16.04 g/mol = 0.0354 lb/mol MASS OF GAS = 5000 lbs

$PV = nRT$

$\therefore V = \frac{nRT}{P}$

$n = 5000 \times 0.0354 = 177$ mol

$R = 1545$ lb/lb mol °R

$T = 959.67$ °R (converted 500°F to °R)

$P = 288{,}000$ lb/ft² (from 2000 psi)

$$V = \frac{177 \times 1545 \times 959.67}{288{,}000}$$

$= 911.24$ ft³ volume of methane

3.4	*Compressibility factor*	*Poss.*	*Mark*
1	Calculate the volumes in cubic feet of the following gases given the mass, pressure and temperature as outlined in the table below. Assume that the gases are ideal.	10	VOLUME FT³

Gas	MW	Pc (psia)	Tc (°R)	Mass (lbs)	Pressure (psi)	Temperature (°F)	VOLUME FT³
Methane	16.04	668	343	5000	2000	500	29.51
					2000	250	
Ethane	30.07	708	550	2500	1500	450	
					3000	450	

3	1. Calculate the approximate specific gravity of a gas with the following composition. Gas may assumed to be ideal.	10	

Component	MW	Pc	Tc	Composition (mole fraction)
Methane	16.04	668	343	0.850
Ethane	30.17	708	550	0.090
Propane	44.10	616	666	0.040
n-Butane	58.12	551	765	0.020

5			
7			
9			

3.4 Compressibility Factor and Compressibility Charts

Review

In this topic the student is introduced to the properties of gases and is shown how to use known pure gas properties to predict properties of natural gases found in oil / gas reservoirs by calculating reduced properties. The use of Kay's rules to find pseudo critical temperature and pressure for mixtures, and calculation of reduced properties to be used in the generalised compressibility chart is described.

Content

At low pressures all pure gases and gas mixtures behave in a manner which can be approximately represented by the ideal gas law (or perfect gas law) which is:

$$\boxed{pV = nRT}$$

where:

p = pressure V = volume
T = temperature (absolute)
n = no of moles
R = gas constant for 1 mole

1 mole of a substance is the quantity of substance having a mass equal to the molar mass in grams. In the SI system of units the kmol – ie, kilomole, having a mass equal to the molar mass in kg - is used. In Imperial units the lb. mol, having a mass equal to the molar mass in lb, is used. To avoid any risk of confusion the mole is sometimes written g mol to emphasis that it is based on the gram as the mass unit. Values of R in the systems of units commonly encountered are given below:

Pressure	**Volume**	**Temperature**	**R**
kN/m^2	m^3	K	8.314kJ/kmol K
Atm	cm^3	K	$82.06 cm^3$ atm/mol K
Psia	ft^3	°R	10.73psia ft^3/lb mol °R
lb/ft^2	ft^3	°R	1545ft lb/lb mol °R