Ch.4.4 Redox Reactions

The loss and gain of valence electrons.

D. Gilliland, PreAICE Chemistry @ SHS

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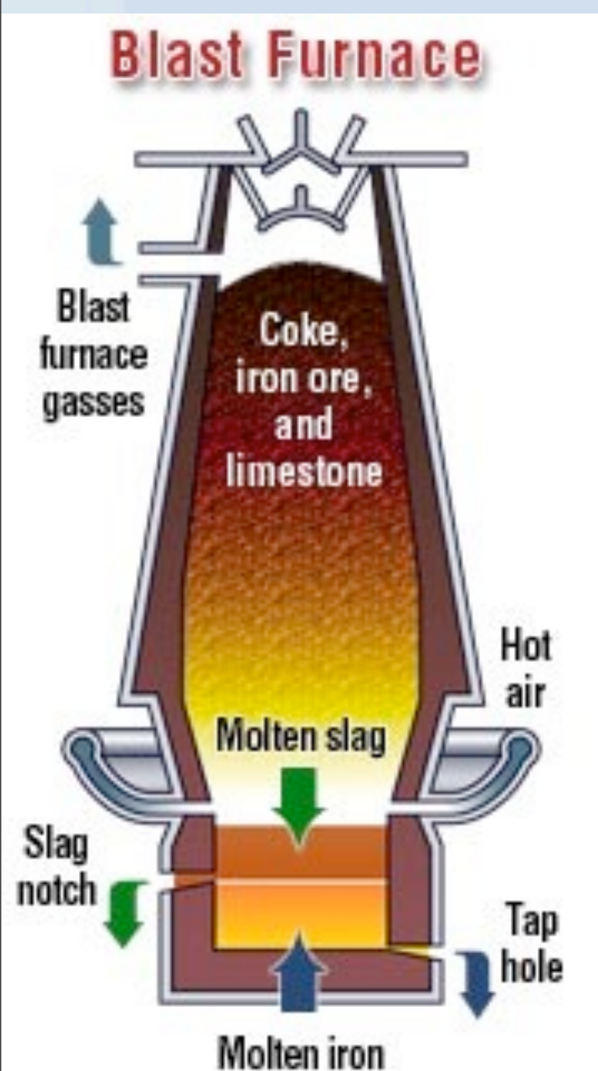
- The pure element iron does not exist in nature. Instead iron ore, iron(III) oxide, is mined and separated into iron and oxygen.

Reduction


Blast Furnace
Blast furnace gasses
Coke, iron ore, and limestone
Hot air
Molten slag
Slag notch
Tap hole
Molten iron

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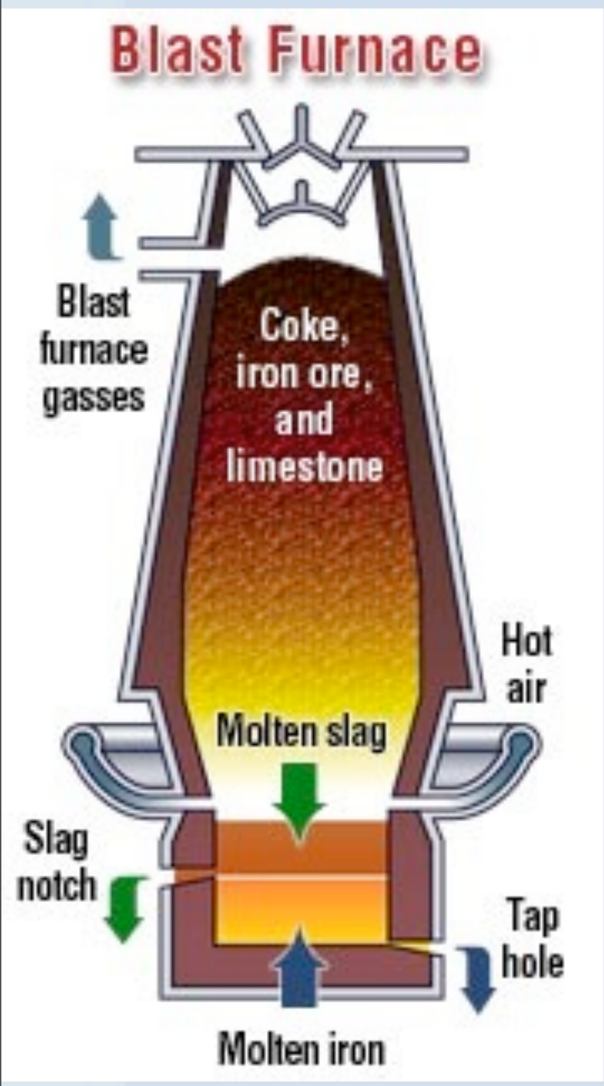

