Name:________________________
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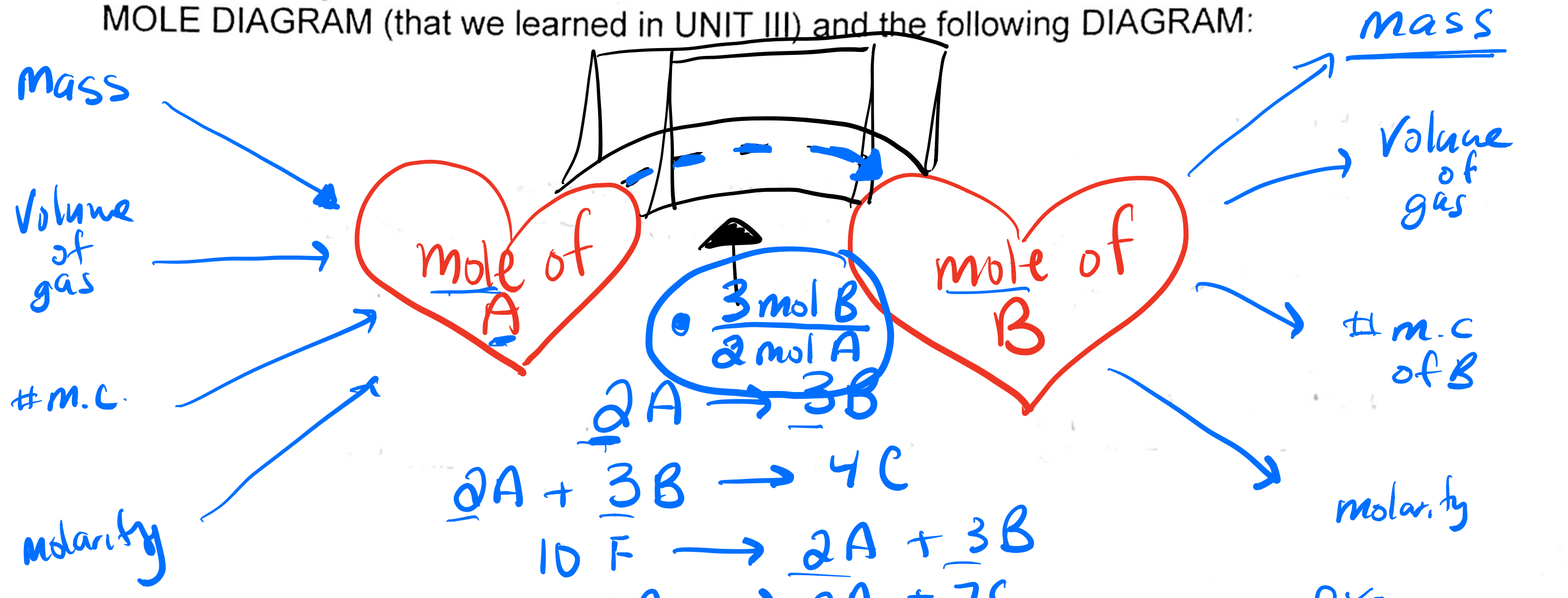
Chemistry 11
STOICHIOMETRY Calculations Involving MOLES, MASS, GAS VOLUME AND MOLECULES

The balanced equation gives rise to CONVERSION FACTORS that are sometimes referred to as the ~~moledengate~~ bridge.

The mole bridge is the ratio which allows us to make connections between the MOLE DIAGRAM (that we learned in UNIT III) and the following DIAGRAM:



2A → 3B
2A + 3B → 4C
10 F → 2A + 3B
5Z + 3B → 2A + 7C

A = know B = ?

exo
Combustion!

