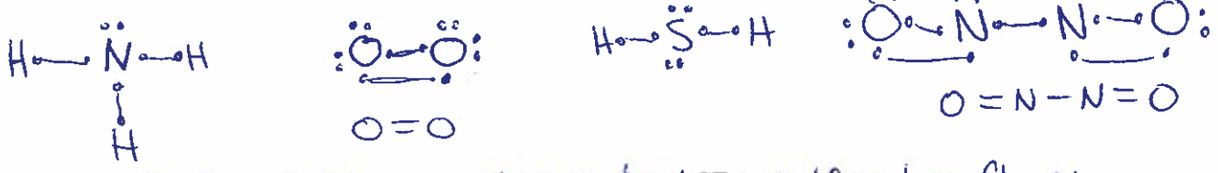
Review 1: Stoichiometry & gases

1) Draw the Lewis dot structures for: NH_3 O_2 H_2S N_2O_2



2) Name N_2H_4 ~~Dinitrogen tetroxide~~ tetrahydride ClO_2 Chlorine dioxide SF_6 sulfur hexafluoride

3) Name $Ca(NO_3)_2$ ~~Calcium nitrate~~ H_2SO_4 Hydrogen sulfate. LiOH Lithium hydroxide.

4) Write out the molecular formulas for each substance:
   a. Lithium chlorate $LiClO_3$
   b. Cobalt(II) chloride vs Cobalt(III) chloride $CoCl_2$ $CoCl_3$
   c. Sodium Nitride Na_3N
   d. Calcium carbonate $CaCO_3$
   e. Ammonium hydroxide NH_4OH

5) You have a 10.0 g sample of sodium hydroxide (NaOH). How many molecules does this represent?

$\frac{1\text{ mol NaOH}}{x} = \frac{40.00}{10.0}$

$x = 0.25\text{ mol NaOH} \times 6.02\times10^{23} =$ **1.51×10^{23} particles**

6) Sodium reacts with nitrogen to form sodium nitride as shown: $3\ Na_{(s)} + \frac{1}{2}\ N_{2(g)} \rightarrow Na_3N_{(s)}$
   a. What mass of nitrogen is needed to react with 200 g of sodium in this reaction?
   b. What mass of sodium is needed to react with 50 litres of nitrogen measured at 30 °C and 140 kPa?

a) $\frac{68.97\text{g Na}}{200\text{g}} = \frac{14.00\text{g } N_2}{x}$ (22.99×3; 28×0.5) $x = 40.6\text{g } N_2$

or

$n = \frac{m}{mm} = \frac{200}{22.99} = 8.70\text{ mol Na}$

$\frac{3\text{ mol Na}}{8.70} = \frac{0.5\text{ mol } N_2}{x}$ $x = 1.45\text{ mol } N_2$

$n = \frac{m}{mm}$ $1.45\times28 = 40.6\text{g } N_2$

b) $PV=nRT$ $n = \frac{PV}{RT} = \frac{(140)(50)}{(8.31)(303)} = 2.78\text{ mol } N_2$

$\frac{0.5\text{ mol } N_2}{2.78\text{ mol } N_2} = \frac{3\text{ mol Na}}{x}$ $x = 16.68\text{ mol Na}$

$\frac{1\text{ mol Na}}{16.68\text{ mol Na}} = \frac{22.9\text{g}}{x}$ $x = 383\text{g Na}$

7) Calcium reacts with water to produce calcium hydroxide and hydrogen gas. $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$
   a. What mass of water is needed to react with 75.0g of calcium?
   b. If 40.0g of water react with calcium as above, what volume of hydrogen would be produced at STP?

a) $\frac{40.08\text{g Ca}}{75.0\text{g}} = \frac{36.04\text{g } H_2O}{x}$ $x = 67.44\text{g } H_2O$

b) $\frac{1\text{ mol } H_2O}{x} = \frac{18.01\text{g } H_2O}{40.0\text{g}}$ $x = 2.22\text{ mol } H_2O$

$\frac{2\text{ mol } H_2O}{2.22\text{ mol}} = \frac{1\text{ mol } H_2}{x}$ $x = 1.11\text{ mol } H_2$

$PV = nRT$ $V = \frac{nRT}{P} = \frac{(1.11)(8.31)(273)}{101.3} = 24.9\text{L}$ ($\times 22.4$)

8) A 4.0g sample of methane gas (CH_4) and a 16.0g sample of oxygen are placed in the same flask together. The total pressure of these gases is 75 kPa. What is the partial pressure of each gas?

$\frac{1\text{ mol } CH_4}{x} = \frac{16.04\text{g}}{4.0\text{g}}$ $x = 0.25\text{mol } CH_4$

$\frac{1\text{mol } O_2}{x} = \frac{32.00\text{g}}{16.0\text{g}}$ $x = 0.50\text{ mol } O_2$

$n_T = 0.25 + 0.50 = 0.75$

$P_{CH_4} = \left(\frac{n_{CH_4}}{n_T}\right)P_T = \left(\frac{0.25}{0.75}\right)(75) = 25\text{ kPa}$

$P_{O_2} = \left(\frac{n_{O_2}}{n_T}\right)P_T = \left(\frac{0.50}{0.75}\right)(75) = 50\text{kPa}$