1. (20) When organic compounds are burned in O\textsubscript{2}, they react to form CO\textsubscript{2} and H\textsubscript{2}O. The combustion of pentane is shown below.

\[ \text{C}_5\text{H}_{12} + 8 \text{O}_2 \rightarrow 5 \text{CO}_2 + 6 \text{H}_2\text{O} \]

a) Balance the above reaction.

b) According to the balanced reaction, how many moles of O\textsubscript{2} are needed to burn 10 mol of C\textsubscript{5}H\textsubscript{12}?
\[ 10 \text{ mol C}_5\text{H}_{12} \times 8 \text{ mol O}_2/1 \text{ mol C}_5\text{H}_{12} = 80 \text{ mol O}_2 \]

c) If 1.4 mol of C\textsubscript{5}H\textsubscript{12} reacts with excess O\textsubscript{2}, how many moles of water will form?
\[ 1.4 \text{ mol C}_5\text{H}_{12} \times 6 \text{ mol H}_2\text{O}/1 \text{ mol C}_5\text{H}_{12} = 8.4 \text{ mol H}_2\text{O} \]

d) If I use 8.0 moles of C\textsubscript{5}H\textsubscript{12} and 8.0 moles of O\textsubscript{2} in this reaction, which reactant will have some remaining unreacted (which reactant is used in excess)? C\textsubscript{5}H\textsubscript{12}. How many moles of this compound will be left over unreacted? Since only 1.0 mole of C\textsubscript{5}H\textsubscript{12} can react with 8.0 moles of O\textsubscript{2}, you will have 7.0 moles of C\textsubscript{5}H\textsubscript{12} left over.

2. (20) The following questions refer to the chemical equation below.

\[ \text{I}_2 + 5 \text{Cl}_2 \rightarrow 2 \text{ICl}_5 \]

a) Balance the equation.

b) Assuming excess Cl\textsubscript{2} is available, how many moles iodine pentachloride will form from 2.5 moles of iodine?
\[ 2.5 \text{ mol I}_2 \times 2 \text{ mol ICl}_5/1 \text{ mol I}_2 = 5.0 \text{ mol ICl}_5 \]

c) How many molecules iodine pentachloride is this?
\[ 5.0 \text{ mol ICl}_5 \times 6.02 \times 10^{23} \text{ molecules ICl}_5/1 \text{ mol ICl}_5 = 3.01 \times 10^{24} \text{ molecules ICl}_5 \]

d) How many moles of chlorine are needed to react with 0.250 moles of iodine?
\[ 0.250 \text{ mol I}_2 \times 5 \text{ mol Cl}_2/1 \text{ mol I}_2 = 1.25 \text{ mol Cl}_2 \]

e) What mass (grams) of Cl\textsubscript{2} is needed to react with 0.250 moles of iodine?
\[ 0.250 \text{ mol I}_2 \times 5 \text{ mol Cl}_2/1 \text{ mol I}_2 \times 70.90 \text{ g Cl}_2/1 \text{ mol Cl}_2 = 88.6 \text{ g Cl}_2 \]
3.(20) Balance the following reactions:

a) $\text{Ca(NO}_3\text{)}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{CaSO}_4 + 2 \text{HNO}_3$
   balance NO$_3$ groups first

b) $\text{NaHCO}_3 + \text{HBr} \rightarrow \text{NaBr} + \text{CO}_2 + \text{H}_2\text{O}$
   already balanced :-) 

c) $\text{C}_{12}\text{H}_{22}\text{O}_{11} + \text{H}_2\text{O} \rightarrow 4 \text{C}_2\text{H}_6\text{O} + 4 \text{CO}_2$
   balance H first on product side with C$_2$H$_6$O, then C with CO$_2$

d) $6 \text{HCl} + 2 \text{Al} \rightarrow 2 \text{AlCl}_3 + 3 \text{H}_2$
   balance Cl first (3 HCl), then you need 1.5 H$_2$ --
   then double everything to have integers as coefficients