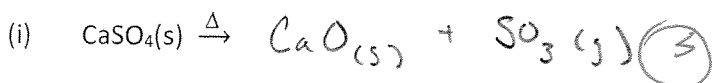
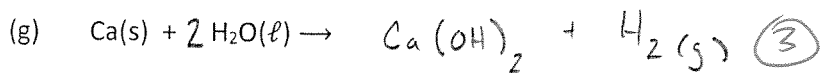
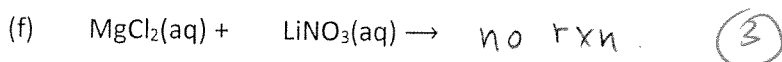
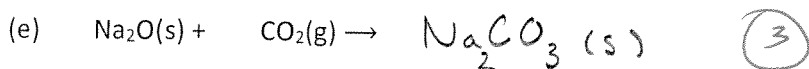
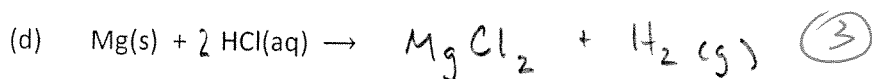
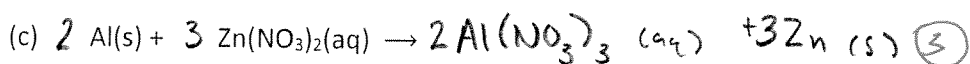
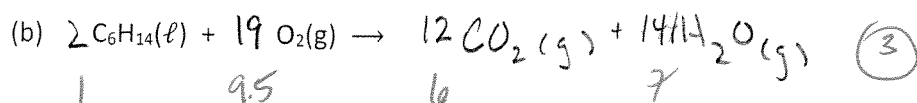
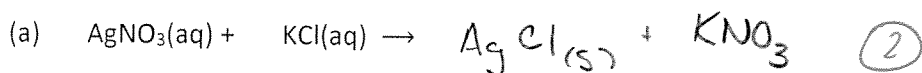


Exam #3—100 points

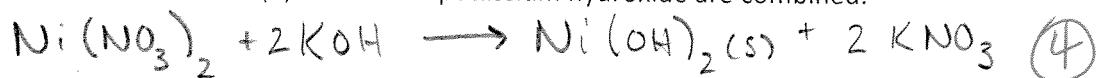
Directions: Answer each question below to the best of your ability. Show all work where calculations are required. Always indicate the states of all species when writing chemical reactions; if you do not indicate a state I will assume that you mean that the chemical is in an aqueous solution.

1. (26) Fill in the product(s) of each chemical reaction below, then balance the chemical equation. Write "no rxn." if you do not expect a reaction to occur.



2. (12) Write balanced chemical equations for each of the following reactions. Indicate all states. A reaction does occur in each case; do not write "no reaction."

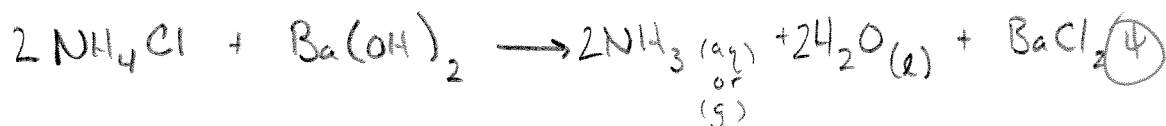
(a) Aqueous solutions of nickel (II) nitrate and potassium hydroxide are combined.



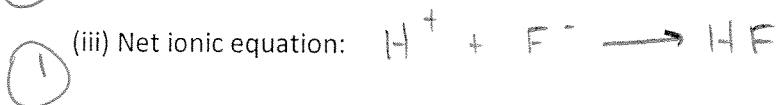
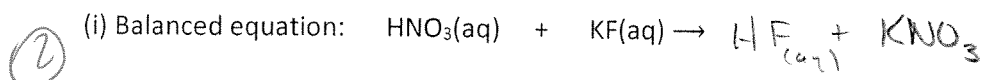
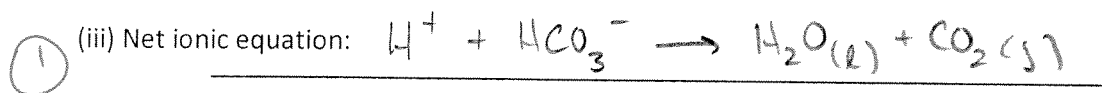
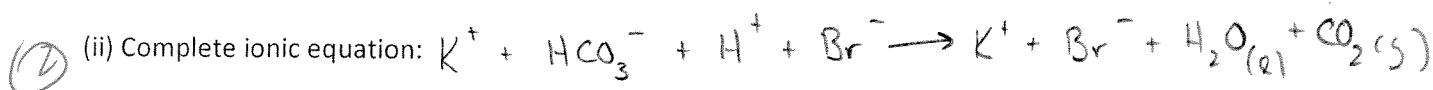
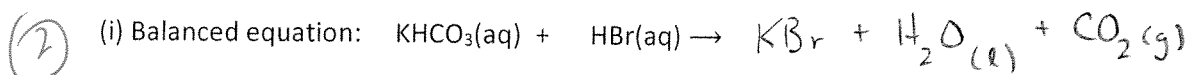
(b) Ethyl butyrate is a liquid which smells like pineapples and has molecular formula  $\text{C}_6\text{H}_{12}\text{O}_2$ . It is burned in air.



