Introduction to Energy Resources
(자원공학개론) (38523)

- 2020 Final Examination -

Student ID: **Name:**

Notice

- Fill your name in the following:
  "I, _____, swear I solve all problems by myself in this final examination.
  I will take any disadvantages if any dishonesty such as cheating is acted on my solution."
  5 points will be deducted from your total score if you do not fill in your name above.

Problem 1.

List the five assumptions for Darcy's law [5 pts.].

Problem 2.

Compare absolute permeability, effective permeability, and relative permeability [10 pts.]

Problem 3.

3-1. Derive the Archie's Equation [5 pts.].

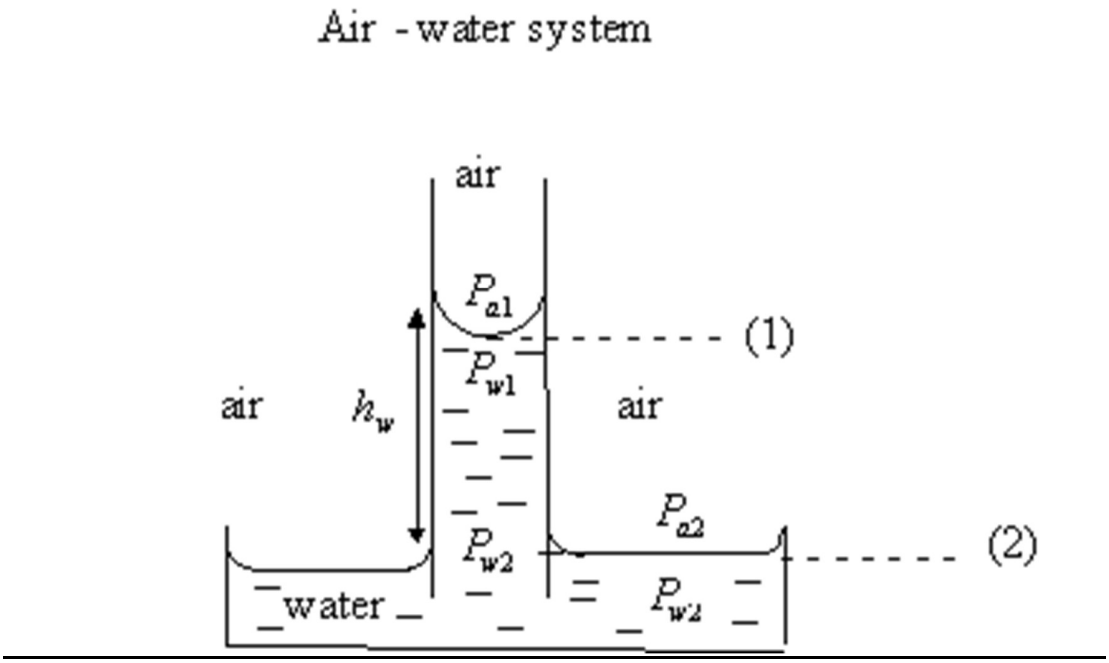
3-2. Calculate water saturation (S_w) under the following condition [10 pts.].

Cementation factor, *m*	2.0	Porosity	0.25
Empirical constant, *a*	1.0	Resistivity of formation water	0.10
Saturation exponent, *n*	2.0	True formation resistivity	40.0

Problem 4.

Show your work that the capillary pressure at (1) in the air-water system is as follows:

$P_c = \rho_w g h_w$ [10 pts.]



Problem 5.

Draw a graph that shows the relationship between the saturation of wetting phase (e.g., water) capillary pressure. What is the implication of capillary pressure that affects the thickness of the transition zone where the wetting phase (e.g., water) and non-wetting phase (e.g., oil) co-exist? [10 pts.]

Problem 6.

Define each formation volume factor. Also, draw the corresponding graph as a function of reservoir pressure [15 pts.].

(a) Oil formation volume factor (B_o)

(b) Gas formation volume factor (B_g)

(c) Solution gas/oil ratio (R_s)

Problem 7.

Draw the PVT diagrams for the following fluid types. Explain the phase behavior of each fluid type with the graph when the fluid pressure decreases from the initial reservoir pressure to the separator pressure [15 pts.].

(a) Dry gas

(b) Wet gas

(c) Gas condensate

(d) Volatile oil

(e) Black oil

Problem 8.

8-1. Derive both oil rate $q(t)$ and cumulative oil production N_p for exponential, hyperbolic, and harmonic decline curve equations, respectively [10 pts.].

8-2. Calculate the ten-year (i.e., t = 10 years) cumulative oil production N_p for exponential, hyperbolic, and harmonic decline curve equations, respectively, where the initial oil rate q_i = 100,000 STB/year and the decline exponent b = 0.2. For the hyperbolic decline curve, let the decline rate d be 0.5/year [10 pts].

---------- This is the End of the Final Examination ----------