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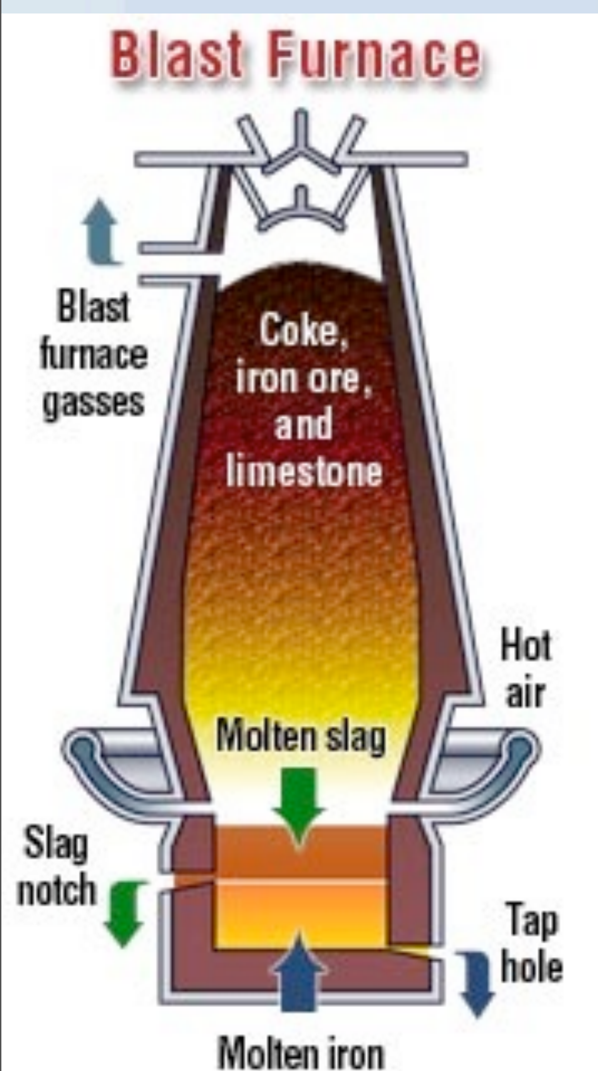

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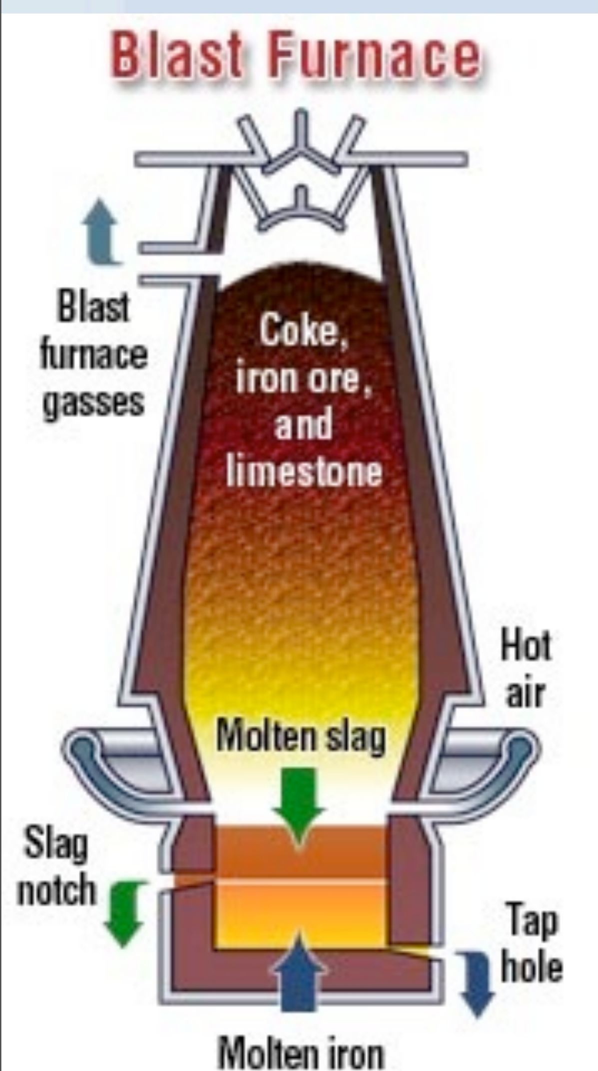

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- When this occurs an iron(III) cation (Fe^{+3}) gains 3 electrons from carbon and becomes an iron atom (Fe^0).

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- Reduction is the “removal” of oxygen.
  When oxygen is removed from iron ore the iron cation gains electrons and becomes a neutral atom. When this occurs the *oxidation number decreases* from +1, +2 or +3 to zero.
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- In a redox reaction, one substance loses one or more valence electrons and becomes **oxidized**. This term was chosen because when substances combine with oxygen they lose electrons and are therefore oxidized.
- Another substance gains those electrons and becomes **reduced**. This term was chosen because the valence of the substance is reduced (decreases).