(c) Aqueous solutions of ammonium chloride and barium hydroxide are mixed together.



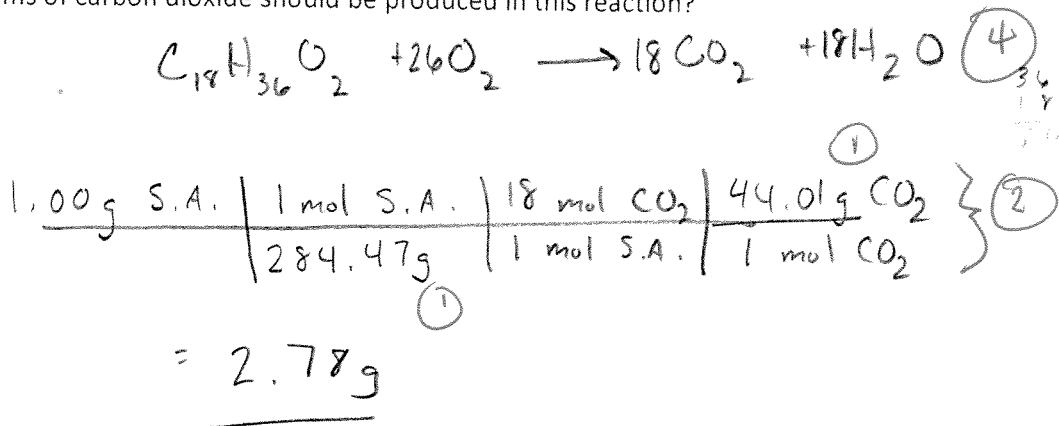
3. (10) For the reactions below, (i) complete and balance the chemical equation, (ii) provide a complete ionic equation, and (iii) write the net ionic equations. A reaction does occur in each case; do not write "no reaction."



4. (3) List the formulas of any three *weak* acids.

Varies:  $\text{HF}$ ,  $\text{HC}_2\text{H}_3\text{O}_2$ ,  $\text{H}_3\text{PO}_4$ ,  $\text{HCN}$ ,  $\text{H}_2\text{C}_2\text{O}_4$ , etc.

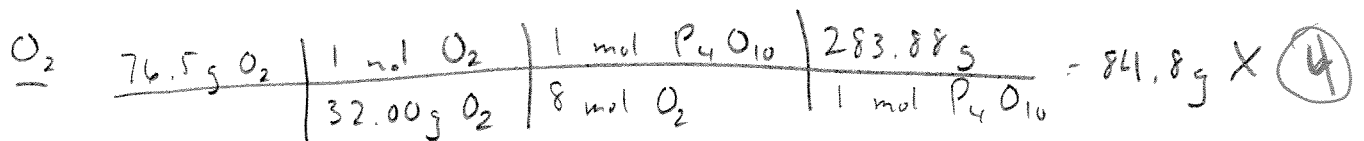
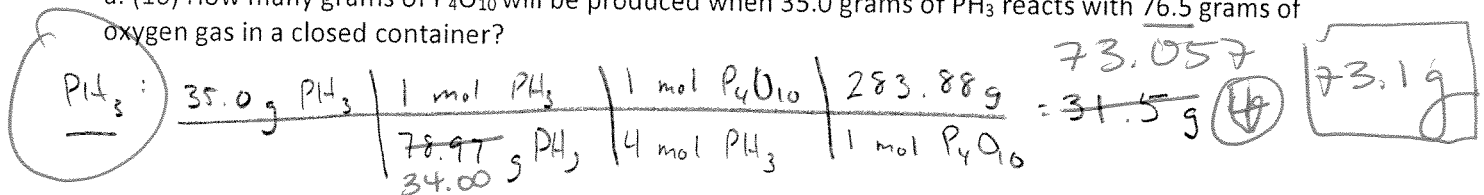
5. (8) Stearic acid is a fatty acid with formula  $C_{18}H_{36}O_2$  which is found in large concentrations in some high-fat foods. Suppose that a 1.00 gram sample of stearic acid is burned in excess oxygen. How many grams of carbon dioxide should be produced in this reaction?



