

BALANCING REDOX REACTIONS

STEP BY STEP IN TWO WAYS...



BOTH START THE SAME WAY

1. ASSIGN OXIDATION NUMBERS TO EACH ATOM



NOTE: OXIDATION NUMBERS SUM UP TO ZERO EVERYWHERE

2. IDENTIFY THE OXIDATION AND REDUCTION HALF-REACTIONS

3. BALANCE EACH HALF-REACTION SEPARATELY

4. REVERSE YOUR EQUATION AND THE HALF-REACTIONS BALANCING ALL ATOMS INVOLVED IN IT

NOTE: REVERSE IT! + BECOMES - AND VICE-VERSA

OXIDATION: $\text{Fe}^{2+} \longrightarrow \text{Fe}^{3+}$

REDUCTION: $\text{SO}_4^{2-} \longrightarrow \text{SO}_2$

HALF-REACTION METHOD (in acidic conditions)

5. BALANCE OXIDATION

$\text{Fe}^{2+} \longrightarrow \text{Fe}^{3+} + 1\text{e}^-$

$\text{Fe}^{2+} + \text{SO}_4^{2-} \longrightarrow \text{SO}_2$

6. BALANCE REDUCTION

$10\text{H}^+ + \text{SO}_4^{2-} \longrightarrow \text{SO}_2 + 2\text{H}_2\text{O}$

$\text{Fe}^{2+} + \text{SO}_4^{2-} \longrightarrow \text{SO}_2 + 10\text{H}^+$

7. BALANCE CHARGES WITH ELECTRONS

NOTE: BALANCE CHARGES FIRST BY ADDING H⁺ AND THEN BALANCE THE ATOMS

$\text{Fe}^{2+} + 10\text{H}^+ + \text{SO}_4^{2-} \longrightarrow \text{SO}_2 + 10\text{H}^+ + \text{Fe}^{3+}$

$-2 + 10 - 2 = 0$

$\text{Fe}^{2+} + \text{SO}_4^{2-} \longrightarrow \text{SO}_2 + 10\text{H}^+ + \text{Fe}^{3+}$

$-2 = 0 + 10 - 2 = 8$

8. MAKE SURE THE NUMBER OF ELECTRONS IS THE SAME

NOTE: YOU CAN BALANCE EACH HALF-REACTION SEPARATELY UNDER ANY CONDITIONS

$\text{Fe}^{2+} + 10\text{H}^+ + \text{SO}_4^{2-} \longrightarrow \text{SO}_2 + 10\text{H}^+ + \text{Fe}^{3+} \quad \times 2$

$\text{Fe}^{2+} + \text{SO}_4^{2-} \longrightarrow \text{SO}_2 + 10\text{H}^+ + \text{Fe}^{3+} \quad \times 2$

9. PUT BOTH REACTIONS BACK TOGETHER

$2\text{Fe}^{2+} + 2\text{SO}_4^{2-} + 2\text{H}^+ + 10\text{H}^+ + 2\text{Fe}^{3+} \longrightarrow$

$2\text{Fe}^{3+} + 10\text{H}^+ + 2\text{SO}_2 + 10\text{H}^+ + 2\text{Fe}^{3+}$

10. CHECK FOR ANYTHING THAT IS BOTH A PRODUCT AND REACTANT

NOTE: SOME REACTIONS CAN BE DONE WITH ANY OTHER IONS

$2\text{Fe}^{2+} + 2\text{SO}_4^{2-} + 2\text{H}^+ + 10\text{H}^+ + 2\text{Fe}^{3+} \longrightarrow$

$2\text{Fe}^{3+} + 10\text{H}^+ + 2\text{SO}_2 + 10\text{H}^+ + 2\text{Fe}^{3+}$



BUT WHAT ABOUT BASIC CONDITIONS?

WHEN WE SAY "ACIDIC" OR "BASIC" WE ARE USING TWO APPROXIMATE DEFINITIONS:

ACIDIC CONDITIONS HAVE H⁺ AND BASIC CONDITIONS HAVE OH⁻

SO HOW DO WE TURN OUR REACTION FROM ACIDIC INTO A REACTION PERFORMED IN BASIC CONDITIONS?

OXIDATION NUMBER METHOD (in basic conditions)

5. BALANCE OXIDATION SEPARATELY WITH OTHERS FIRST

NOTE: YOU CAN BALANCE EACH HALF-REACTION BY ITSELF FIRST UNDER ANY CONDITIONS



6. MAKE SURE THE NUMBER OF ELECTRONS IS THE SAME

NOTE: YOU CAN BALANCE EACH HALF-REACTION BY ITSELF FIRST UNDER ANY CONDITIONS

$\text{Fe}^{2+} + \text{SO}_4^{2-} \longrightarrow \text{SO}_2 + 10\text{H}^+ + \text{Fe}^{3+} \quad \times 2$

$\text{Fe}^{2+} + \text{SO}_4^{2-} \longrightarrow \text{SO}_2 + 10\text{H}^+ + \text{Fe}^{3+} \quad \times 2$

7. PUT BOTH REACTIONS BACK TOGETHER AND CHECK FOR ELECTRONS

$2\text{Fe}^{2+} + 2\text{SO}_4^{2-} + 2\text{H}^+ + 10\text{H}^+ + 2\text{Fe}^{3+} + 2\text{SO}_2 + 2\text{H}_2\text{O} + 2\text{Fe}^{3+}$

8. BALANCE OXIDATION

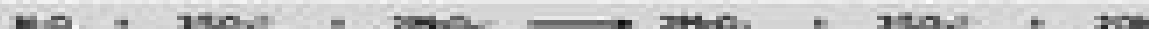
$2\text{Fe}^{2+} + 2\text{SO}_4^{2-} \longrightarrow 2\text{Fe}^{3+} + 2\text{SO}_2 + 10\text{H}^+ + 2\text{H}_2\text{O}$

$-2 + 2 = 0$

9. BALANCE REDUCTION

$2\text{H}^+ + 2\text{SO}_4^{2-} + 2\text{H}^+ + 10\text{H}^+ + 2\text{Fe}^{3+} + 2\text{SO}_2 + 2\text{H}_2\text{O} + 2\text{Fe}^{3+}$

$2 = 0 + 10 + 2 = 12$



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Teaching Chemistry - A

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