Chemical Equations v0.2
— Molecular, Net Ionic & Balanced Eqns
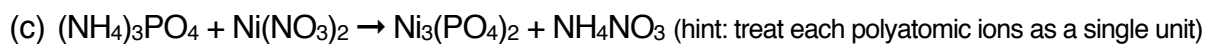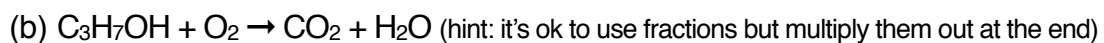
Name: _____

Student ID: _____

Date: _____

1. For each reaction below, write the chemical equation described and then balance that chemical equation. To show your work you must show at least one intermediate step in balancing the equation. You do not need to show the state of the substances.

(a) Solid ammonium nitrate is heated to release nitrogen gas, oxygen gas, and water vapor.

(b) Trihydrogen phosphide and magnesium chloride react to produce magnesium phosphide and hydrogen chloride.

(c) Perbromic acid reacts with tetraphosphorus decoxide to produce phosphoric acid and dibromine heptoxide.

2. Balance the following equations. To show your work you must show at least one intermediate step in balancing the equation. You do not need to show the state of the substances.

(a) $NO_2 + H_2O \rightarrow HNO_3 + NO$ (hint: balance H first, since they appear in only two molecules)

(b) $C_3H_7OH + O_2 \rightarrow CO_2 + H_2O$ (hint: it's ok to use fractions but multiply them out at the end)

(c) $(NH_4)_3PO_4 + Ni(NO_3)_2 \rightarrow Ni_3(PO_4)_2 + NH_4NO_3$ (hint: treat each polyatomic ions as a single unit)

3. Each aqueous mixture below undergoes a double displacement process and produces a chemical reaction. Products may include precipitates, water and insoluble gases. Predict the products and write the molecular equation (include appropriate state symbols).

Do not balance these equations.

(a) Aqueous solutions of magnesium chloride and lead (II) acetate, are mixed, a bright yellow solid appears in the solution.

(reminder: acetate ion may be written OAc^{1-} or CH_3COO^{1-})

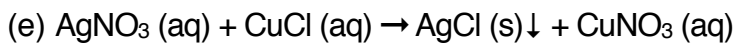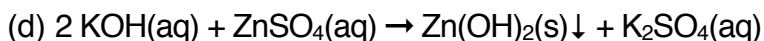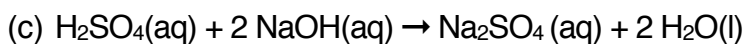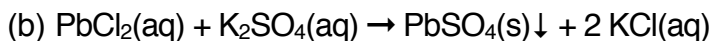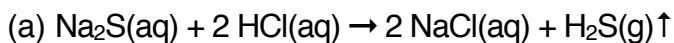(b) Solutions of aluminum nitrate and sodium phosphate are mixed. The solution becomes milky white.

(c) Nitric acid solution is added to a solution of sodium hydrogen carbonate. The solution begins to bubble.

(d) A solution of sulfuric acid is added to a solution of potassium hydroxide. The test tube becomes hot to the touch.

4. Write the balanced net ionic equation for each reaction.

Hint: to find the net ionic equation, rewrite the balanced molecular equation representing each soluble ionic compound (product and reactant) as dissociated ions. Put an X over each spectator ion. Whatever is left is the net ionic equation. Spectator ions will appear twice, once on each side of the equation.

(a) $Na_2S(aq) + 2\ HCl(aq) \rightarrow 2\ NaCl(aq) + H_2S(g)\uparrow$

(b) $PbCl_2(aq) + K_2SO_4(aq) \rightarrow PbSO_4(s)\downarrow + 2\ KCl(aq)$

(c) $H_2SO_4(aq) + 2\ NaOH(aq) \rightarrow Na_2SO_4\ (aq) + 2\ H_2O(l)$

(d) $2\ KOH(aq) + ZnSO_4(aq) \rightarrow Zn(OH)_2(s)\downarrow + K_2SO_4(aq)$

(e) $AgNO_3\ (aq) + CuCl\ (aq) \rightarrow AgCl\ (s)\downarrow + CuNO_3\ (aq)$

5. Given the following balanced equation, solve each stoichiometry problem below. Use dimensional analysis and show your calculation in each case.

$$3 \, NO_2 + H_2O \rightarrow 2 \, HNO_3 + NO$$

(a) If 21 molecules of nitrogen dioxide are consumed, how many molecules of nitrogen monoxide are produced?

(b) If 7.35 moles of nitric acid are produced, how many moles of water were consumed?

(c) If 2.54 moles of nitric acid are produced, how many molecules of nitrogen dioxide are consumed?

6. If 14.3 grams of sodium hydroxide are consumed in the following balanced equation, (a) how many moles of elemental phosphorous is consumed? (b) How many moles of individual phosphorus atoms are consumed?

$$3 \, NaOH + P_4 + 3 \, H_2O \rightarrow 3 \, NaH_2PO_2 + PH_3$$
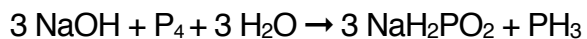
7. Given the following balanced equation, solve each stoichiometry problem below. Use dimensional analysis and show your calculation in each case.

$$4\ KClO_3 \rightarrow 3\ KClO_4 + KCl$$

(a) If 0.237 moles of potassium chloride is produced, how many grams of potassium chlorate would be consumed?

(b) If you decomposed 12.2 grams of potassium chlorate, how many grams of potassium perchlorate would be produced?

(c) To produce 6.15 grams of potassium chloride, how many grams of potassium perchlorate would you need?

8. How many moles of ferric hydroxide would be produced if 7.35 grams of ferric chloride and 4.42 grams of ammonium hydroxide were allowed to react. You are given the following balanced equation.

Hint: You will need to identify the limiting reactant to solve this problem.

$$FeCl_3 \ + \ 3\,NH_4OH \ \longrightarrow \ Fe(OH)_3 \ + \ 3\,NH_4Cl$$
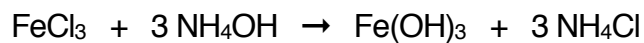
9. How many grams of water would be produced if 11.5 grams of silicon dioxide and 19.6 grams of hydrogen fluoride were allowed to react. You are given the following balanced equation.

$$SiO_2 \ + \ 4\,HF \ \longrightarrow \ SiF_4 \ + \ 2\,H_2O$$
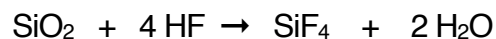
10. Iron and elemental sulfur react to make iron (III) sulfide. If I have 20.0 grams of each, (a) which is the limiting reagent? (b) How much of the excess reagent is left over?

$$16\ Fe\ +\ 3\ S_8\ \rightarrow\ 8\ Fe_2S_3$$
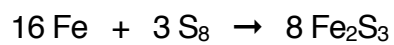
11. Tetraphosphorus decoxide and water react to form phosphoric acid. If you have 10.2 grams of tetraphosphorus decoxide and 4.75 grams of water, what would be your theoretical yield? If you conducted this experiment and got an actual yield of 12.1 grams phosphoric acid, what is your percent yield?

$$P_4O_{10} \ + \ 6 \, H_2O \ \rightarrow \ 4 \, H_3PO_4$$