

Name _____

**PETROLEUM ENGINEERING 310
EXAM # 1**

September, 28, 1993

Closed Book.

Do all your work on the test paper; if you use extra paper for any question, please attach it immediately after that question.

Remember to show all your work!!!! Answers with no evidence of calculations where they are required will not be graded.

The point value of each question is given in parentheses after the question.

1. Give an example of an alkane that is liquid at ambient temperatures and pressures, name it and describe the distinguishing features of molecules of the family. Also give the other names for the family, the general formula of alkanes, and the structural formula for the alkane you have used as your example? (3)

Draw the structural formula of 4-dimethyl -2-octene and draw and name one structural isomer of this substance (3)

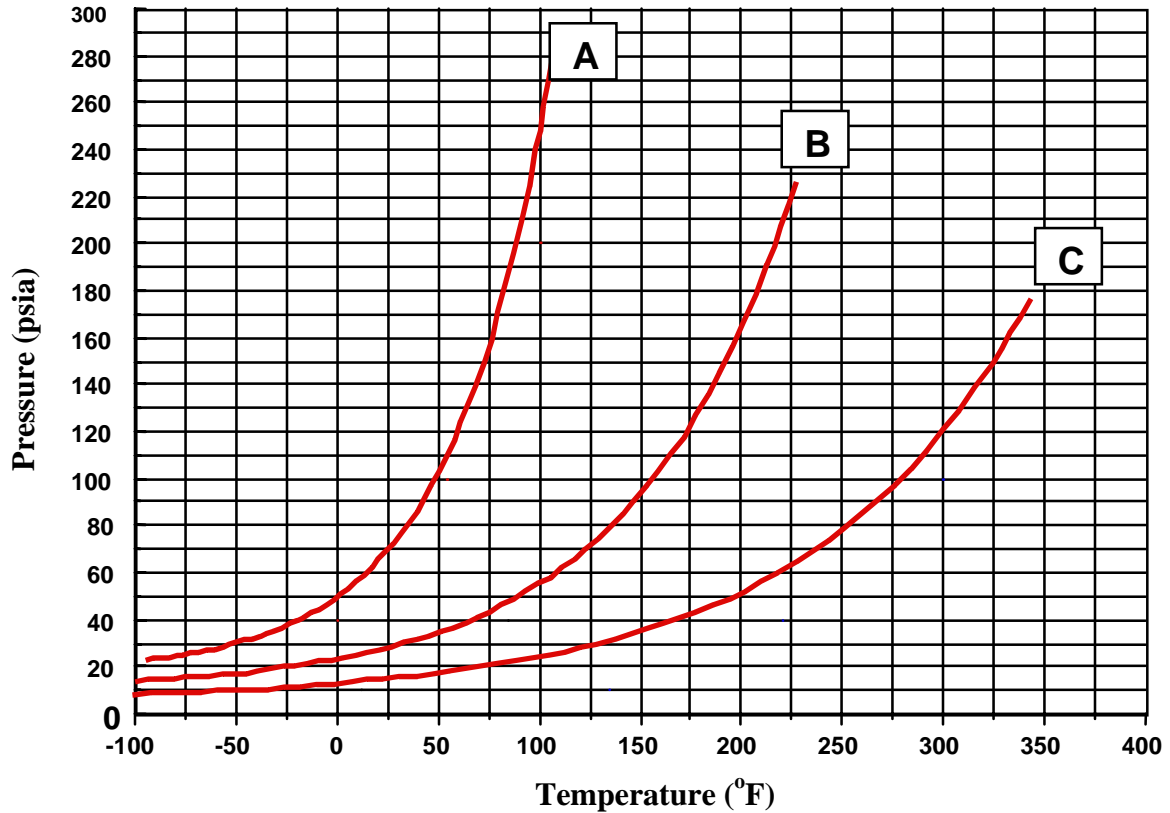
2. The densities of methane liquid and gas in equilibrium along the vapor-pressure line are given below. If 10 pounds of methane are charged to a 1 cubic feet container at -181°F (at equilibrium) find the volumetric and mass percentages of liquid and gas in this volume.(15)

Temperature °F	Density of saturated methane	
	liquid lb/cu ft	gas lb/cu ft
-253.	26.17	0.1443
-235.	25.25	0.2747
-217.	24.28	0.4766
-199.	23.18	0.7744
-181.	21.89	1.202
-163.	20.48	1.810

