CST —

em 3a, 3b, 3d

Sticks & Stones

Chemcatalyst:

Q: What do the coefficients mean? Why are they important?
Q: Do you think 1.0g of CaI_2 & 1.0g of $Na_2C_2O_4$ will make 1.0g of $CaC_2O_4(s)$?

precipitate

$$CaI_2(aq) + Na_2C_2O_4(aq) \rightarrow CaC_2O_4(s) + 2\,NaI(aq)$$

Q: How many moles is 1.0g CaI_2? $Na_2C_2O_4$?

Notes:

- What is a precipitate?
  - a solid that is formed from the rxn of 2 liquids
- What do the coefficients in the chemical equations stand for?
  - * the # of MOLES of a substance that is taking part in the chemical rxn
  - ex: $CaI_2(aq) + Na_2C_2O_4(aq) \rightarrow CaC_2O_4(s) + 2NaI(aq)$ (precipitate)
    - in this chemical rxn: 1 mole of CaI_2 reacts w/ 1 mole of $Na_2C_2O_4$ to produce 1 mole of CaC_2O_4 & 2 moles of NaI.
  - these coefficients will give you the mole ratio of reactants & products
    - ex: mole ratio of CaI_2 to NaI? 1:2
    - ex: mole ratio of $Na_2C_2O_4$ to CaC_2O_4? 1:1

Student Worksheet

Sticks and Stones

Name: _____

Period:_____ Date: _____

Purpose: You will determine what ratio of reactants gives the maximum amount of products.

Procedure: Calcium oxalate – kidney stones

1. Label five small test tubes with numbers from 1 to 5.
2. Add 2 drops, 4 drops, 6 drops, 8 drops, and 10 drops of 0.10 M $CaCl_2$ to Test tubes #1, #2, #3, #4, and #5 as indicated in the table below.
3. Add 10 drops, 8 drops, 6 drops, 4 drops, and 2 drops of 0.10 M $Na_2C_2O_4$ to Test tubes #1, #2, #3, #4, and #5 as indicated in the table below.
4. Shake each test tube gently in order to mix the reactants.
5. Allow the precipitate to settle for about 10-15 minutes.
6. While you are waiting for the precipitates to settle, complete the table, and answer questions 1–3.

Calcium oxalate – kidney stones

Test tube #	1	2	3	4	5
Drops of 0.1 M $CaCl_2$	2	4	6	8	10
Drops of 0.1 M $Na_2C_2O_4$	10	8	6	4	2
$CaCl_2$: $Na_2C_2O_4$	1:5	1:2	1:1	2:1	5:1

Procedure: Calcium phosphate – bones

1. Label four small test tubes with numbers from 6 to 9.
2. Add 2 drops, 4 drops, 6 drops, and 8 drops of 0.10 M $CaCl_2$ to Test tubes #6, #7, #8, and #9 as indicated in the table below.
3. Add 8 drops, 6 drops, 4 drops, and 2 drops of 0.10 M Na_3PO_4 to Test tubes #6, #7, #8, and #9 as indicated in the table below.
4. Shake each test tube gently in order to mix the reactants.
5. Allow the precipitate to settle for about 10-15 minutes.
6. While you are waiting for the precipitates to settle, complete the table, and answer questions 1–3.

Calcium phosphate – bones

Test tube #	6	7	8	9
Drops of 0.1 M $CaCl_2$	2	4	6	8
Drops of 0.1 M Na_3PO_4	8	6	4	2
$CaCl_2$: Na_3PO_4	1:4	2:3	3:2	4:1

Answer the following questions:

1. Suppose you add 1 drop of 0.1 M $CaCl_2$ (aq) and 1 drop of 0.1 M $Na_2C_2O_4$ (aq) to a well.
   a) Have you added equal moles of the two substances? Explain your thinking.
   Yes mol = M x L (volume) which is same for both
   b) Have you added equal grams of the two substances? Explain your thinking.
   No they weigh different

2. Analyze the reaction between calcium chloride and sodium oxalate:
   a) Write the balanced equation for the reaction of calcium chloride, $CaCl_2$ (aq), with sodium oxalate, $Na_2C_2O_4$ (aq), to produce calcium oxalate, CaC_2O_4 (s), and sodium chloride, NaCl (aq).

$$CaCl_2 + Na_2C_2O_4 \rightarrow CaC_2O_4 + 2NaCl$$

   b) What is the white precipitate in this reaction? CaC_2O_4
   c) Use the balanced equation to predict the ratio of $CaCl_2$ (aq) to $Na_2C_2O_4$ (aq) that will produce the maximum volume of CaC_2O_4 (s). 1:1

3. Analyze the reaction between calcium chloride and sodium phosphate:
   a) Write the balanced equation for the reaction of calcium chloride, $CaCl_2$ (aq), with sodium oxalate, Na_3PO_4 (aq), to produce calcium oxalate, $Ca_3(PO_4)_2$ (s), and sodium chloride, NaCl (aq).

$$3CaCl_2 + 2Na_3PO_4 \rightarrow Ca_3(PO_4)_2 + 6NaCl$$

   b) What is the white precipitate in this reaction? $Ca_3(PO_4)_2$
   c) Use the balanced equation to predict the ratio of $CaCl_2$ (aq) to Na_3PO_4 (aq) that will produce the maximum volume of $Ca_3(PO_4)_2$ (s). 3:2

5. After the precipitates have settled (approx 10 to15 minutes), look at the test tubes at eye level on your bench to identify the one with the largest volume of precipitate for CaC_2O_4 and $Ca_3(PO_4)_2$. Circle the ratio that gave the largest volume for each in the two tables. 1:1 3:2

6. How do the ratios you predicted from the two balanced equations above compare with your observations from the experiment? Same

Making sense:
Explain how you can use the coefficients in the balanced chemical equation to determine the ratio of reactants that will produce the maximum amount of product.

If you finish early…
Suppose you reacted calcium chloride, $CaCl_2$ (aq), with sodium oleate, $NaC_{18}H_{33}O_2$ (aq). What product do you expect? What ratio of drops would give you the largest volume of precipitate? (Note: The product is calcium oleate, commonly referred to as soap scum.)

Making Sense Notes:

- What else do the coefficients of chemical rxns tell you?

- tell you the # of moles NOT the mass or volume
- also tells you the MOLAR RATIO: the ratio of reactants that give the maximum product
  - ex: $2Na + Cl_2 \rightarrow 2NaCl$
    a 2:1 ratio of $Na:Cl_2$ gives the maximum product

Check-In

Q: Balance & tell the ratio of reactants that give the max product.

$3AgNO_3 + Na_3PO_4 \rightarrow Ag_3PO_4 + 3NaNO_3$

D. 3:1