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- Since metals lose e^{-} in chemical reactions we say they are oxidized. ***Any substance that is oxidized always <u>increases</u> in charge.***

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- Since nonmetals gain e^- in chemical reactions we say they are reduced. ***Any substance that is reduced in a reaction always <u>decreases</u> in charge.***

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What happens to e-?

OIL RIG

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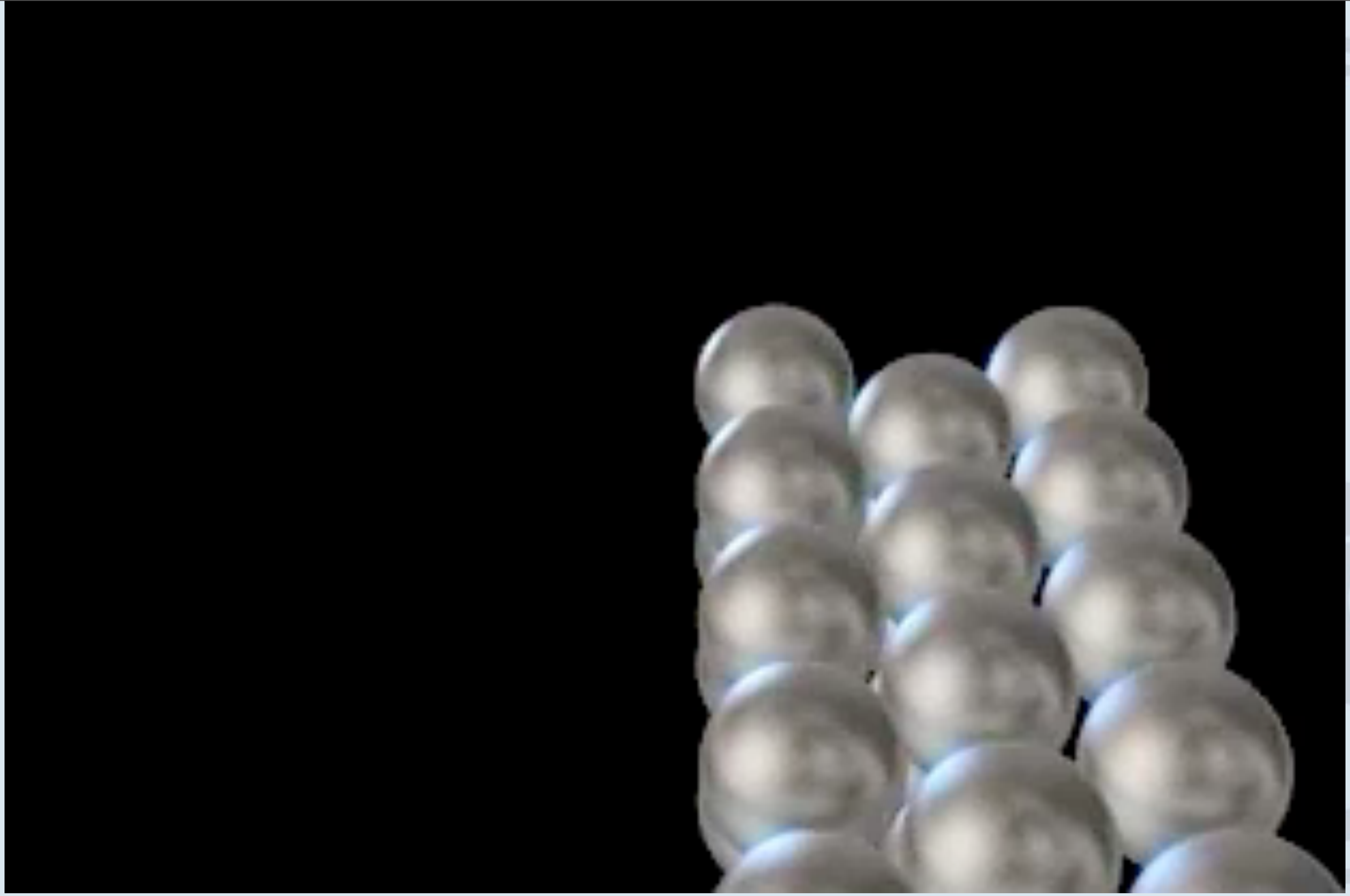
- Oxidation can’t occur without reduction!

