# Ideal Gas Law Worksheet 2

## Gas Stoichiometry and Molecular Formula Determination

Methane, the principal component of natural gas, is used for heating and cooking.

a) Write a balanced chemical equation for the combustion of methane.
b) If 15 moles of methane are reacted, what is the volume of carbon dioxide (in liters) produced at at 23.0°C and 0.985 atm? (Chang #52)

370L

2004 Exam Question 2

$$Fe(s) + 3/2\ O_2\ (g) \rightarrow Fe_2O_3\ (s)$$

Iron reacts with oxygen to produce iron (III) oxide, as represented by the equation above. A 75.0 g sample of Fe(s) is mixed with 11.5 L of $O_2$ (g) at 2.66 atm and 298 K.

a) calculate the number of moles of each of the following before the reaction begins.
   i) Fe (s) ii) $O_2$(g)

ice table

b) Identify your limiting reactant when the mixture is heated to produce solid iron (III) oxide.
c) Calculate the number of moles of iron (III) oxide produced when the reaction proceeds to completion.

a) $\frac{75.0\text{g F}}{55.85} = 1.34\text{ mol Fe}$

$PV=nRT$

$n = \frac{PV}{RT} = \frac{(2.66)(11.5)}{(.0821)298}$

$1.25\text{ mol } O_2$

$Fe + \frac{3}{2}O_2 \longrightarrow F_2O_3$

$4Fe + 3O_2 \longrightarrow 2Fe_2O_3$

| 1.34 | 1.25 | 0 |
|---|---|---|
| −1.34 | −1.005 | +.067 |
| 0 | .245 mol $O_2$ | .67 mol $Fe_2O_3$ c |

$1.25\text{ mol } O_2 \times \frac{4Fe}{3O_2} = 1.66\text{ mol Fe}$

$1.34\text{ mol Fe} \times \frac{3O_2}{4Fe} = 1.005\text{ mol}$

1998 AP exam

An unknown compound contains only the three elements C,H, and O. A pure sample of the compound is analyzed and found to be 65.60 percent C and 9.44 percent H by mass.

(a) Determine the empirical formula of the compound.

(b) When 1.570 grams of the compound is vaporized at 300 °C and 1.00 atmosphere, the gas occupies a volume of 577 milliliters. What is the molar mass of the compound based on this result?

$MM = \frac{mRT}{PV} = \frac{(1.570)(.0821)(573)}{(1)(.577)} = 128.00\ g/mol$

(c) Determine the molecular formula of the compound.

same!

a) $\frac{65.60\ g\ C}{12.011}$ $\frac{9.44\ g\ H}{1.008}$ $\frac{24.96\ g\ O}{16.00}$

mol C: $\frac{5.46}{1.56}$ mol H: $\frac{9.37}{1.56}$ mol O: $\frac{1.56}{1.56}$

| C | H | O |
|---|---|---|
| 3.5 | 6 | 1 |

$C_7H_{12}O_2$ a

2003 Exam B

In an experiment, a sample of an unknown, pure gaseous hydrocarbon was analyzed. Results showed the sample contained 6.000 g of carbon and 1.344 g of hydrogen.

a) determine the empirical formula of the hydrocarbon.

b) The density of hydrocarbon at 25°C and 1.09 atm is 1.96 g/L.
   i) Calculate the molar mass of the hydrocarbon
   ii) Determine the molecular formula of the hydrocarbon

$\frac{25}{273}$
$\frac{}{298}$

$\frac{6.000\ g\ C}{12.0}$ $\frac{1.344}{1.0}$

$\frac{.5\ mol\ C}{.5}$ $\frac{1.344}{.5}$

1 : 2.7

$C_3H_8$

$36+8 = 44\ g/mol$

$MM = \frac{DRT}{P} = \frac{1.96(.0821)(298)}{1.09} = 43.99\ g/mol$

SAME