Example 1. For the reaction of tricarbon octahydride with oxygen:
a. What mass of CO_2 is produced by reacting 2.00 mol of O_2 (g)?
Step 1. Write out the balanced equation:

$$C_3H_8(g) + 5\,O_2(g) \rightarrow 3\,CO_2(g) + 4\,H_2O(g)$$

1 C = 12.0
2 O = 32.0
44.0 g/mol

Step 2. Use the above diagram to identify the unknown, the initial and the conversion factors and solve:

$$2.00\ \text{mol } O_2 \left(\frac{3\ \text{mol } CO_2}{5\ \text{mol } O_2}\right)\left(\frac{44.0\ \text{g } CO_2}{1\ \text{mol } CO_2}\right) = 52.8\ \text{g } CO_2$$

b. What mass of C_3H_8 is required to produce 100.0 grams of H_2O?
Step 1. Write out the balanced equation:

$$1\,C_3H_8(g) + 5\,O_2(g) \rightarrow 3\,CO_2(g) + 4\,H_2O(g)$$

3 C = 36.0
8 H = 8.0
44.0 g C_3H_8

Step 2. Use the above diagram to identify the unknown, the initial and the conversion factors and solve:

$$100.0\ \text{g } H_2O \left(\frac{1\ \text{mol } H_2O}{18.0\ \text{g}}\right)\left(\frac{1\ \text{mol } C_3H_8}{4\ \text{mol } H_2O}\right)\left(\frac{44.0\ \text{g } C_3H_8}{1\ \text{mol } C_3H_8}\right) = 61.1\ \text{g } C_3H_8$$

2 H = 2.0
1 O = 16.0
18.0 g H_2O / 1 mol H_2O

void from sig figs

c. If a sample of tricarbon octahydride is burned, what mass of H_2O (g) is produced if the reaction also produces 50.0 L of CO_2 at STP?

Step 1. Write out the balanced equation:

$$1\ C_3H_8(g) + 5\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O(g)$$

Step 2. Use the above diagram to identify the unknown, the initial and the conversion factors and solve:

$$50.0\ L\ of\ CO_2 \left(\frac{1\ mol\ CO_2}{22.4\ L}\right)\left(\frac{4\ mol\ H_2O}{3\ mol\ CO_2}\right)\left(\frac{18.0\ g\ H_2O}{1\ mol\ H_2O}\right) = 53.6\ g\ H_2O$$

d. A tricarbon octahydride burner is used in a laboratory as part of a chemistry demonstration. What volume of O_2 (g) at STP is consumed from the laboratory air when the burner produces 10.0 L of CO_2 (g) at STP during the demo?

Step 1. Write out the balanced equation:

$$1\ C_3H_8(g) + 5\ O_2(g) \rightarrow 3\ CO_2(g) + 4\ H_2O(g)$$

Step 2. Use the above diagram to identify the unknown, the initial and the conversion factors and solve:

$$10.0\ L\ CO_2 \left(\frac{1\ mol\ CO_2}{22.4\ L}\right)\left(\frac{5\ mol\ O_2}{3\ mol\ CO_2}\right)\left(\frac{22.4\ L}{1\ mol\ O_2}\right) = 16.7\ L\ of\ O_2$$

e. A sample of porous, gas-bearing rock is crushed and 1.35×10^{-6} grams of CH_4 (g) is extracted from the powdered rock. How many molecules of CO_2 (g) are produced if the gas sample is burned in the presence of O_2 (g)?

Step 1. Write out the balanced equation:

$$1\ CH_4(g) + 2\ O_2(g) \rightarrow 1\ CO_2(g) + 2\ H_2O(g)$$

Step 2. Use the above diagram to identify the unknown, the initial and the conversion factors and solve:

$$1.35 \cdot 10^{-6}\ g\ CH_4 \left(\frac{1\ mol\ CH_4}{16.0\ g\ CH_4}\right)\left(\frac{1\ mol\ CO_2}{1\ mol\ CH_4}\right)\left(\frac{6.02 \cdot 10^{23}\ m.c.\ CO_2}{1\ mol\ CO_2}\right)$$

$$= 5.08 \cdot 10^{16}\ molecules\ of\ CO_2$$

1 C = 12.0
4 H = 4.0
16.0 g CH_4 / 1 mol

Ex: 6-12 pg 127