Chem1311Ch4Ep6Transcript

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Hello and welcome to the 6th episode of Reactions in Aqueous Solutions.

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Previously in reactions in aqueous solutions.

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We learned to assign oxidation states to elements in a compound.

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Today's episode will require for you to be able to assign oxidation numbers, not sort of know it, but actually know it well.

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You have been forewarned.

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There are five major types of redox reactions.

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Combination, also known as synthesis in older texts, decomposition, combustion.

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Single displacement or just displacement in your text.

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And disproportionation.

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Your goals for redox reactions are.

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To be able to identify each reaction from its equation.

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To identify the oxidizing agent and reducing agent in any of the redox reactions.

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And to be able to predict whether a single displacement reaction will proceed or not.

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First, the combination reaction.

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It consists of two or more reactants forming a single product.

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Aluminum and bromine gas react to form aluminum bromide.

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And they are an example of a combination reaction.

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By assigning oxidation numbers to each element in the reaction.

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It is possible to see which element's the oxidation number increased.

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We can see that.

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Aluminum oxidation number increased from zero to positive 3.

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Aluminum oxidized and therefore it is the reducing agent.

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We can see that Bromine's oxidation number decreased from zero to negative one.

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Bromine was reduced and therefore it is the oxidizing agent.

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The decomposition reaction consists of a single reactant breaking up into two or more products.

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The opposite of the combination reaction.

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Potassium chlorate breaking into potassium chloride and oxygen.

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It's an example of a decomposition reaction.

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By assigning oxidation states to each element in the reaction, we can determine which oxidation numbers changed and which didn't.

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We can see that chlorine.

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Chlorine’s oxidation number decreased from positive 5 to negative one.

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Chlorine was reduced and therefore it is the oxidizing agent.

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Oxygen’s oxidation number increased from negative 2 to 0.

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Oxygen was oxidized.

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The irony I know, and therefore it is the reducing agent.

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The combustion reaction is characterized by oxygen as one of the reactants and an oxide or oxides as the products.

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Notice that when an element is combusted, the reaction fits the definition of a combination reaction.

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If you must choose between combination and combustion, choose combustion.

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Sulfur burning in oxygen is an example of a combustion reaction.

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By assigning each element an oxidation number.

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We can see that Sulfur's oxidation number increased from zero to positive 4.

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Sulfur was oxidized.

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And therefore, is the reducing agent.

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We can also see that oxygen's oxidation state decreased from zero to negative 2.

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Oxygen was reduced.

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And therefore, it is the oxidizing agent.

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Another example of a combustion reaction is the burning of magnesium.

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By assigning each element its oxidation state.

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We can see that magnesium oxidation number increased from zero to positive 2.

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Magnesium was oxidized.

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And therefore, it is the reducing agent.

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Oxygen oxidation number decreased from zero to negative 2.

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Oxygen was reduced.

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And therefore, it is the oxidizing agent.

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A third example of a combustion reaction is the burning of methane.

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By assigning the oxidation states to each element.

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We can see that Carbon's oxidation number increased.

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From negative 4 to positive 4.

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Carbon was oxidized.

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And therefore, is the reducing agent.

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We can also see that oxygen's oxidation number.

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Decreased from zero to negative 2.

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Oxygen was reduced.

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And therefore, it is the oxidizing agent.

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The single displacement reaction is characterized.

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By an element taking the place of another in a compound.

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The displacement reaction can also be named by the element or type of element being displaced.

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This, for example is called the hydrogen displacement reaction.

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By assigning oxidation states to all the elements in this reaction.

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We can see that strontium’s oxidation number increase from zero to positive 2.

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Strontium was oxidized.

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And therefore, it is the reducing agent.

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We can also see that hydrogen's oxidation number decreased from positive 1 to 0.

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Hydrogen was reduced.

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And therefore, it is the oxidizing agent.

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In the next example, titanium is displaced by magnesium.

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Which is why it can be called a metal displacement reaction.

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By assigning oxidation states to all the elements in the reaction.

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We can see that titanium oxidation number decreased from positive 4 to 0.

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Titanium was reduced.

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And therefore, titanium chloride is the oxidizing agent.

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We can also see that magnesium oxidation number.

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Increased from zero to positive 2.

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Magnesium was oxidized.

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And therefore, it is the reducing agent.

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This third example of a displacement reaction shows chlorine, displacing bromine.

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This is why it can be called a halogen displacement reaction.

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By assigning the oxidation states to every element in the equation.

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We can see that chlorine's oxidation number decreased from zero to negative one.

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Chlorine was reduced and therefore it is the oxidizing agent.

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We can also see that Bromine's oxidation number increased from negative 1 to 0.

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Bromide was oxidized, and therefore potassium bromide is the reducing agent.

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There is one important consideration about the single displacement reactions.

