Exam AES1340

Applied Reservoir Engineering

re-examination 23 June 2010
10:00-13:00

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 answer 9. An answer without derivation or explanation will receive a lower score than a complete answer.

Question 1:

a) What is the key difference between Reserves and Scope for Recovery?

b) What is the key difference between developed and undeveloped reserves?

c) Consider an oil field of 1000 mln blls where the facilities are build but not assembled yet at the oil field. The facilities and wells are sized based on a study of some years ago, indicating a Recovery Factor of 30% with a range between 25% and 35%. In the mean time the development team has indicated that with infill drilling an extra 10% can be recovered, but they still need to check a few uncertainties. Which volumes will you book under the various classifications as also referred to in the above two questions.

d) What would you report as 'proven' reserves to the SEC?

Question 2:

a) Derive the Gas Initial In Place in a producing gas field at 2000 m depth from the following information:

Pressure (bar)	Produced gas (mln m3)
300	0
250	1,158
200	2,548

Pressure of export gas pipeline is 100 bar
The facilities can allow a THP of 60 bar
Average density of gas column in well is 130 kg/m3
Some Rock properties: Permeability = 5000 mD
Porosity = 0,25
Initial gas saturation = 0,9

Residual gas saturation = 0,3
Rock compressibility = 90 10-6 1/bar

Gas Properties:

Pressure	Density	Z Factor	Viscosity
bar	g/cm³	-	cP
50	0,0379	0,9207	0,014
100	0,0802	0,8706	0,016
150	0,1224	0,8556	0,019
200	0,1602	0,8711	0,022
250	0,1923	0,9074	0,025
300	0,219	0,9562	0,028

rock is incompressible, no aquifer indications

b) Provide options to the general manager to further improve the recovery of this field.

c) Would you propose to use the field for CO2 storage and at what stage of field life? Provide a discussion on risks and opportunities.

Question 3:

a) What are the basic principles for a material balance analysis?

b) Why is in principle the name 'material balance' wrong?

c) Who will mainly use this approach?

Question 4:

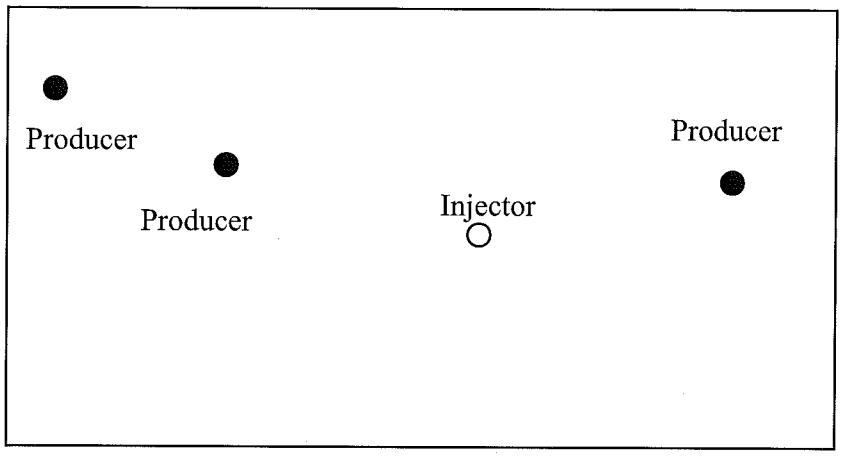
a) Write down the equation for the Dykstra Parson coefficient.

b) What does a value of one represent?

c) In case of a very high DP coefficient, what more factors will influence the displacement efficiency of a water flood?

Question 5:

a) Sketch the expected stream lines in the following well pattern.
(Copy the picture on your answer sheets).



b) What would you propose to the Development Manager to improve the flood, while you know that the budget is already very tight?

c) What are the parallels with the Dykstra-Parson method?

Question 6:

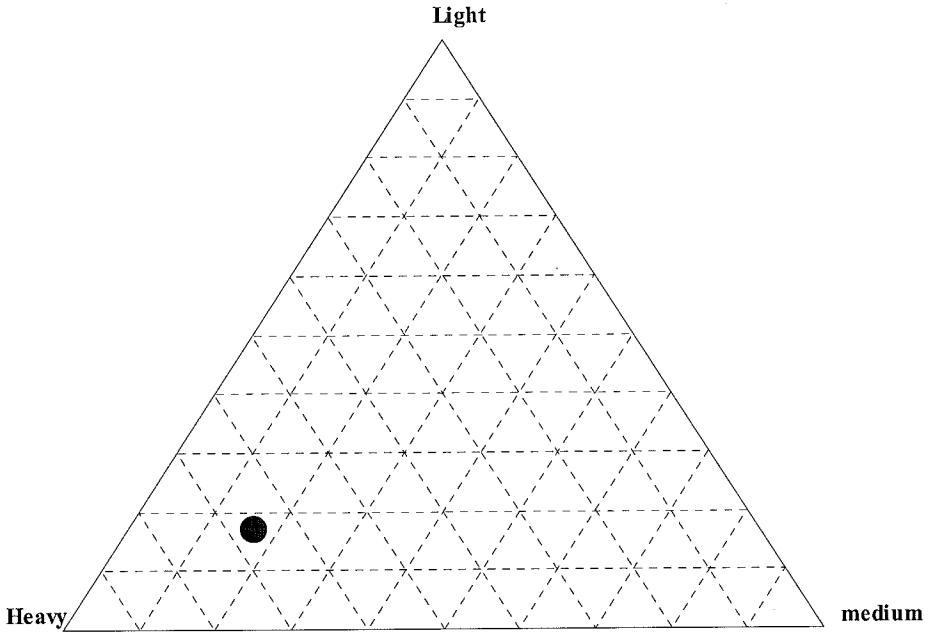
a) How do you derive the permeability and initial reservoir pressure from a build up well test using the Horner plot?

b) Explain in which time period this method is valid and how you could check.

c) Explain the difference between the Horner plot approach and the type curve approach. Which method and why would you prefer?

Question 7:

a) For a given oil composition how would you expect the ternary diagram for HC gas injection and CO2 injection look like. Sketch two graphs, accuracy is not relevant but relative differences are.



b) In the graph for HC gas, illustrate what means to enrich the gas for higher recoveries?

c) Would enrichment make sense for CO2?

Question 8:

a) Describe how polymer flooding works. Use a fractional flow plot to illustrate this.

b) What means 'shear thinning' and 'shear thickening'?

c) What is the key concern at the injectors?

Question 9:

a) What are the key aspects of a field to screen it for steam injection?

b) In which case would you consider polymer flooding a better option?