Balancing Chemical Equations

- In balancing a **chemical equation**, start with the **compound** with the greatest diversity of **atoms**, and balance pure **elements** last; when there is not an obvious starting point, begin with the first compound.
- In a balanced chemical equation, all coefficients must be whole numbers and the number of atoms of each type of element must be the same on both sides of the equation.

$\_KO_2(s) + \_CO_2(g) + \_H_2O(g) \rightarrow \_KHCO_3(s) + \_O_2(g)$	Rules to balance a chemical equation: 1. Start with the compound with the greatest diversity of atoms and put a coefficient of 1 in front of H. 2. Leave pure elements for last. 3. If rule 1 does not indicate where to start, begin with the first compound. Apply rule 1 and start with the first compound on the right side, potassium bicarbonate ($KHCO_3$). Place a "1" before it.
$1KO_2(s) + \_CO_2(g) + \_H_2O(g) \rightarrow 1KHCO_3(s) + \_O_2(g)$	Because only one other species on either the right or left hand side contains K, C, or H, the number of atoms of each is now uniquely determined. Balance the potassium atoms by placing a "1" in front of the potassium dioxide (KO_2). Balance the carbon atoms by doing the same for carbon dioxide (CO_2).
$1KO_2(s) + 1CO_2(g) + \frac{1}{2}H_2O(g) \rightarrow 1KHCO_3(s) + \_O_2(g)$ H atoms: $\frac{1}{2} \cdot 2 = 1 \quad 1 \cdot 1 = 1$	Next, balance the hydrogen atoms by putting a "½" in front of the water molecule. Remember that we are balancing for numbers of atoms of each element.
$1KO_2(s) + 1CO_2(g) + \frac{1}{2}H_2O(g) \rightarrow 1KHCO_3(s) + xO_2(g)$ $2 + 2 + \frac{1}{2} = 3 + 2x$ $4\frac{1}{2} = 3 + 2x$ $1\frac{1}{2} = 2x$ $\frac{3}{4} = x$	Balance the number of oxygen atoms on both sides. To do this, set the coefficient of O_2 to x and solve for it algebraically. The final rules are: 4. All coefficients must be whole numbers, which may require multiplying through by the least common multiple to remove fractions. 5. The number of atoms of each element must be balanced on both sides.
$4KO_2(s) + 4CO_2(g) + 2H_2O(g) \rightarrow 4KHCO_3(s) + 3O_2(g)$	Following rule 4, multiply the entire equation by the lowest common multiple, in this case the "4" in the denominator of the coefficient for O_2. As a final step, verify that the number of atoms of each element balance (rule 5).