Note: There are 7 questions in this exam (check both sides of the sheet).
Fill in your answer in the blank space provided immediately following each question. Half
a point will be subtracted every time you report a numerical result with an incorrect
number of significant figures. A copy of the periodic table is attached. Good luck!

1.   a. (4) What is the chemical formula of magnesium phosphate?

     b. (4) What is the name of the compound $KClO_4$?

     c. (4) How many protons and electrons does the sodium ion have?

     d. (4) What is the molar mass of $PbCO_3$?

     e. (4) Give the name of the elements with the following atomic
     symbols:

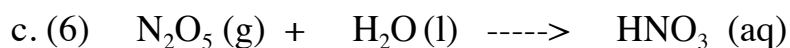   Hg:

           P:
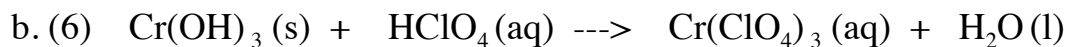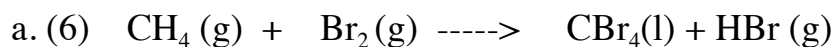
           F:

           Mn:

2. Write a balanced equation for each of the following reactions (it is not necessary to indicate the states of each substance):
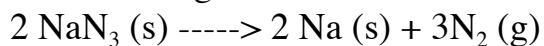
      a. (6) Burning butane in oxygen

      b. (6) Calcium Carbide (CaC_2) reacts with water to form an aqueous solution of calcium hydroxide and acetylene (C_2H_2)

3. Balance the following chemical equations:

      a. (6) CH_4 (g) + Br_2 (g) -----> CBr_4(l) + HBr (g)

      b. (6) $Cr(OH)_3$ (s) + $HClO_4$ (aq) ---> $Cr(ClO_4)_3$ (aq) + H_2O (l)

      c. (6) N_2O_5 (g) + H_2O (l) -----> HNO_3 (aq)

4. (10) Automotive air bags inflate when sodium azide rapidly decomposes:
              $2\ NaN_3$ (s) -----> $2\ Na$ (s) + $3N_2$ (g)
a) (5) How many moles of N_2 are produced by the decomposition of 1.50 moles of NaN_3?

b) (5) How many grams of NaN_3 are required to form 5.00 g of nitrogen gas?

5. (15) Vanillin, the dominant flavoring in vanilla, contains C, H, and O. When 1.050 g of this substance is completely combusted, 2.43 g of CO_2 and 0.500 g of H_2O are produced. What is the empirical formula of vanillin?

6. (15) When chlorine gas is bubbled into hot potassium hydroxide solution, it reacts according to the equation:

$$3Cl_2 \text{ (g)} + 6KOH \text{ (aq)} \rightarrow 5 \text{ KCl (aq)} + KClO_3 \text{ (aq)} + 3H_2O \text{ (l)}$$

A reacting mixture contains 6.00 mol of chlorine and 8.00 mol of potassium hydroxide.

a) (5) Find the limiting reactant

b) (5) How many moles of $KClO_3$ will form and how many moles of excess reactant will remain?

c) (5) How many grams of KOH are needed to form 50.0 Kg of $KClO_3$?

7. (10) Hydrogen chloride is prepared commercially by the reaction of sodium chloride with concentrated sulfuric acid:

$NaCl$ (s) + H_2SO_4 (aq) -$\rightarrow$ $NaHSO_4$ (s) + HCl (g)
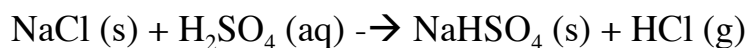
If the percent yield is 81.5%, how many grams of HCl will be obtained by treating 25.0 Kg of NaCl with excess sulfuric acid?