Simple Redox Reactions:

Ionic Synthesis Reactions



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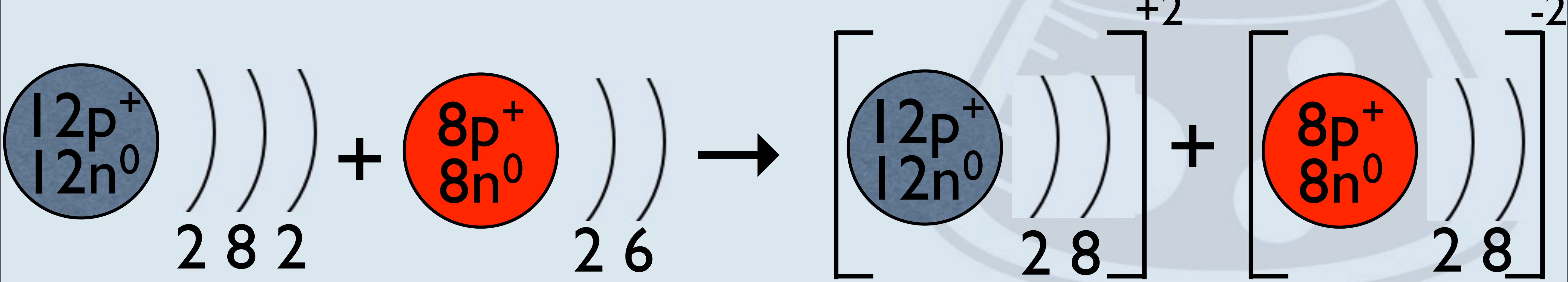

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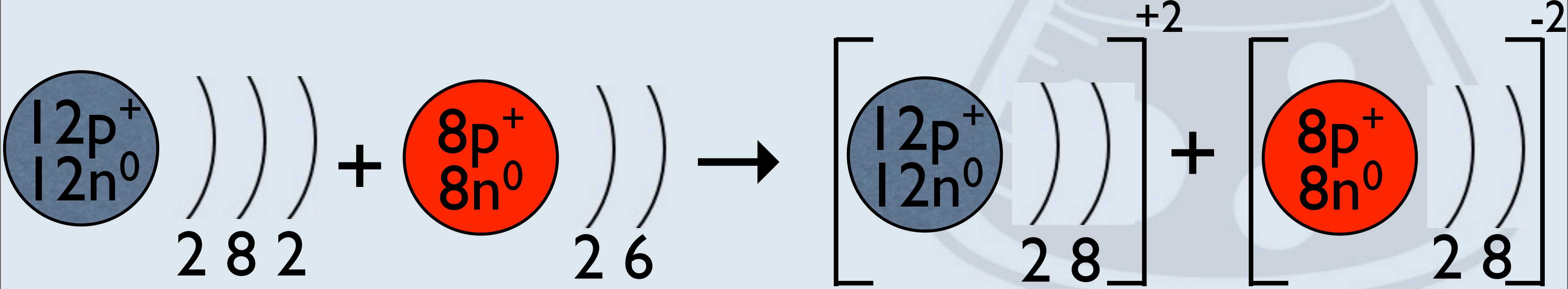

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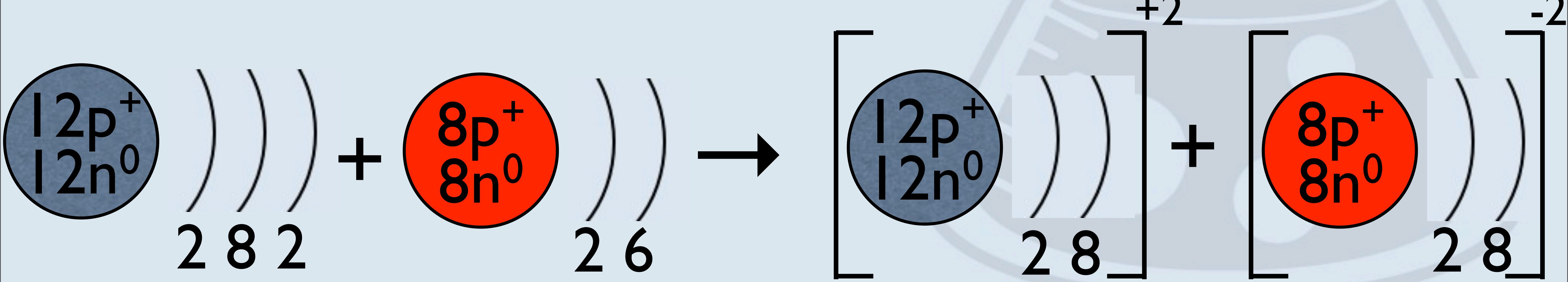

