Exam AES1340

Applied Reservoir Engineering

Re-examination 28 June 2013
14:00-17:00

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 the last answer. An answer without derivation or explanation will receive a lower score than a complete answer.

Question 1:

a) Your field has 5 wells. Exponential decline analysis gives you a value of 3 mln bls future production. The simulator however shows well over 4 mln bls reserves. What volumes would you book under which category?

b) Analogue fields in the same area are more aggressively developed, showing Ultimate recoveries of 30% of STOIP. Your CEO is not so happy that you do less. What will you do and will you reflect this in your reserves booking?

Question 2:

c) Give the equation for the exponential decline analysis of a well performance.

d) What do you plot on x- and y-axis? Explain why and indicate where you read-off the ultimate recovery.

e) What is the difference between the nominal and effective decline factor?

f) Illustrate how an exponential decline plot generally will look like assuming a single well in which late in its life additional zones are being perforated.

Question 3:

g) What is the main aim of the Havlena & Odeh material balance equation (MBE)?

h) What do you need to apply this equation?

i) Will this equation help you to predict water cut development in a field over its life and motivate your answer?

Question 4:

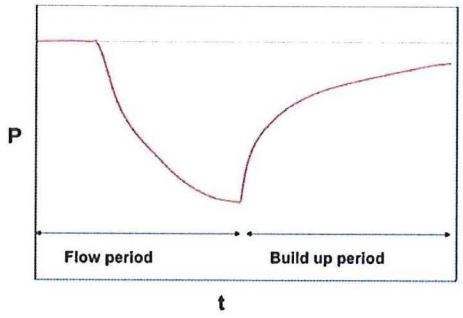
a) Derive the equation for a P/Z plot for gas depletion

b) Draw an example P/Z plot. Indicate the ultimate gas recovery for various tubing-head pressures and the impact of aquifer water influx.

c) Indicate in the plot how the line would go when you install from the start an active water drive. Which factors determine the ultimate recovery in such a situation?

Question 5:

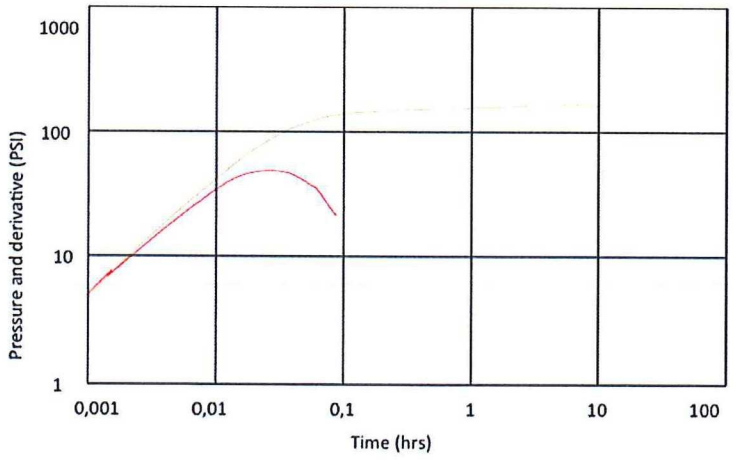
a) Consider the well test data as sketched: what would your best approach be to analyze this data: what to plot against what (redraw this plot on your answer sheet and illustrate which variables you will use).



b) What is the equation for the derivative-curve in type-curve matching? Indicate the key aspect of this curve under purely radial flow.

c) Give the formula for wellbore storage and indicate what is so special in the type curve plot.

d) Consider a long horizontal well in a thin homogeneous reservoir. Redraw the sketch below on your answer sheet and continue the line of the derivative curve and illustrate how you think it will change with time.



Question 6:

A new light oil field has been discovered. A 10 m thick interval stretches horizontally out over a long area. The reservoir is homogeneous. Permeability is low and water saturations of 50% are found in the log. The core analysis, done on the cores, shows relative permeability curves with a connate water saturation of 25% and a residual oil saturation of 30%.

a) What is the reason for the encountered initial water saturation? If you perforate your well, what fluids will you produce from your well? Explain your answer.

b) What kind of well pattern & distances (only rough indication) will you consider and explain the reasoning.

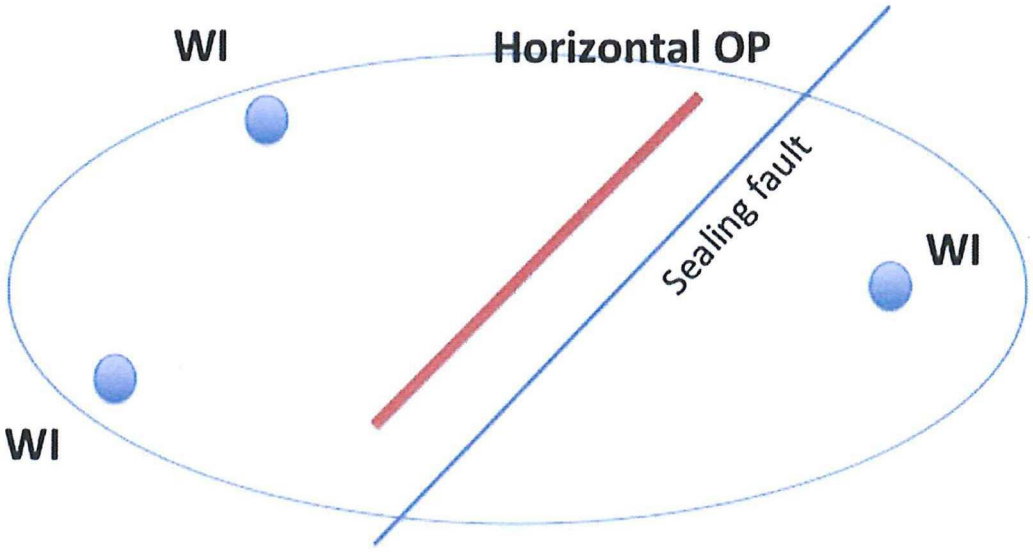
c) What is the maximum recovery factor under waterflooding.? What kinds of studies will you initiate to improve recovery?

Question 7:

a) Describe in words what a streamline is?

b) How can you see that the flow rate in a particular area is relatively high?

c) Copy the next picture of an areal view of a thin reservoir with a horizontal producer and three water injectors on your answer sheet. Sketch the streamlines.



Question 8:

d) Describe the key principle of the Dykstra Parson's method to derive production in a non-communicating layered system.

e) Derive the formula for x_f for a particular layer.

f) Describe how this methodology can help you to derive the production forecast in the situation of question 7c.

Question 9:

a) Draw on your answer paper a typical ternary diagram for a gas displacement. Choice an oil composition and a lean gas composition and indicate areas of immiscible, developed miscible and first-contact miscible displacements.

b) How does the ternary diagram between HC gas and CO2 compare? Give a sketch.

c) What kind of oil will be left in the reservoir? Indicate this in the ternary diagram and provide in words the key characteristic.

Question 10:

a) Sketch and describe what a type III phase behavior of a surfactant system is and how can you observe it in laboratory tests?

b) Why is this type III phase behavior so important?

c) If you add salt to the water, what is the impact and why?

d) How much surfactant will you have to inject over the field life?

e) What is the role of Alkaline in an ASP flood?