King Saud University

Petroleum and Natural Gas Engineering Tuesday, October 21, 2014

PGE 362: **Properies of Reservior Fluids** Duration: **1hour**

Exam – I-Solution

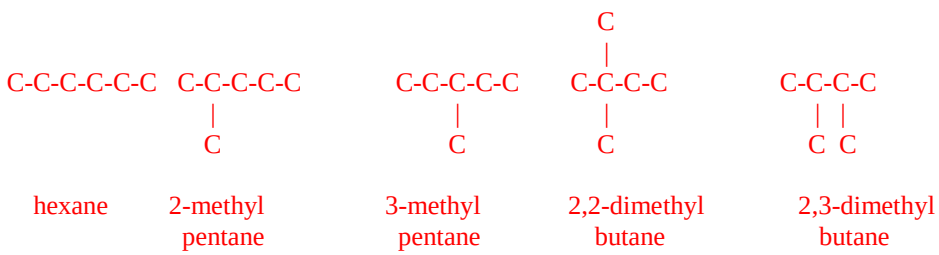
Note: **Use plots, sketch or graphs to support your answer.**

Question 1 (40 marks)

a. Define the Hydrocarbons: Hydrocarbons are organic compounds that are made of only hydrogen and carbon atoms. They are found in many places, including crude oil and natural gas. and indicate their classifications with examples. Lecture 1: slide 2.

b. What is the effect of the chain length and chain branching for Alkanes on the boiling point? BP: increses with chain length (because of more atoms) while decrease with chain branching. (because of less surface area).

c. Define the isomers and draw the structural formulas for the hexane isomers.
Isomers are compounds that have the same chemical formula but different chemical structure.



d. What are the quantities commonly needed to describe a gas?
Pressure, temperature, volume, and amount of gas.

e. Mention the laws used to describe the gas behavoiur.
Lecture 3: slides 3,8,10 and 11.

f. Compare the ideal gas law with the **Van der Waal's** Equation and discuss the modifications made. Lecture-3: slides 17-19

$$PV = nRT$$

$$\left[P_{obs} + a\left(\frac{n}{V}\right)^2\right](V - nb) = nRT$$

g. Why does the quantity $\left(\frac{n}{V}\right)^2$ in the Van der Waal's equation is of second order?

Since two molecules interact, the effect must be squared

h. Define the gas Z factor.The **compressibility factor** (**Z**), also known as the compression **factor**, is the ratio of the molar volume of a **gas** to the molar volume of an ideal **gas** at the same temperature and pressure. It is a useful thermodynamic property for modifying the ideal **gas** law to account for the real **gas** behavior.

Question 2 (40 marks)

A gas has the following composition:

Composition	Volume %	MW
Methane	75	16
Ethane	9	30
Propane	6	44
i-butane	5	58
n-butane	2	58
i-pentane	1	72
n-pentane	2	72

Calculate the following:

i. Mole fraction.
ii. The gas apparent molecular weight and the gas specific gravity.
iii. The partial pressure for each component if the total pressure is 100 psia.
iv. The compressibility factor.

			i	iii	
Composition	**Volume %**	**MW**	**Y_i**	**Yi × MW**	**P_i**
Methane	75	16	0.75	12	75
Ethane	9	30	0.09	2.7	9
Propane	6	44	0.06	2.64	6
i-butane	5	58	0.05	2.9	5
n-butane	2	58	0.02	1.16	2
i-pentane	1	72	0.01	0.72	1
n-pentane	2	72	0.02	1.44	2

ii	AMW	23.56
ii	Sp. Gr.	0.812414

Tpc	423.7843	° R
Ppc	664.4356	psia
Tpr	1.321427	
Ppr	0.150504	

iv	Z	0.985

Question 3 (20 marks)

A piece of sandstone core sample with a bulk volume of **2.5 cc** is contained in a **10-cc** cell filled with helium at **760 mmHg**. Temperature is maintained constant and the cell is opened to another evacuated cell with the same volume. The final pressure in the two vessels is **340.7 mm Hg**. What is the porosity of the sandstone?

$$\emptyset = \frac{V_p}{V_B} = \frac{V_p}{2.5}$$

Applying Boyle's Law:

$$P_1V_1 = P_2V_2$$

$$V_1 = Cell\ one\ volume - V_B + V_p = 10 - 2.5 + V_p = 7.5 + V_p$$

$$V_2 = two\ Cells\ volume - V_B + V_p = 20 - 2.5 + V_p = 17.5 + V_p$$

$$P_1(7.5 + V_p) = P_2(17.5 + V_p)$$

$$760\ (7.5 + V_p) = 340.7\ (17.5 + V_p)$$

After rearrange the equation:

$$V_p = 0.625447$$

$$\emptyset = \frac{0.625447}{2.5} = 0.2501$$