11 Chemical Reactions Practice Problems

MASTERING CHEMISTRY: 11 CHEMICAL REACTIONS PRACTICE PROBLEMS TO SHARPEN YOUR SKILLS

Chemistry often feels like a foreign language to many students. Between the symbols, equations, and balancing acts, it is easy to feel overwhelmed. Yet, understanding how substances interact is fundamental to everything from cooking to medicine. The most effective way to move beyond confusion is through active recall and consistent application. Working through dedicated **11 Chemical Reactions Practice Problems** is a proven strategy to solidify your grasp of reaction types, balancing techniques, and stoichiometric calculations. This guide moves beyond theory, placing you directly in the driver's seat of your own learning. Let us transform abstract concepts into tangible skills.

Before we dive into the specific problems, it helps to understand why targeted practice is so effective. Chemistry is not a spectator sport. You cannot learn to balance equations by simply watching a video or reading a textbook. You must engage with the material, make mistakes, and correct your course. The following set of problems covers synthesis, decomposition, single replacement, double replacement, and combustion reactions. By the end, you will not only have solved eleven distinct equations but will also have developed a sharper intuition for predicting products and conserving mass. Each problem is designed to challenge a different aspect of reaction chemistry, ensuring a well-rounded review.

Understanding the Core Reaction Types

To approach these **11 Chemical Reactions Practice Problems** with confidence, you must first recognize the five major categories. Each type follows a predictable pattern, which allows you to anticipate the products before you ever touch a coefficient.

- **Synthesis (Combination):** Two or more simple substances combine to form a more complex product. The general form is A + B → AB. An example is the formation of water from hydrogen and oxygen gas.
- **Decomposition:** A single compound breaks down into two or more simpler substances. The general form is AB → A + B. Electrolysis of water into hydrogen and oxygen is a classic example.
- **Single Replacement:** One element replaces another element in a compound. The general form is A + BC → AC + B. This often involves metals reacting with acids or salt solutions.
- **Double Replacement:** Ions in two compounds exchange places to form two new compounds. The general form is AB + CD → AD + CB. These reactions frequently occur in aqueous solutions and often produce a precipitate, gas, or water.
- **Combustion:** A hydrocarbon or other fuel reacts with oxygen gas, producing carbon dioxide and water (complete combustion). The general form is $C_xH_y + O_2 \rightarrow CO_2 + H_2O$.

Keeping these patterns in mind will make the following practice problems significantly more manageable. As you work through each one, try to classify it first. Identification is half the battle.

THE 11 CHEMICAL REACTIONS PRACTICE PROBLEMS: STEP-BY-STEP SOLUTIONS

Below are eleven carefully selected problems. For each, I provide the initial reactants and then guide you through the reasoning required to balance the equation correctly. Attempt to write the balanced equation on your own before reading the solution. This active approach dramatically improves retention.

Problem 1: Synthesis of Magnesium Oxide

Reactants: Mg (solid) + O_2 (gas) → ?

Your Turn: Predict the product and balance the equation.

Solution: Magnesium is a metal from group 2, so it forms a +2 cation. Oxygen typically forms a -2 anion. Therefore, the product is MgO. However, we must account for the diatomic nature of oxygen gas. The unbalanced equation is $Mg + O_2 \rightarrow MgO$. To balance, place a coefficient of 2 in front of MgO to get 2 oxygen atoms on the right. Then, place a coefficient of 2 in front of Mg on the left. The final balanced equation is $\mathbf{2Mg + O_2 \rightarrow 2MgO}$. This is a classic synthesis reaction.

Problem 2: Decomposition of Hydrogen Peroxide

Reactants: H_2O_2 (liquid) → ?

Your Turn: What are the decomposition products of hydrogen peroxide?

Solution: Hydrogen peroxide decomposes into water and oxygen gas. The unbalanced equation is $H_2O_2 \rightarrow H_2O + O_2$. Notice that oxygen is unbalanced. On the left, we have two oxygen atoms. On the right, we have three (one in H_2O and two in O_2). To balance, place a coefficient of 2 in front of H_2O_2 and a coefficient of 2 in front of H_2O. This gives 4 hydrogen atoms and 4 oxygen atoms on the left, and 4 hydrogen and 4 oxygen atoms on the right. However, the O_2 now has 2 oxygen atoms, and the $2H_2O$ has 2 oxygen atoms, totaling 4. Wait, let's re-evaluate. $2H_2O_2 \rightarrow 2H_2O + O_2$. Left: 4 H, 4 O. Right: 4 H (from $2H_2O$) and 2 O (from $2H_2O$) + 2 O (from O_2) = 4 H, 4 O. Correct. The balanced equation is $\mathbf{2H_2O_2 \rightarrow 2H_2O + O_2}$.

Problem 3: Single Replacement of Copper

Reactants: Zn (solid) + $CuSO_4$ (aqueous) → ?

Your Turn: Which element will replace which, and what are the products?

Solution: Zinc is more reactive than copper according to the activity series. Therefore, zinc will replace copper in the compound. The products are zinc sulfate ($ZnSO_4$) and solid copper (Cu). The equation is $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$. Notice that sulfate ($SO_4$) is a polyatomic ion and remains intact. The equation is already balanced. This is a single replacement reaction: $\mathbf{Zn + CuSO_4 \rightarrow ZnSO_4 + Cu}$.

