

Practice sheet #1: Fundamentals.

1. Solve the following mathematical operations using the correct amount of significant figures. NO CALCULATORS are allowed. You should be able to solve these by hand.

1a.  $35 : 17 + 230 - 9.23104 \times 2.1 =$

1b.  $2.13 \times 10^{-7} + (5.000/2.3) \times 10^{-2} + [\log(1.26/12600.)] \times 10^{-3} =$

1c.  $\sqrt{((641 : 4.0) \times 10^{-9})} =$

1d.  $\log 10^{9.21} + 120 =$

1e.  $\ln(e^{-4.265}/e^{2.00}) =$

2. The following molecules were analyzed by Mass spec and elemental analysis and the results are shown below. For each molecule, write the empirical formula and the molecular formula.

2a. MS: m/z: 137.05 (100.0%), 138.05 (7.7%); Elemental Analysis: C, 61.31; H, 5.15; N, 10.21; O, 23.33.

Empirical Formula: \_\_\_\_\_ Molecular formula: \_\_\_\_\_

2b. MS: m/z: 138.04 (100.0%), 139.05 (6.6%); Elemental Analysis: C, 52.17; H, 4.38; N, 20.28; O, 23.17.

Empirical Formula: \_\_\_\_\_ Molecular formula: \_\_\_\_\_

2c. MS: m/z: 249.94 (100.0%), 251.94 (97.3%), 250.95 (8.8%), 252.95 (8.6%); Elemental Analysis: C, 38.28; H, 2.01; Br, 31.83; F, 15.14; O, 12.75.

Empirical Formula: \_\_\_\_\_ Molecular formula: \_\_\_\_\_

2d. MS: m/z: 273.13 (100.0%), 274.13 (19.6%), 275.13 (2.0%), 274.12 (1.1%); Elemental Analysis: C, 79.10; H, 5.53; N, 15.37.

Empirical Formula: \_\_\_\_\_ Molecular formula: \_\_\_\_\_

3. Using dimensional analysis, express the following amounts of ethanol ( $d = 789.00 \text{ kg/m}^3$ ) in mL (use scientific notations if needed).

3a.  $\frac{1}{8}$  Gal

3b. 1 lb 6 oz

3c.  $3.56 \text{ m}^3$

3d. 2.3012 mol

4. Calculate the amount of moles of:

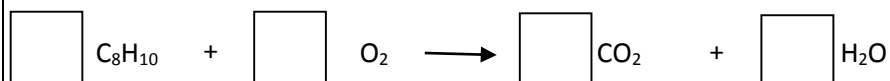
4a. hydrogen atoms in 2.43 g of ammonia (NH<sub>3</sub>)

4b. a sample of nitrogen atoms in a sample of  $25.4 \times 10^{18}$  molecules of nitrogen gas (N<sub>2</sub>)

5. Complete the table below with the missing amounts for the reactions of combustion of these hydrocarbons: (NOTE: the reactions need to be balanced!)

|                       |                                                                                                                                         |      |      |      |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------|------|------|------|
| 5a.                   | <div><div></div> C<sub>2</sub>H<sub>2</sub> + <div></div> O<sub>2</sub> → <div></div> CO<sub>2</sub> + <div></div> H<sub>2</sub>O</div> |      |      |      |
| Mass                  | 15.0 g                                                                                                                                  |      |      |      |
| Molar mass (g/mol)    |                                                                                                                                         | 32.0 | 44.0 | 18.0 |
| Number of moles (mol) |                                                                                                                                         |      |      |      |

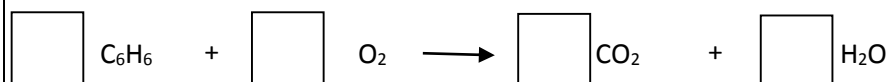
5b.



|                       |  |         |      |      |
|-----------------------|--|---------|------|------|
| Mass                  |  | 1.20 hg |      |      |
| Molar mass (g/mol)    |  | 32.0    | 44.0 | 18.0 |
| Number of moles (mol) |  |         |      |      |

Note: hg is not a typo, it stands for 1.20 hectograms of oxygen. You may express the masses of the other species in any unit you may find more convenient.

5c.



|                       |  |      |      |      |
|-----------------------|--|------|------|------|
| Mass (g)              |  |      |      |      |
| Molar mass (g/mol)    |  | 32.0 | 44.0 | 18.0 |
| Number of moles (mol) |  |      | 16.2 |      |

6. For the reaction of combustion of octane (problem 5b), say whether the following amounts of octane and oxygen are in a stoichiometric ratio or there is an excess of a reagent. In this latter case, say which is the limiting reagent.

| Amount of octane | Amount of oxygen gas | Stoichiometric ratio (Y/N) | Limiting reagent |
|------------------|----------------------|----------------------------|------------------|
| 12 g             | 2.1 mol              |                            |                  |
| 13 mol           | 2.01 mg              |                            |                  |
| 1.5 mol          | 0.504 kg             |                            |                  |
| 100.1 mg         | 203 mg               |                            |                  |