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Just because you can write the equation.

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Does not mean it's going to happen.

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Allow me to illustrate the point.

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If this reaction, in which magnesium tells titanium.

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This solution is not big enough for the both of us.

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Takes place it's because magnesium.

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Is stronger than titanium.

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Therefore, the opposite reaction in which titanium tells magnesium.

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Take your electrons and leave the solution before sundown.

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Could not possibly happen because titanium is not stronger than magnesium.

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Likewise, if bromine is strong enough.

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To push chlorine out of the solution.

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Then chlorine is not strong enough to push bromine.

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So the opposite reaction cannot happen.

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What a nightmare, but fortunately we have an activity series.

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An activity series is like a ranking listing the most active metals at the top.

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The metals get less active as you go down the list.

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So that gold cannot displace anybody, whereas lithium can displace everybody.

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For a displacement reaction to proceed.

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The pure metal must outrank the metal in solution.

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You cannot steal from anyone stronger than you.

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This activity series also includes hydrogen.

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But hydrogen complicates things because its ionic bonds are weaker than its covalent bonds.

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You will notice that there are several tiers for metals when it comes to displacing hydrogen.

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At the very bottom.

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Are the metals that under no circumstances can displace hydrogen and are shaded light blue.

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They are all below hydrogen in the rankings.

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Those metals above hydrogen are all capable of displacing hydrogen from an acid solution and are shown here with a bracket.

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The top two tiers shown with this bracket can displace hydrogen from steam.

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And the very top tier is capable of displacing hydrogen from cold water.

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Consider this example.

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Locate iron and magnesium on the activity series.

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We see that iron is not higher than magnesium, so that it.

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Cannot displace him.

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Therefore, no reaction will take place.

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Now consider the following reaction.

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Locate magnesium and zinc.

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On the activity series.

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Because magnesium is higher than zinc, this reaction will proceed.

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Now consider this reaction between tin and cobalt iodide.

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Locate tin and cobalt in the activity series.

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Because tin is lower than cobalt.

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It cannot displace it.

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And therefore, no reaction takes place.

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Let's next consider the reaction between aluminum and chromium nitrate.

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Because aluminum is higher than chromium.

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This reaction proceeds.

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Hydrogen displacement reactions can also be predicted using the activity series.

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This example has calcium reacting with water.

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We locate calcium in the activity series.

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And see that it is in the top tier and capable of reacting with water.

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Therefore, this reaction will proceed.

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This next example has lead displacing hydrogen from water.

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We find lead in the activity series and see that it is in the third tier and unable to displace hydrogen from water.

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Therefore, there is no reaction.

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Just like metals have an activity series, halogens too have one that could be referenced for halogen displacement reactions.

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In this example.

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Chlorine displaces bromine in potassium bromide.

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Because chlorine is higher than bromine, this reaction will proceed.

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In this example.

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Iodine displaces bromine.

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But because iodine is not higher than bromine, there is no reaction.

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The 5th type of redox reaction is the disproportionation reaction.

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In this type of reaction, the same element is both oxidized and reduced.

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This example is a net Ionic equation, but don't let that bother you.

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By assigning oxidation states we can see that only chlorine's oxidation state changes.

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And chlorine is both oxidized.

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And reduced.

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Does that mean it is the oxidizing and reducing agent? Yes.

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Does that mean it's a double agent? No.

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Well, maybe. I don't know.

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Here's another example of a disproportionation reaction.

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By assigning oxidation states to every oxygen.

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We see that this too is a disproportionation reaction.

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Practice assigning oxidation states, determining oxidizing and reducing agents.

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And classifying each of the following reactions.

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Pause the video, write down your answers, and then come back.

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Welcome back.

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The first example has nitrogen being reduced.

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And that makes nitrogen the oxidizing agent.

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We have oxygen being oxidized.

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And that makes it the reducing agent.

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This reaction is an example of a decomposition reaction.

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For the next example, we have these oxidation states.

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Lithium is oxidized in this reaction.

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Which makes it the reducing agent.

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Nitrogen is reduced.

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And that makes it the oxidizing agent.

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This reaction is an example of a combination reaction.

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These are the assigned oxidation states.

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For the third reaction.

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In this reaction we have nickel being oxidized.

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And that makes it the reducing agent.

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We also have lead being reduced.

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And that makes it the oxidizing agent.

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This is an example of a single displacement reaction.

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These are the oxidation states of the fourth reaction.

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And they show nitrogen.

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Being reduced.

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Making it the oxidizing agent.

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And also, being oxidized.

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Making it also the reducing agent.

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Which can only mean that this is a disproportionation reaction.

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The commonly used breathalyzer test is a redox reaction that relies on the color change resulting from the reduction of chromium.

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Please remember to practice these skills before the exam.

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Because that's all there is.

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There isn't any more.