Exam AES1340

Applied Reservoir Engineering

29 June 2012
14:00-17:00

Name:
Student number:

Use separate sheets to write your answers with name and student number indicated at the top. Also present them in the order from answer 1 to answer 7 in good handwriting and logical flow of arguments.

Question 1:

a) Please explain why a volatile oil description (using Bo, Bg etc) depends on separator condition.

Question 2:

a) Write down the material balance equation for an oil reservoir according to Havlena and Odeh.

b) Write down the simplified form for the situation of a gas cap drive.

c) How do you derive the initial STOIP from production data in this situation and explain how to handle inaccuracies in gas cap size?

d) What are the disadvantages of a MBE approach?

Question 3:

a) How do you determine the GIIP from production data from a pure gas field? Make the relevant graph.

b) Assuming no aquifer, please indicate two methods to enhance gas recovery once the tubing head pressure has reach 100 bar (which is the pressure at which the well can flow directly into an existing gas export system).

c) If you want recover another 60% of the gas left at the 100 bar pressure, quantify what you need to do in both methods.

Assume: Initial pressure =300 bar, GIIP=30,000 mln m^3 , T=100 C, ideal gas law applies below 100 bar, Scw=10%, residual gas saturation = 20%, under

injection only 70% of the reservoir can be reached, depth=3 km, pipeline pressure= 100 bar.

d) Is a high compaction value a good or bad thing for developing a pure gas reservoir? Explain your answer.

Question 4:

a) Explain via graphs and sketches how the Dykstra Parson's methods works.

b) If I have a homogeneous reference layer (k=10 mD, Porosity=10%, height=50 m, Swc=10%, Sor=10%, viscosity oil and water is 1 cP, end point relative permeability for both water and oil is 0.8) with one high permeable 'thief zone' (k=100 mD, Porosity=20%, height=5 m, Swc=10%, Sor=10%, end point relative permeability for both water and oil is 0.8) , sketch the expected oil production curve against PV injected for a one dimensional displacement.

Question 5:

a) What are the basic assumptions in Streamline modeling?

b) How are the calculations done?

c) Please sketch an example where the relevance of this approach versus a 1-D approach is illustrated?

Question 6:

a) What are 'Developed reserves'?

Question 7:

a) Write down the equation for the transient radial solution of the well bore pressure under a constant rate production.

b) Explain how wellbore storage will influence the solution

c) Explain how a damaged area around the wellbore will influence the solution.

d) Which two curves constitute a type-curve plot (what is along the y-axis and x-axis)?

e) What is the characteristic of a type curve for pure radial flow? Please prove this by using the equation for transient radial flow.

Question 8:

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 9:

For steam flooding Marx-Langenheim have derived the following heat balance:

$$m_s H_s = h(\rho c)_1 \Delta T \frac{dA_s}{dt} + 2\Delta T \sqrt{\frac{\lambda_2 (\rho c)_2}{\pi}} \int_0^t \frac{1}{\sqrt{t-t'}} \frac{dA_s}{dt} dt'$$

a) Describe in words the meaning of the left hand side term and the first and second term on the left side (also the meaning of the integral).

b) What conditions will favor a heat efficient displacement?