

Name: \_\_\_\_\_

**PETROLEUM ENGINEERING 310  
EXAMINATION 2  
Sample 1**

**Rules:**

**This exam is with closed book, homeworks and notes. You are allowed to have four sheets with written formulas, graphs, conversion factors or anything that may help you to understand this subject.**

**In addition I am giving to you information which should be enough to solve this exam.**

**State any assumptions you make and show all your work or you get no credit.**

- 1.** You need to deliver methane from Houston to Alaska using cylinders of 3 cubic feet capacity. The maximum pressure allowed in these cylinders is 2500 psia. Using corresponding states charts for the compressibility factor ( $z$ ) estimate: What is the maximum mass in pounds of gas that can be shipped (safely) using ten of these cylinders? **(pts 15)**

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2. A laboratory cell with a moving piston is loaded with **one** pound of a binary mixture of 50 % methane and 50% propane (on molar basis), at this point the measured pressure is 362.5 psia. If the cell original volume is reduced by 50 % by displacing the piston forward and the temperature is held constant at 70 °F throughout the process estimate:

a) Expected pressure if the mixture behaves as a mixture of Ideal Gases **(pts 5)**

b) Expected pressure using the Redlich-Kwong EOS. **(pts 15)**

The following values for the a and b constants in the Redlich-Kwong EOS have been calculated. Subscript "1" indicates methane.

$$a_1 = 1.6107 \times 10^5 \frac{\text{psia ft}^6 \text{ R}^{0.5}}{\text{lb mole}^2}$$

$$a_2 = 9.1479 \times 10^5 \frac{\text{psia ft}^6 \text{ R}^{0.5}}{\text{lb mole}^2}$$

$$b_1 = 4.769 \times 10^{-1} \frac{\text{ft}^3}{\text{lb mole}}$$

$$b_2 = 10.026 \times 10^{-1} \frac{\text{ft}^3}{\text{lb mole}}$$

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3. You need to design a PVT cell such that you can accomplish your own PVT experiment at the pressure and temperature specified in Figure A.

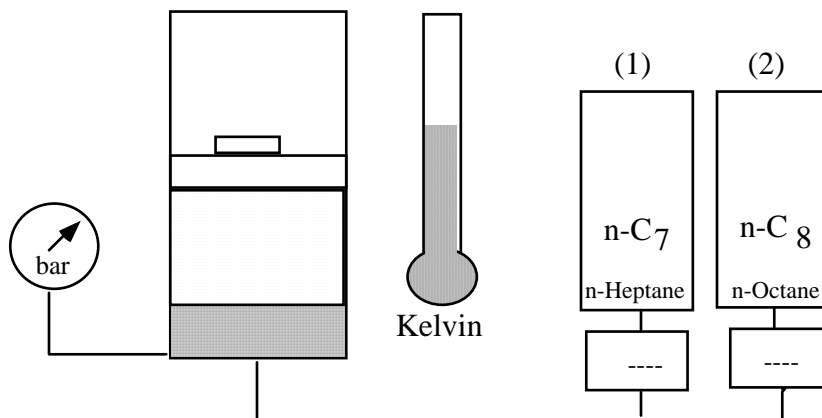
Fill up the missing information in the output (Figure A) based upon the following requirements:

- a) The molar ratio of n-Octane to n-Heptane has to be 4 : 1.
- b) Total mass to load in the cell is 1000 grams

**Hint:** To fill in the blanks, you must do some intermediate calculations  
I want to see **all** the steps and assumptions that you make.  
You don't need any conversion factor. **(pts 15)**

- (a) What is the mol fraction of n-Octane in the liquid phase? **(pts 2)**
- (b) What is the volume of liquid produced? **(pts 2)**
- (c) The molar volume of this mixture at reservoir conditions of  $P = 105.8$  bar and  $T = 70.2$  °C has been measured as  $V_M = 196.7$  cc /mol  
Can you estimate the formation volume factor of this oil. If not what type of information do you need? **(pts 3)**
- (d) What is the mass density of the vapor produced? .( That is  $\rho_V = \text{---- gr / cm}^3$ ) **(pts 3)**

Temp : 172.2 °C      Phase Vapour-Liquid  
 Press: 5.8 bar  
 Vol : ----- cc      Molar Volume 5277.7 cc/mol (46.3 %) n - C<sub>7</sub>: 26.1 %  
 Num: ----- millimol      250.3 cc/mol (----- %) n - C<sub>7</sub>: 19.8 %



**Figure A**

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4. Construct **one** plot showing the P vs T behavior of the five different reservoir fluids. Be sure to note and label all pertinent lines, points, and regions. Indicate in the plot the pressure and temperature of the the reservoir as well as the separator conditions. **(pts 5)**

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5. Given the following compositional data for a natural gas, perform the following calculations at a pressure of 2500 psia and a temperature of 160°F.

<u>Component</u>	<u>Composition mole fraction</u>
Carbon Dioxide	0.10
Hydrogen Sulfide	0.10
Water Vapor	0.05
Methane	0.70
Ethane	0.05
Total	1.00

- (a) Determine the pseudocritical temperature and pressure of the gas mixture. **(pts 5)**

Pseudocritical temperature \_\_\_\_\_

Pseudocritical pressure \_\_\_\_\_

- (b) Calculate the z-factor of the gas. **(pts 5)**

- (c) Calculate the gas formation volume factor given the experimental value of the z-factor is 0.80. How well does compare this z factor with the one calculated in part (b) **(pts 5)**

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6. The following report shows experimental pressure versus mass density at  $T=250^{\circ}\text{F}$  for a dry gas. Estimate the isothermal compressibility of this gas at 350 psia. (pts 15)

Pressure (psia)	Density (lb/ cf)
478.1	6.931
449.5	5.864
420.4	5.075
391.5	4.432
362.7	3.885
333.5	3.406
304.5	2.978
246.1	2.234
188.3	1.600