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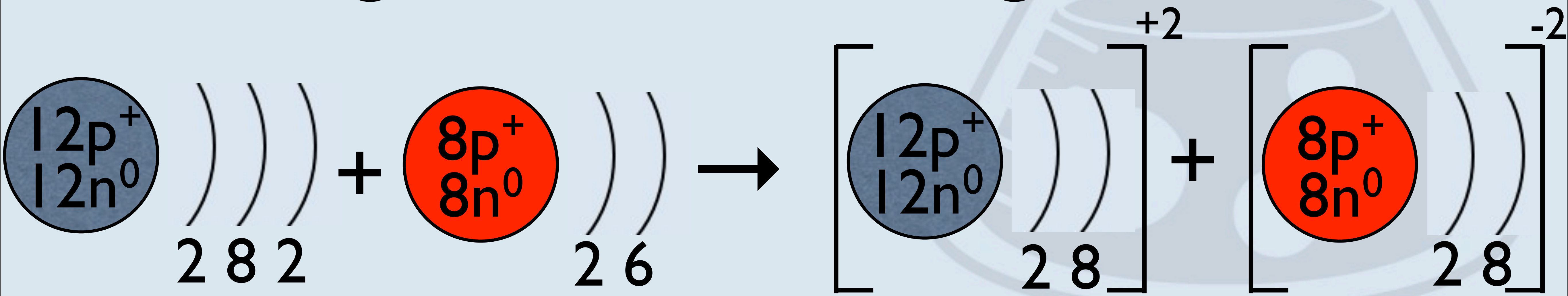

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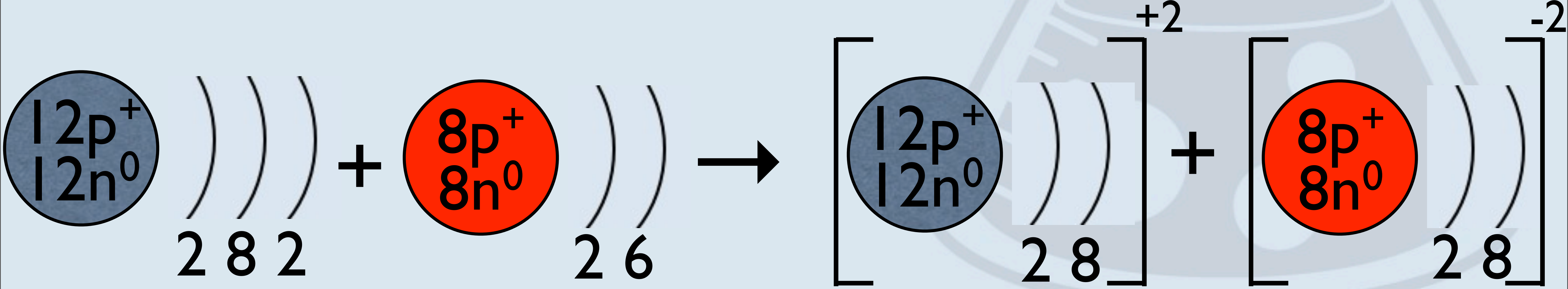

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Now let's include the coefficients in the half reactions to show the total number of electrons involved.

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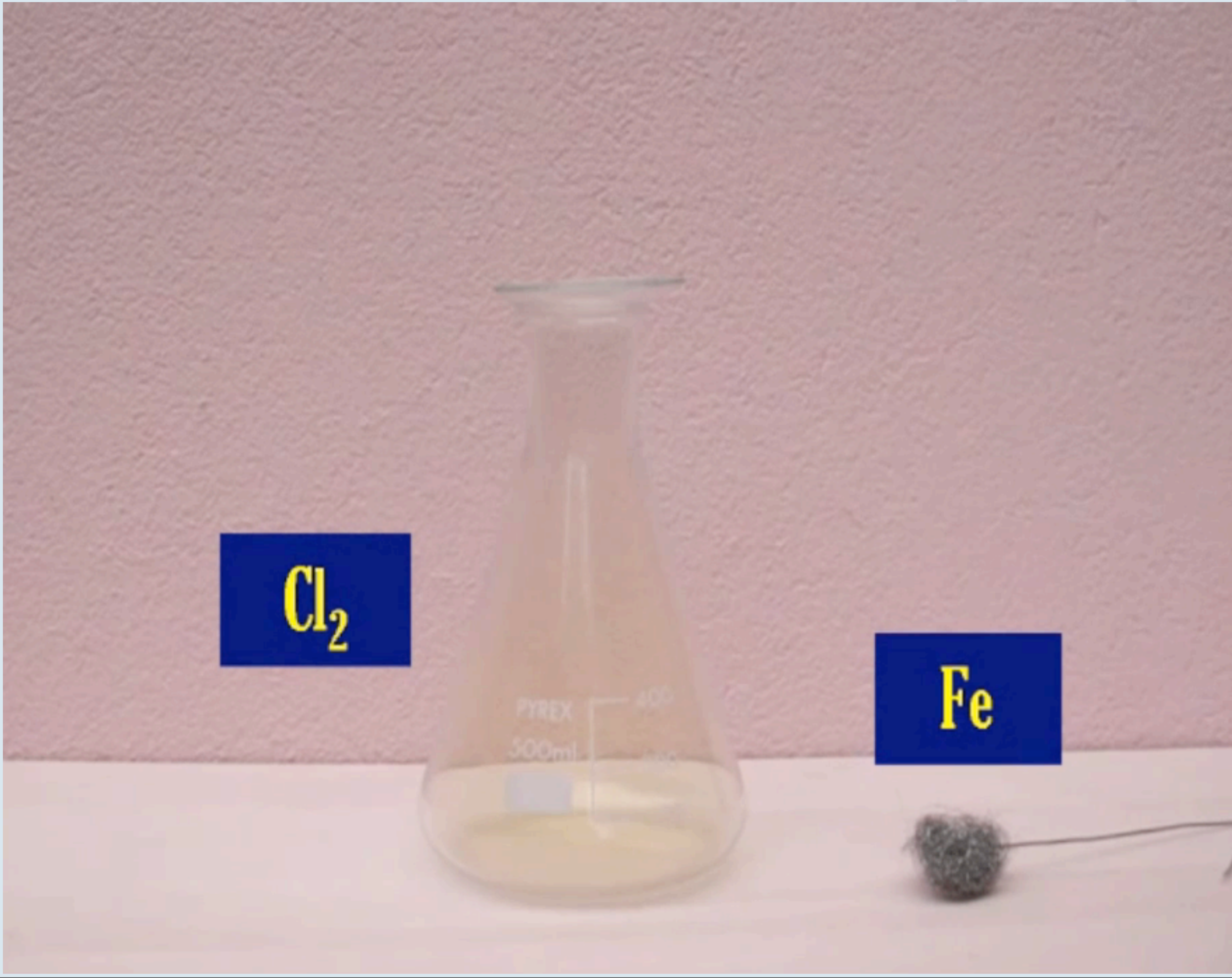

