 4:

lecture 02

- ✓ a) Given the following data, do a Horner analysis of the build-up and derive the permeability. Be clear on the equations you use.

time [hrs]	pressure [psi]
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0	
0,012063	3571,266
0,053179	3393,69
0,111658	3347,114
1,033557	3269,431
2,170113	3246,75
20,08747	3175,08
100,2102	3099,767
145,2064	3079,677
210,4066	3059,009

$t_p \rightarrow$	238,09	3052,02	end of drawdown
	238,0911	3076,184	
	238,1007	3235,929	
	238,1772	3463,19	
	238,2972	3501,14	
	238,6471	3534,143	
	239,5877	3564,652	
	242,1166	3593,926	
	250,3407	3626,894	
	275,3619	3665,466	
	292,0977	3679,472	
	351,4874	3706,722	
	402,4049	3718,97	

$(t_p + \Delta t) / \Delta t$	
12.3	
10.1	
7.6	
6.9	
5.5	
4.9	
3.4	
2.4	
2.7	
1.6	
1.7	

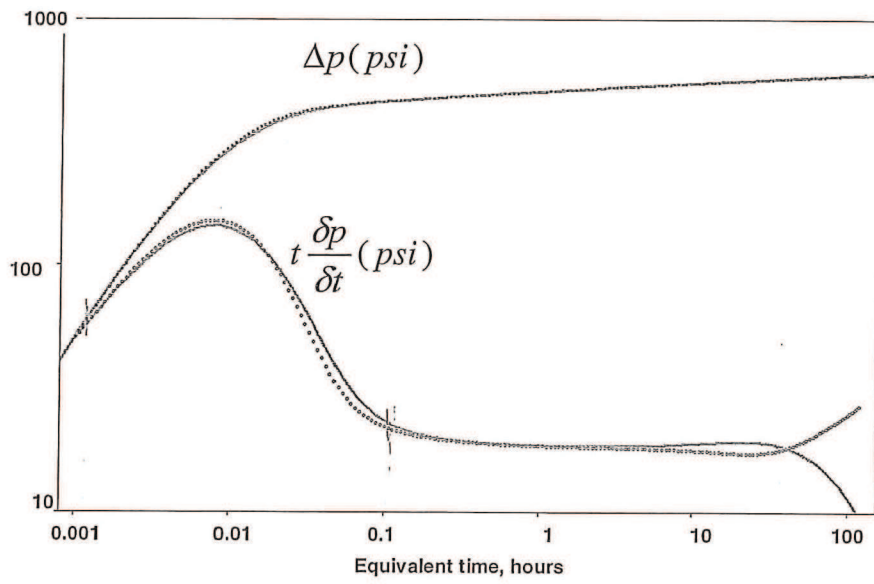
Known parameters in SI units

q	0,006944	m ³ /s
Bo	1,2	
μ	0,004	Pa/s
h	25	m
c	1,00E-09	1/Pa
rw	0,1	
Gamma	0,5772	
1 psi =	6896,5	N/m ²

- ✓ b) What are the two key aspects you can take away from p^* (no need to derive the value !)
- ✓ c) What is a radius of investigation, provide formula and where do you use it for?

Question 5: *lecture 02*

- a) How do you derive the permeability from the well test results given in the plot below? Give the key equation.



- b) Describe in words what happens the first 0,002 hours. What happens after that until about 0,1 hours.
- c) Sketch how the graph would change if you install a domwhole shut-in device with down hole gauges.
- d) Describe what happens during Semi-Steady State. When would you expect it to start in the above graph.

Question 6: *lec 3a*

