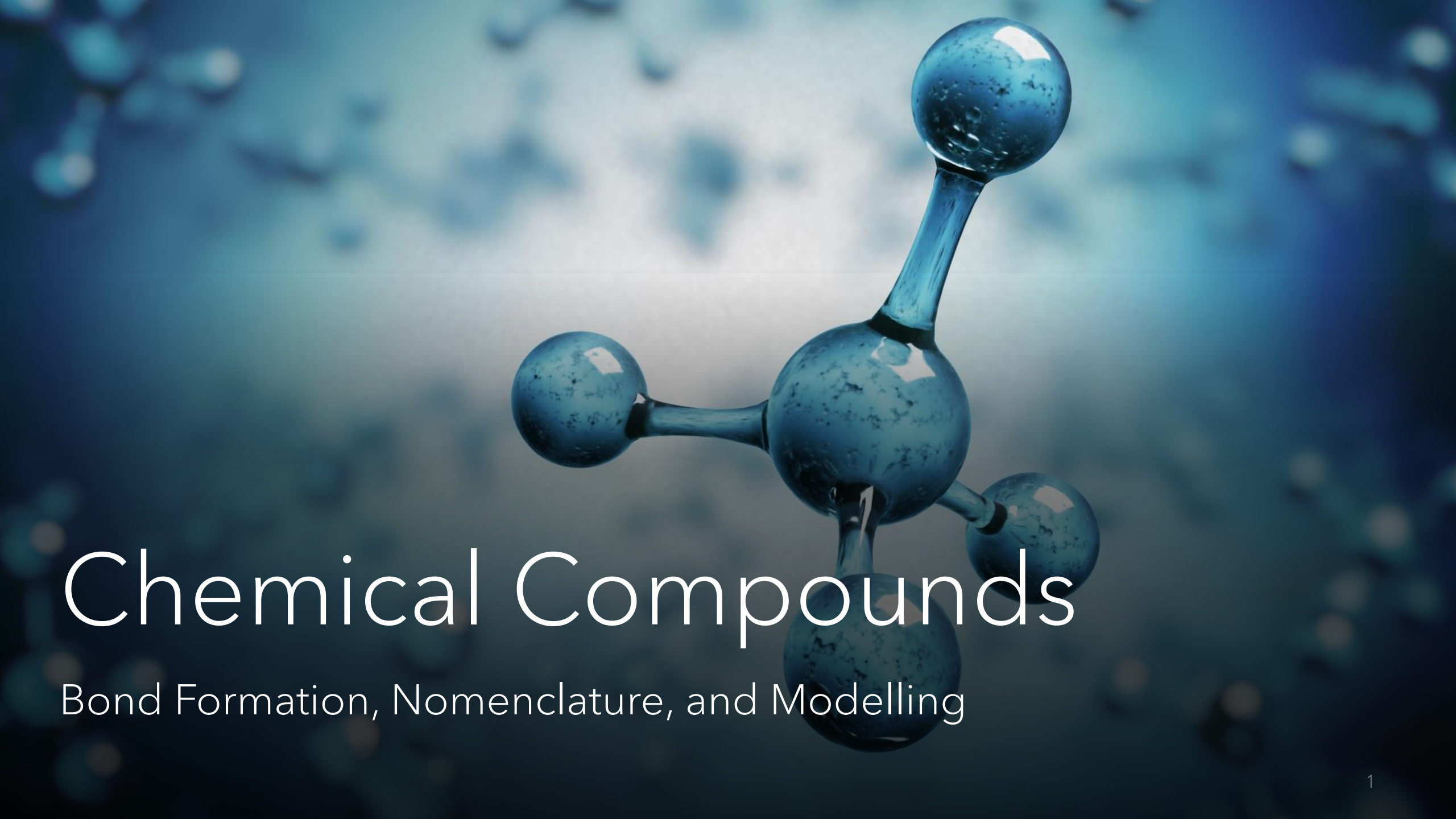

Chemical Compounds

Bond Formation, Nomenclature, and Modelling

Overview

Review: atoms and subatomic particles, ions

Modelling Atoms and Compounds

- Counting Atoms
- Bohr Models
- Lewis Diagrams

IUPAC Naming and Writing Formulas

Balanced Chemical Equations

Section 4: Balancing Chemical Equations

(textbook pgs 125-133)

Chemical Equation Vocabulary

Reactants: what **goes into** the reaction; on the **left side** of reaction arrow

Products: what **comes out** of the reaction; on the **right side** of reaction arrow

$$Zn + HCl \rightarrow ZnCl_2 + H_2$$

Chemical Equation Vocabulary

Word equation: uses **words** to describe reactants and products

$$\text{zinc} + \text{hydrogen chloride} \rightarrow \text{zinc chloride} + \text{hydrogen}$$

Skeleton equation: uses **chemical formulas** to describe reactants and products

$$Zn + HCl \rightarrow ZnCl_2 + H_2$$

Tip: When converting between word and skeleton equations, remember your diatomic elements!