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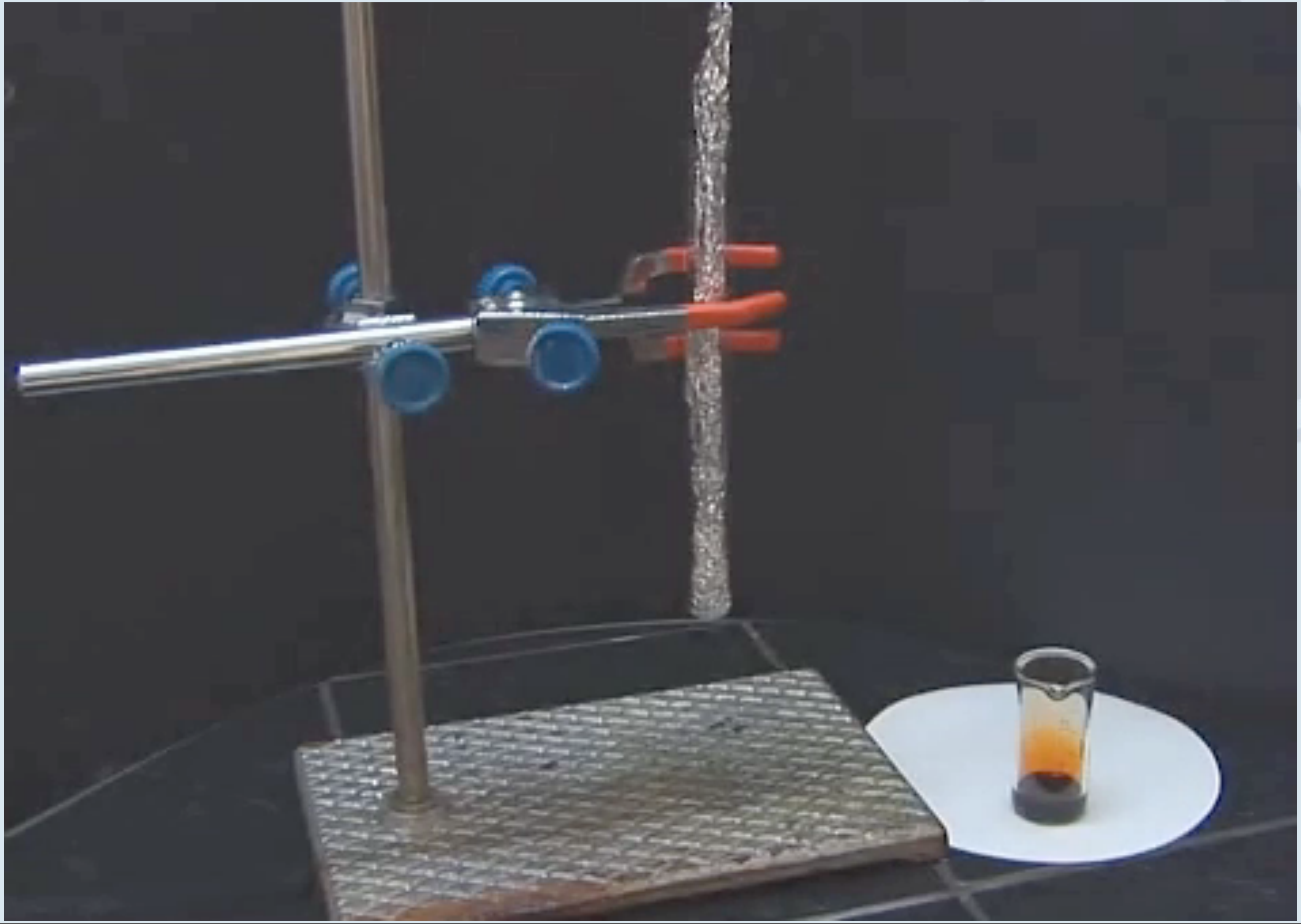