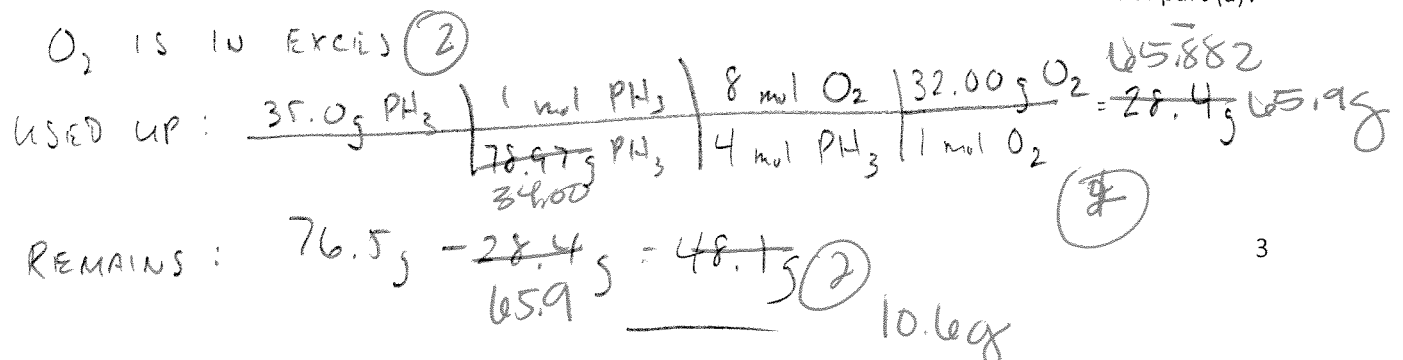
6. When phosphine gas combines with oxygen gas, tetraphosphorus decoxide and water are produced:



- a. (10) How many grams of  $P_4O_{10}$  will be produced when 35.0 grams of  $PH_3$  reacts with 76.5 grams of oxygen gas in a closed container?



- b. (6) Which reagent was in excess, and how many grams of it remain unreacted at the end of part (a)?



7. Suppose that a solution contains 100.00 grams of  $\text{MgCl}_2$  for every 2500. mL of solution.

a. (5) What is the molarity of the solution?

$$\frac{100.00 \text{ g MgCl}_2}{95.21 \text{ g}} \left| \frac{1 \text{ mol}}{95.21 \text{ g}} \right. = 1.050 \text{ mol} \quad (2)$$

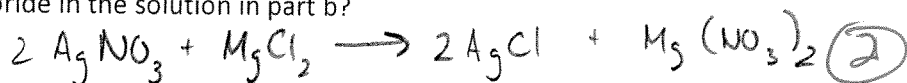
$$\text{Molarity} = \frac{1.050 \text{ mol}}{2.500 \text{ L}} = 0.4201 \text{ M} \quad (2)$$

b. (4) Suppose that 5.00 mL of this solution is added to 55.0 mL of water, forming a new solution. What is the molarity of this new solution?

$$M_1 V_1 = M_2 V_2$$

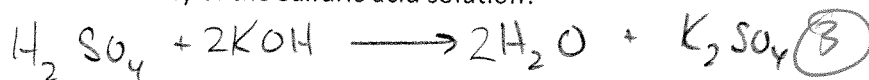
$$M_2 = \frac{M_1 \cdot V_1}{V_2} = \frac{(0.4201 \text{ M})(5.00 \text{ mL})}{(60.0 \text{ mL})} = 0.0350 \text{ M} \quad (2)$$

c. (6) How many milliliters of a 0.250 M  $\text{AgNO}_3$  solution would be needed to completely react with all the magnesium chloride in the solution in part b?



$$\frac{60.0 \text{ mL}}{1000 \text{ mL}} \left| \frac{0.0350 \text{ mol MgCl}_2}{1000 \text{ mL}} \right. \left| \frac{2 \text{ mol AgNO}_3}{1 \text{ mol MgCl}_2} \right. \left| \frac{1000 \text{ mL AgNO}_3}{0.250 \text{ mol AgNO}_3} \right. = 16.8 \text{ mL} \quad (2)$$

8. (10) To determine the concentration of a sulfuric acid ( $\text{H}_2\text{SO}_4$ ) solution, a chemist titrates it using a 0.3555 M potassium hydroxide solution. 22.45 mL of the KOH is required to completely neutralize 10.00 mL of the acid. What is the molarity of the sulfuric acid solution?



$$\frac{22.45 \text{ mL KOH}}{1000 \text{ mL KOH}} \left| \frac{0.3555 \text{ mol KOH}}{1000 \text{ mL KOH}} \right. \left| \frac{1 \text{ mol H}_2\text{SO}_4}{2 \text{ mol KOH}} \right. = 0.003990 \text{ mol} \quad (3)$$

$$\text{molarity} = \frac{0.003990 \text{ mol}}{0.01000 \text{ L}} = 0.3990 \text{ M} \quad (4)$$