Chemical Reaction Vocabulary

Balanced chemical equation: uses **coefficients** and chemical formulas to describe reactants and products in their correct **proportions**

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

Chemical Reaction Vocabulary (FYI only)

In chemical equations, you will sometimes see information about the state that a chemical substance is in.

E.g. $2Mg_{(s)} + O_{2(g)} \rightarrow 2MgO_{(s)}$

(g): Gas

(l): Liquid

(s): Solid

(aq): Aqueous solution (substance is dissolved in water)

Fruit Tart Case Study

You are making fruit tarts for a party. You have a certain number of each ingredient. How many tarts can you make? What is left over?

https://www.mypetitejoys.com/no-bake-blackberry-mini-tarts/ https://leaf.nutrisystem.com/recipes/skinny-mini-fruit-tart/ https://www.youtube.com/watch?v=mfGNSkXOUHo

Fruit Tart Case Study

You are making fruit tarts for a party. Unfortunately, after you are finished, you see an Instagram picture that makes you want to rearrange your fruit tarts. You need 3 finished raspberry/blackberry tarts in total. How many of each tart will you start with? What will you be left with?

6 raspberries each

+

1 blackberry each

→

2 raspberries +
1 blackberry each

https://www.mypetitejoys.com/no-bake-blackberry-mini-tarts/ https://leaf.nutrisystem.com/recipes/skinny-mini-fruit-tart/ https://www.youtube.com/watch?v=mfGNSkXOUHo

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+

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→

2 raspberries +
1 blackberry each

+

fruitless tart

Discuss: approaches and strategies in completing this problem

https://www.mypetitejoys.com/no-bake-blackberry-mini-tarts/

https://leaf.nutrisystem.com/recipes/skinny-mini-fruit-tart/

https://veenaazmanov.com/homemade-mini-tart-shells/

https://www.youtube.com/watch?v=mfGNSkXOUHo

Fruit Tart Case Study

6 raspberries each

+

1 blackberry each

→

2 raspberries +
1 blackberry each

+

fruitless tart

$$\underline{1}\ Rb_6T + \underline{3}\ BbT \rightarrow \underline{3}\ Rb_2BbT + \underline{1}\ T$$

Legend
Rb = "raspberry" element
Bb = "blackberry" element
T = "tart" element

Follow-up: Now, suppose that you need 12 tarts instead of 3. How many raspberry and blackberry tarts do you start with?

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Balancing Chemical Equations

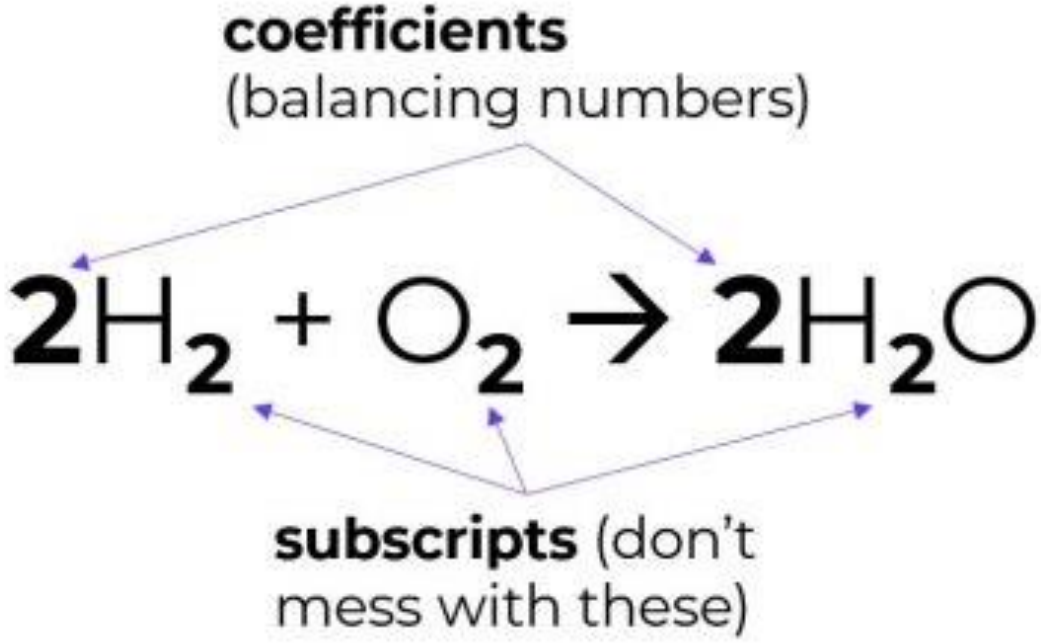
Why balance?

