Key Solution

CHEN 490 – Fundamentals of Petroleum Engineering
HW 2 – Due 25/9/2014

1. Calculate the mass and density of methane gas contained at 1000 psia and 65 F in a cylinder with volume of 3.20 cu ft. Assume that methane is an ideal gas.

2. Dry air is a gas mixture consisting essentially of nitrogen, oxygen, and small amounts of other gases. Compute the apparent molecular weight of air given its appropriate composition:

Component	Composition, mole fraction
N	0.78
O	0.21
Argon	0.01

3. Calculate the specific gravity of a gas of the following compositions:

Component	Composition, mole fraction
Methane	0.850
Ethane	0.090
Propane	0.040
n-butane	0.020

4. Converting from a weight percent analysis to mole percent for a hydrocarbon gas:

Component	Weight, %	Molecular weight
C_1	30	16.04
C_2	40	30.07
C_3	30	44.09

1. Assume that methane is an ideal gas

$P = 1000$ psia and $T = 68^{\circ}F$ in a cylinder

with $V = 3.20\ ft^3$

Solution

$$m = \frac{PMV}{RT}$$

$$m = \frac{(1000\ psi)\left(16.04\ \frac{lb}{lb\text{-}mole}\right)(3.20\ ft^3)}{\left(10.73\ \frac{psi \cdot ft^3}{lb\text{-}mole\ ^{\circ}R}\right)(528^{\circ}R)}$$

$$m = \underline{9.1}\ lb$$

$$\rho_g = \frac{PM}{RT}$$

$$\rho_g = \frac{(1000\ psi)\left(16.04\ \frac{lb}{lb\text{-}mole}\right)}{\left(10.73\ \frac{psi \cdot ft^3}{lb\text{-}mole\ ^{\circ}R}\right)(528^{\circ}R)}$$

$$\rho_g = \underline{2.83}\ \frac{lb}{ft^3}$$

2. Dry air

Component	Composition mole fractio
N_2	0.78
O_2	0.21
Argon	0.01

Solution

$$M_a = y_{N_2} M_{N_2} + y_{O_2} M_{O_2} + y_A M_A$$

$$M_a = (0.78)(28.01) + (0.21)(32.0) + (0.01)(39.94)$$

$$M_a = 28.97 \text{ lb/lb mole}$$

or $= 29$ lb/lb-mole

3. A gas

Component	Composition, mole fraction	molecular wt.	M_a $y_i M_i$
C_1	0.850	16.04	13.63
C_2	0.090	30.07	2.71
C_3	0.040	44.10	1.76
$n-C_4$	0.02	58.12	1.16
			19.26

First calculate apparent molecular weight. $y_i M_i$

2nd Calculate sp. gravity

$$\gamma_g = \frac{M_a}{29} = \frac{19.26}{29} = 0.664$$

4. Converting from a weight percent to mole percent: for a hydrocarbon gas?

Solution

(1) Component	(2) wt.%	(3) M	(4) (2)÷(3) moles/100 lb	mole%
C_1	30	16.04	1.87	48.2
C_2	40	30.07	1.33	34.3
C_3	30	44.09	0.68	17.5
			3.88	100.00