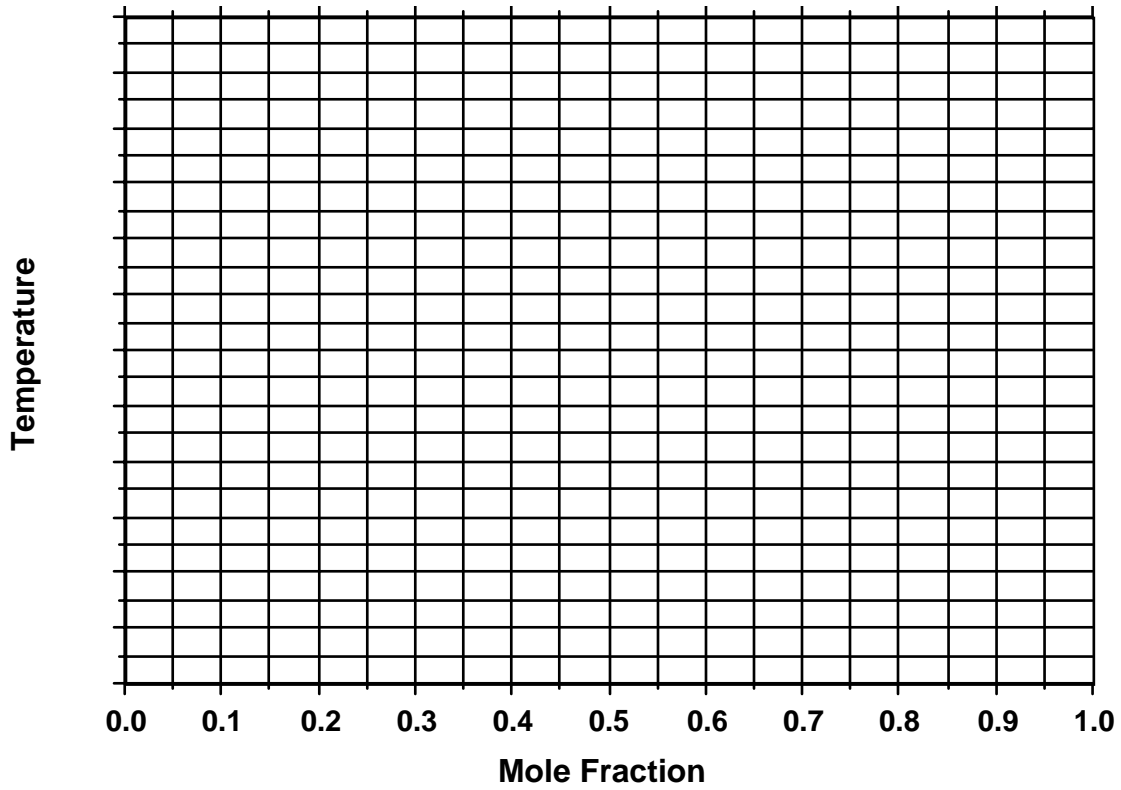
What are the maximum and minimum amounts of mass that could be charged to this container at these equilibrium conditions? **(5)**

Sketch the corresponding PV diagram labeling all important points **(5)**

- 3.** The following diagram indicates vapor pressures of three different substances A, B and C.
- (a) Indicate which one is the "heaviest" and which one the "lightest" and why. **(3)**
 - (b) What is the state of A at $P=200$ psia? **(4)**
 - (c) What are the states of B and C at $T = 150^{\circ}\text{F}$ and $P = 80$ psia? **(3)**
- Locate all the points in the graph



4. The following figure illustrates various binary mixtures of methane and ethane. Note the many different saturation envelopes for differing compositions. Identify the cricondenbar, cricondentherm and critical point of one of these envelopes. Using data from this diagram draw a temperature composition diagram for the 400 psia isobar that intersects the vapor pressures of both pure compounds. Note: you do not need to plot ALL the points that can be read from this figure. (15)



5. Given the following ternary phase diagram (for mixtures of methane, propane and n-pentane at 160°F and 1500 psia, answer the following questions.
- a. Plot on the diagram a mixture of 50% methane, 15% propane and 35% n-pentane **(3)**
 - b. Determine the composition of equilibrium liquid and gas if the mixture from part (a) is brought to equilibrium at 160°F and 1500 psia **(12)**

Gas _____ % C₁
 _____ % C₃
 _____ % C₅

Liquid _____ % C₁
 _____ % C₃
 _____ % C₅

- c. Calculate the fraction of the mixture described in part (a) that is gas and the fraction of the mixture that is liquid. (3)

6. Assume the following gas mixture behaves like an ideal gas. Calculate the amount of mass of the gas mixture that can be transported at 70°F and 2000 psia in five containers sized to hold up to 3 ft³ each.

Component	Composition (mole fraction)	Pc (psia)	Molecular Weight	Tc °F
methane (C ₁)	0.80	666.4	16.043	-116.67
ethane (C ₂)	0.10	706.5	30.070	89.92
propane (C ₃)	0.05	616.	44.097	206.06
n-butane (n - C ₄)	0.05	550.6	58.123	305.62

1.00

Somebody told you that you are making a big mistake by considering an "ideal gas mixture". Estimate the error you are making by making that assumption, and express your error as:

$$\text{error} = (\text{mass ideal} - \text{mass real}) / \text{mass ideal} * 100.$$

Where mass real is the mass calculated using the compressibility equation of state (26)

Useful information:

$$R = 10.732 \text{ psia} \cdot \text{cu ft} / \text{°R lb mol}$$