- Chemical "recipes": how much do you put in? how much do you expect to yield?
- **Conservation of mass**: no atoms are ever created or destroyed

https://www.budgetbytes.com/

Balancing Chemical Equations: Vocabulary

Balancing chemical formulas involves adding **coefficients** in front of elements and compounds until ***the total number of atoms of each element in the reactants equals the products***.



Balancing Chemical Equations: Vocabulary

Balancing chemical formulas involves adding **coefficients** in front of elements and compounds until ***the total number of atoms of each element in the reactants equals the products***.

Reactants: what goes into the reaction

Products: what comes out of the reaction

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

PhET Simulation

https://phet.colorado.edu/sims/html/balancing-chemical-equations/1.1.0/balancing-chemical-equations_en.html

Google: “Phet Balancing”

- Do Introduction first
- Move on to Game and progress through the levels when you are ready
- Discuss strategies you used.

Balancing Chemical Equations: Tips

- **Goal: the number of atoms of each element in the reactants equals the products.**
- Change coefficients only. Never add or change subscripts.
- Balance atoms in compounds first. Save elements for last.
- If the same **polyatomic ion** appears in the reactants *and* products, you can often treat it as a **group of atoms** instead of splitting it up.
- At the end, reduce all coefficients to lowest whole-number terms.
- Note: **Do not write a coefficient** if there is only **"1"** of that element or compound.

Balancing can be frustrating at first. Practice, practice, practice!

Balancing Examples (easy)

1. ___ N_2 + 3 H_2 → 2 NH_3

Note: Do not write a coefficient if there is only "1" of that element or compound.

2. 2 NaCl + ___ F_2 → 2 NaF + ___ Cl_2

3. 2 Ag_2O → 4 Ag + ___ O_2

4. 4 P + 5 O_2 → 2 P_2O_5

Balancing Examples (medium)

Treat polyatomic ions as groups if they appear in reactants and products (e.g. #2 & #3 but not #5)

5. 2 $NaBr + \_\_\_ CaF_2 \rightarrow$ 2 $NaF + \_\_\_ CaBr_2$

6. ___ $FeCl_3$ + 3 $NaOH \rightarrow$ ___ $Fe(OH)_3$ + 3 $NaCl$

7. ___ H_2SO_4 + 2 $NaNO_2 \rightarrow$ 2 HNO_2 + ___ Na_2SO_4

8. 6 CO_2 + 6 $H_2O \rightarrow$ ___ $C_6H_{12}O_6$ + 6 O_2

9. 2 $HCl + \_\_\_ CaCO_3 \rightarrow$ ___ $CaCl_2$ + ___ H_2O + ___ CO_2

Balancing Examples (hard)

10. ___ C_3H_8 + 5 O_2 → 3 CO_2 + 4 H_2O

11. 2 C_6H_{14} + 19 O_2 → 12 CO_2 + 14 H_2O

12. 2 C_8H_{18} + 25 O_2 → 16 CO_2 + 18 H_2O

Make sure to balance the element (O_2) last!

Trick for Combustion Reactions (e.g. #10-12)

1. Balance every atom except oxygen.

$$\_\_\_C_6H_{14} + \_\_\_ O_2 \rightarrow \underline{6}\ CO_2 + \underline{7}\ H_2O$$

2. Find out how many oxygen atoms you need the $\_\_O_2$ to contribute. Divide that number by 2. This is your *temporary* coefficient for O_2.

$$\_\_\_C_6H_{14} + \frac{19}{2}\ O_2 \rightarrow \underline{6}\ CO_2 + \underline{7}\ H_2O$$

$6CO_2$ has 12 oxygen atoms. $7H_2O$ has 7 oxygen atoms. In total, there are 19 oxygen atoms in the products.

3. You are not allowed to have fractional coefficients in your final answer. Multiply all the coefficients by 2.

$$\underline{2}\ C_6H_{14} + \underline{19}\ O_2 \rightarrow \underline{12}\ CO_2 + \underline{14}\ H_2O$$

Resources

- Naming and Writing Chemical Formulas
  - Tyler DeWitt Videos https://www.youtube.com/user/tdewitt451/videos
  - Mr. Carman's Blog (generates quizzes) https://www.kentschools.net/ccarman/cp-chemistry/practice-quizzes/compound-naming/
  - Mr. Eisley (list of other resources to practice http://www.mreisley.com/nomenclature-practice.html
  - ChemFiesta (worksheets with answers) https://chemfiesta.org/2015/01/13/naming-worksheets/
- Balancing Chemical Equations
  - TemplateLAB (explanations and many worksheets with answers) https://templatelab.com/balancing-equations-worksheet/