Chem1A, General Chemistry I

1.) Dimethylhydrazine is a carbon-hydrogen-nitrogen compound used in rocket fuels. When complete combusted, a 0.505 g sample of dimethylhydrazine yields 0.741 g CO_2 and 0.605 g H_2O. The molecular weight for dimethylhydrazine is 60.099 g/mol. What is its molecular formula?

2.) A 293 mL sample of 2.1 M calcium chloride is mixed with 109 mL of 1.5 M sodium hydroxide. A double displacement reaction is observed to occur.

a.) Write the **balanced molecular equation** for this reaction.

b.) Write the **total (complete) ionic equation** for this reaction.

c.) Write the **net ionic equation** for this reaction.

d.) Determine the theoretical yield of solid product, in g (molar mass = 74.10 g/mol).

e.) What is the limiting reactant?

3.) Hydrogen can be produced by "water splitting" according to the following reaction:

$$H_2O(l) \rightarrow H_2(g) + \frac{1}{2} O_2(g)$$

a.) What element is being oxidized?

b.) What element is being reduced?

c.) In a container, 0.0183 mols H_2 (g), and 0.0294 mols of O_2 (g) are held over water at 25°C. The vapor pressure of water at this temperature is 23.5 mmHg. The total pressure inside the container is 892 mmHg. Calculate the partial pressure of H_2(g) and O_2(g) in mmHg.

4.) A 1.620 g sample of naphthalene ($C_{10}H_8$), is completely burned in a bomb calorimeter, resulting in a temperature increase of 8.44°C. If the heat of combustion of naphthalene is -5156 kJ/mol, calculate the heat capacity of the bomb calorimeter in kJ/°C.

5.) Calculate the change in internal energy (ΔE or ΔU) for a gas that releases 32.5 kJ of heat and has 52.3 kJ of work done on it by the surroundings, in kJ.

6.) Use the following heats of formation to solve for the $\Delta H°$ for the below reaction.

$$4\ NH_3(g) + 7\ O_2(g) \rightarrow 4\ NO_2(g) + 6\ H_2O(l)$$

Compound	**$\Delta H_f°$**
$NH_3(g)$	- 46.19 kJ/mol
$NO_2(g)$	33.84 kJ/mol
$H_2O(l)$	- 285.83 kJ/mol

7.) A 1.231 g sample of an unknown gas is measured in a 250.0 mL container at 365.2 torr and 156.1 K. Calculate the molar mass of the unknown gas.

8.) Rank the following gases in terms of (a) *increasing* root mean square velocity and (b) *decreasing* rate of effusion at a constant temperature: H_2, H_3, Ne, Cl_2, N_2, Xe.

a.)

b.)