

**Ministry of Higher Education & Scientific Research
Misurata University - Libya**

**PE-210 Introduction to Petroleum Engineering
Time: 3 Hours
Spring 2015/2016**

**Final Exam
Date: 22/05/2016
Prof. Dr. Ali Elsaeh Enbaia**

Answer All Questions:

Full Mark (50 Marks)

Question 1:-

1. What is the API approved standard conditions for measuring Oil and Gas volumes? Calculate the specific gravity and API number for crude oil systems with a measured density of 50.5 lb/ft³, and 53 lb/ft³. Which crude system is better and why? (Assume the density of water is 62.4 lb/ft³) . (5 Marks)

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Question 2:-

1. Prove that the porosity for hexagonal packing of identical spherical grains can be mathematically expressed as:

$$\phi = 1 - \frac{\pi}{6\sin(\theta)}$$

Hence determine the porosity for:

1. Hexagonal packing ($\theta = 60$ degree?)
2. Rhombus packing ($\theta = 45$ degree?) **(5 Marks)**

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2. The differential form of Darcy's law for horizontal flow is $q = -\frac{kA}{\mu} \frac{dp}{dx}$. Answer the following questions:

1. Name all the symbols used in Darcy Equation (1 Mark)
2. Name at least two important assumptions considered in Darcy's Law. (1 Mark)
3. What is the field unit of Permeability? Using the Darcy equation, define the field unit of permeability? (3 Marks)
4. Calculate the average permeability considering for both radial and linear systems based on data given in the following table. The data are obtained from three vertical beds. Assume that the well radius of 6 inch. (5 Marks)

Bed	Length of the bed, (ft)	Permeability (mD)
1	1.5	10
2	2	12
3	1	11

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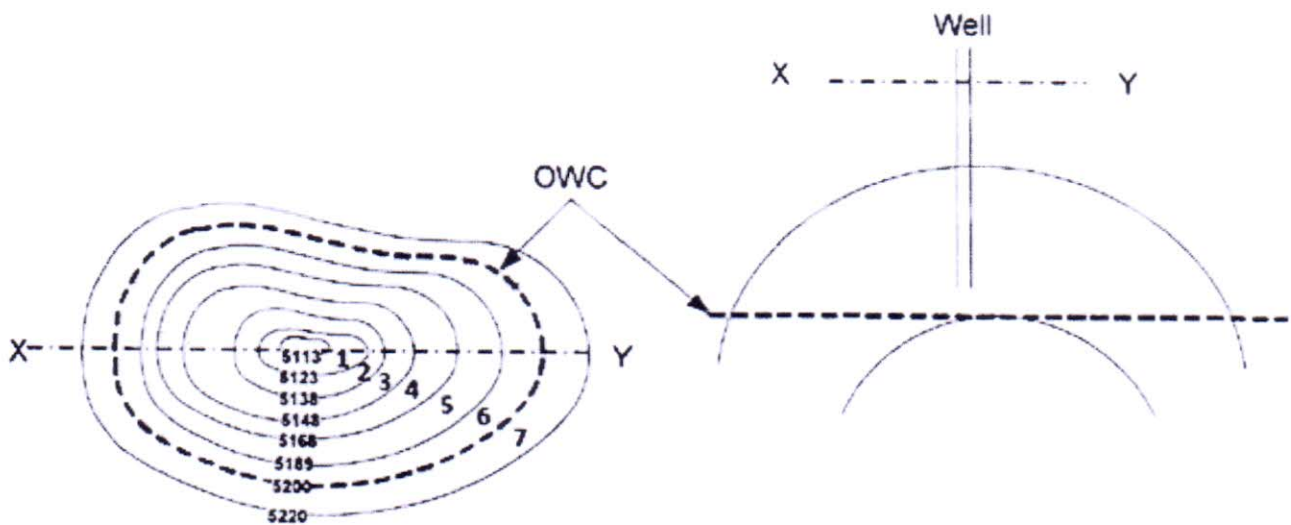
Question 3:-

1. If the geology department provides a contour map of the top and base of an oil reservoir as show in the figure below, estimate the possible amount of oil reserve initially in place in stock tank barrel. The mean contour areas within each interval are given in the table below. (5 Marks)

Assume:

- Formation volume factor of oil = 1.20 bbl/STB
- Connate water saturated = 17%
- Average porosity = 20%

Sample Interval	Contour Area, (Acre)
1	100
2	200
3	250
4	300
5	480
6	620
7	720



2. A well with open-hole diameter of 8 1/2 inch was drilled at the crest of the reservoir (as shown in the figure above). If the average reservoir pressure, and wellbore flowing pressure are, respectively 5500 psi and 3500 psi, calculate the approximate production rate of the well in STB/day when the average reservoir permeability is 120 mD; and oil viscosity is of 1.2 cP. (5 Marks)
3. Derive the expression for Productivity index. Hence, calculate the Productivity index in STB/Day/psi drawdown and absolute Open Flow Capacity of the well. (5 Marks)

Assume:

- The reservoir boundary is at the boundary of the water contact and
- Flow is steady state in a radial flow system.

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Question 4:-

1. What is drilling Rig? Provide at least 2 basic functions of a drilling rig? (2 Marks)

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2. What is drilling mud? Provide three major function of the drilling mud? (2 Marks)

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3. Name at least 5 types of well typically drilled for petroleum production? (2 Marks)

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4. Name three basic bottomhole completion options usually practiced in the industry, and provide at least two basic features of each of the options. (2 Marks)

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5. What are the three main methods used in oil and gas exploration? (2 Marks)

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Some Useful Equations:

$$API\ Gravity\ (Degree) = \frac{141.5}{\gamma_f} - 131.5$$

$$B_o = 0.9759 + 0.000120 \times \left[R_s \left(\frac{\gamma_g}{\gamma_o} \right)^{0.5} + 1.20 \times T \right]$$

$$Specific\ Gravity\ of\ Oil = \frac{Density\ of\ Oil}{Density\ of\ Water}$$