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Redox Reactions: Ionic Single Replacement Reactions

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What happened to chloride?

It didn't change (Cl^- on both sides of the equation).

Ions that don't change in a reaction are called *spectator ions*.

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Ions that keep their oxidation number in a reaction are called *Spectator Ions*.

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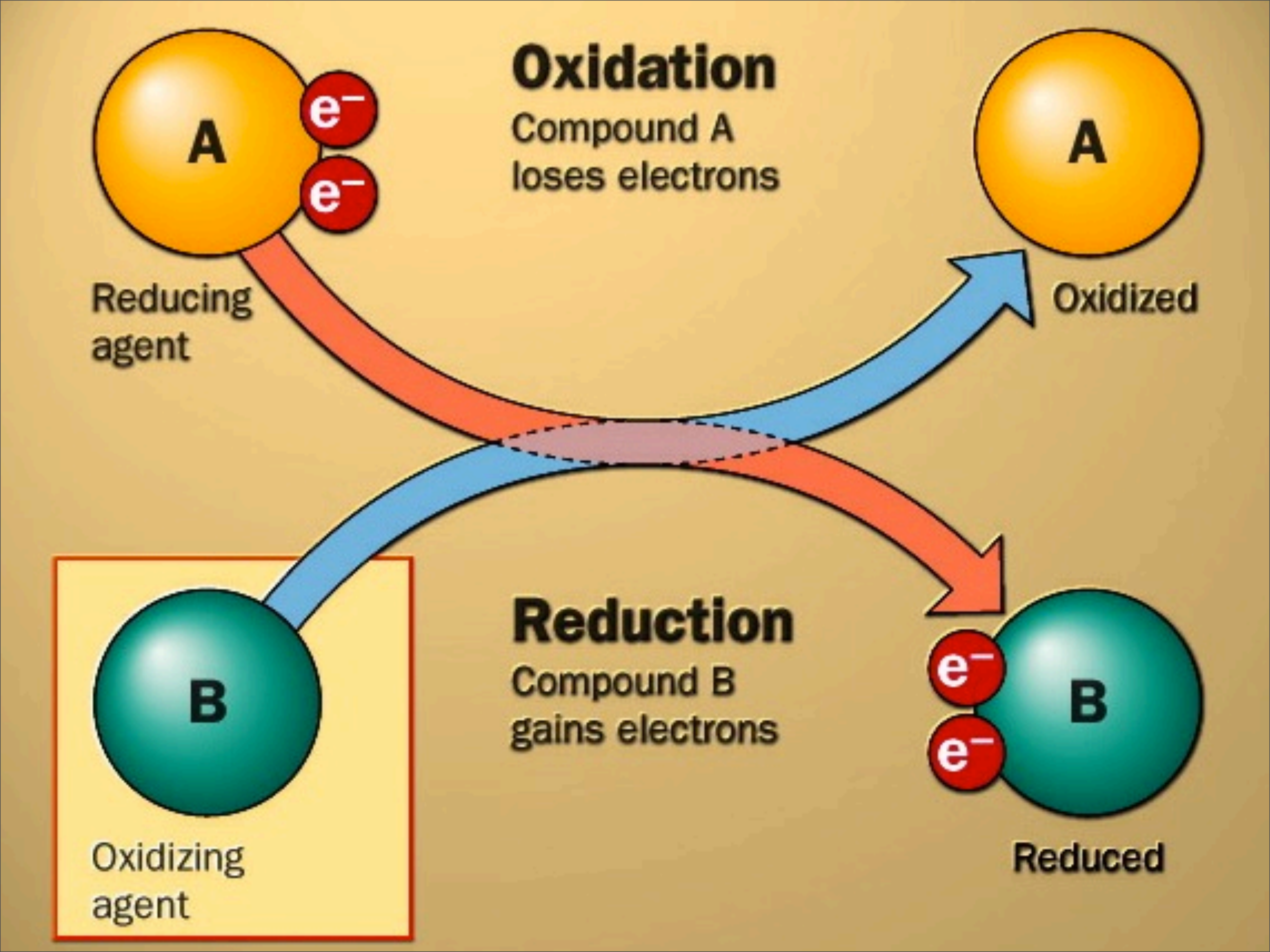
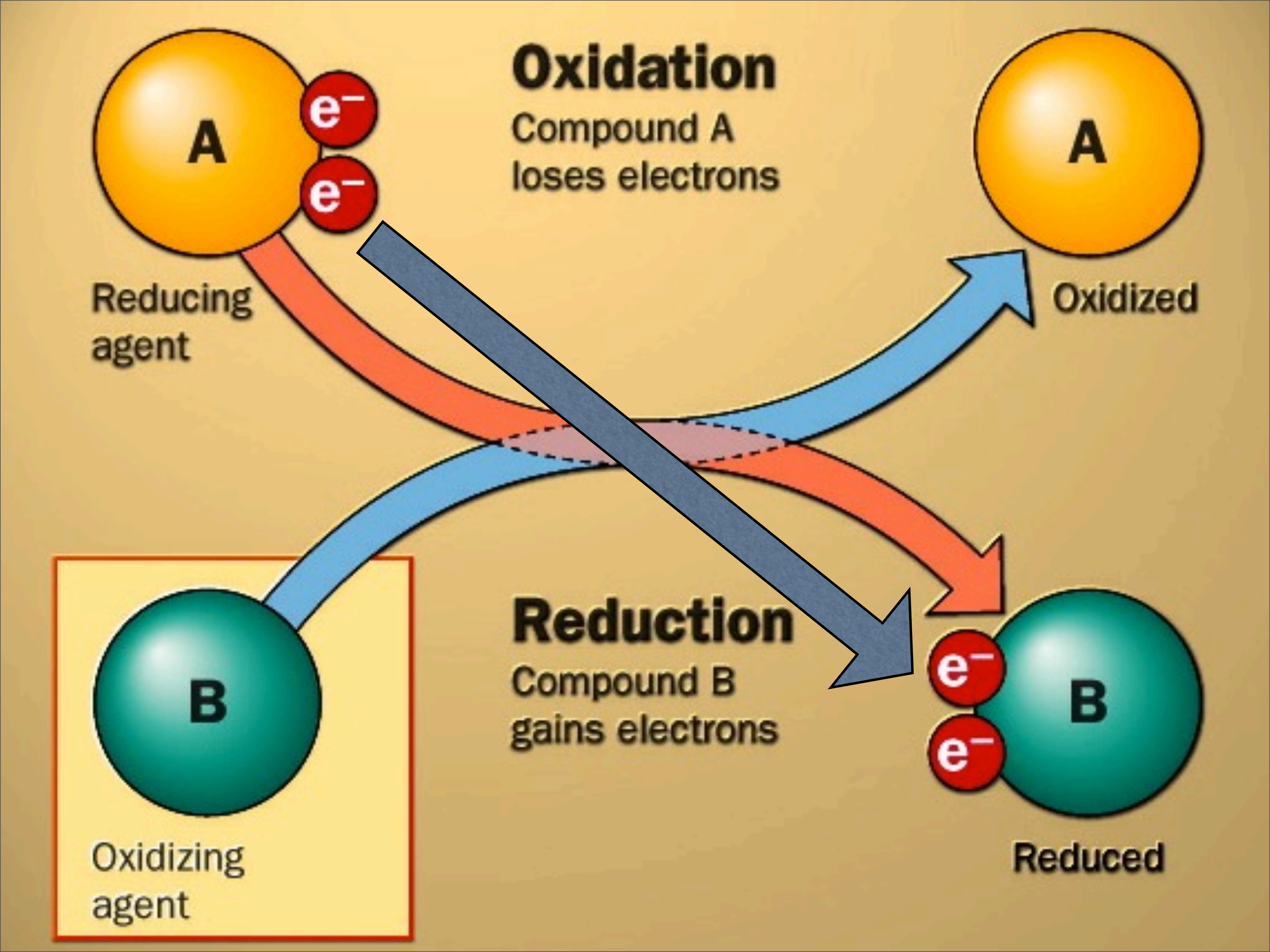

Oxidation
Compound A
loses electrons
A
e−
e−
Reducing
agent
A
Oxidized
Reduction
Compound B
gains electrons
B
Oxidizing
agent
e−
e−
B
Reduced


Oxidation
Compound A
loses electrons
A
e⁻
e⁻
Reducing
agent
A
Oxidized
Reduction
Compound B
gains electrons
B
Oxidizing
agent
e⁻
e⁻
B
Reduced