Problem 4: Single Replacement of Hydrogen

Reactants: Fe (solid) + HCl (aqueous) → ?

Your Turn: Iron typically forms Fe^{2+} or Fe^{3+}. Assume iron(II) for this reaction.

Solution: Iron is more reactive than hydrogen, so it will replace hydrogen in hydrochloric acid. The products are iron(II) chloride ($FeCl_2$) and hydrogen gas (H_2). The unbalanced equation is $Fe + HCl \rightarrow FeCl_2 + H_2$. To balance, we need two chlorine atoms on the right, so place a coefficient of 2 in front of HCl. This also gives 2 hydrogen atoms, which matches H_2. The balanced equation is $\mathbf{Fe + 2HCl \rightarrow FeCl_2 + H_2}$.

Problem 5: Double Replacement: Formation of a Precipitate

Reactants: $BaCl_2$ (aqueous) + Na_2SO_4 (aqueous) → ?

Your Turn: Predict the products and identify any precipitate. Use solubility rules.

Solution: In a double replacement, the cations and anions exchange partners. Barium (Ba^{2+}) pairs with sulfate (SO_4^{2-}) to form barium sulfate ($BaSO_4$). Sodium (Na^+) pairs with chloride (Cl^-) to form sodium chloride (NaCl). According to solubility rules, $BaSO_4$ is insoluble (it forms a white precipitate), while NaCl is soluble. The unbalanced equation is $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + NaCl$. To balance, note that there are two sodium atoms and two chlorine atoms on the left. Place a coefficient of 2 in front of NaCl. The balanced equation is $\mathbf{BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl}$. This is a great example of a precipitation reaction.

Problem 6: Double Replacement: Formation of a Gas

Reactants: HCl (aqueous) + $NaHCO_3$ (aqueous) → ?

Your Turn: This is the classic baking soda and vinegar reaction. What products form?

Solution: The initial exchange would give H_2CO_3 (carbonic acid) and NaCl. However, carbonic acid is unstable and decomposes into water and carbon dioxide gas. The overall reaction is $HCl + NaHCO_3 \rightarrow NaCl + H_2O + CO_2$. Check balancing: Left: 1 H, 1 Cl, 1 Na, 1 C, 3 O. Right: 1 Na, 1 Cl, 1 C, and from H_2O (2 H, 1 O) plus CO_2 (1 C, 2 O) gives 2 H, 3 O. Wait, hydrogen is off. Left has 1 H (from HCl) plus 1 H (from $NaHCO_3$) = 2 H. Right has 2 H (from H_2O). So hydrogen is balanced. Oxygen: left has 3 O (from $NaHCO_3$). Right has 1 O (from H_2O) plus 2 O (from CO_2) = 3 O. Everything is balanced. The balanced equation is $\mathbf{HCl + NaHCO_3 \rightarrow NaCl + H_2O + CO_2}$.

Problem 7: Complete Combustion of Methane

Reactants: CH_4 (gas) + O_2 (gas) → ?

Your Turn: Write the balanced equation for the complete combustion of methane.

Solution: Complete combustion of a hydrocarbon yields carbon dioxide and water. The unbalanced equation is $CH_4 + O_2 \rightarrow CO_2 + H_2O$. Balance carbon first: 1 carbon on each side, set. Balance hydrogen: 4 hydrogen on left, so place a coefficient of 2 in front of H_2O. This gives 4 hydrogen on right. Now oxygen: left has 2 oxygen atoms, right has 2 (from CO_2) + 2 (from $2H_2O$) = 4 oxygen atoms. Place a coefficient of 2 in front of O_2. The balanced equation is $\mathbf{CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O}$.

Problem 8: Combustion of Propane

Reactants: C_3H_8 (gas) + O_2 (gas) → ?

Your Turn: Balance the combustion of propane, a common fuel.

Solution: The products are CO_2 and H_2O. $C_3H_8 + O_2 \rightarrow CO_2 + H_2O$. Balance carbon: 3 carbons on left, so $3CO_2$ on right. Balance hydrogen: 8 hydrogens on left, so $4H_2O$ on right. Now count oxygen: right has 3×2 = 6 from CO_2 plus 4×1 = 4 from H_2O, total 10 oxygen atoms. Left has O_2, so we need $5O_2$. The balanced equation is $\mathbf{C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O}$.

Problem 9: Decomposition of Calcium Carbonate

Reactants: $CaCO_3$ (solid) → ? (with heat)

Your Turn: When limestone is heated strongly, it decomposes. What are the products?

Solution: Calcium carbonate decomposes into calcium oxide (quicklime) and carbon dioxide gas. The unbalanced equation is $CaCO_3 \rightarrow CaO + CO_2$. Notice that one calcium, one carbon, and three oxygen atoms are on each side. The equation is already balanced. This is a thermal decomposition reaction: $\mathbf{CaCO_3 \rightarrow CaO + CO_2}$.

Problem 10: Synthesis of Ammonia

Reactants: N_2 (gas) + H_2 (gas) → ?

Your Turn: This is the Haber process, essential for fertilizer production.

Solution: The product is ammonia (NH_3). The unbalanced equation is $N_2 + H_2 \rightarrow NH_3$. Balance nitrogen first: 2 nitrogen on left, so $2NH_3$ on right. This gives 6 hydrogen atoms on right. Place a coefficient of 3 in front of H_2 on left. The balanced equation is **N**