

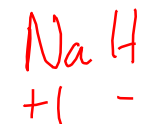
Spontaneous Reactions



Outcomes:

- Develop an activity series experimentally
- Predict spontaneous reactions using an activity series

Redox Review:

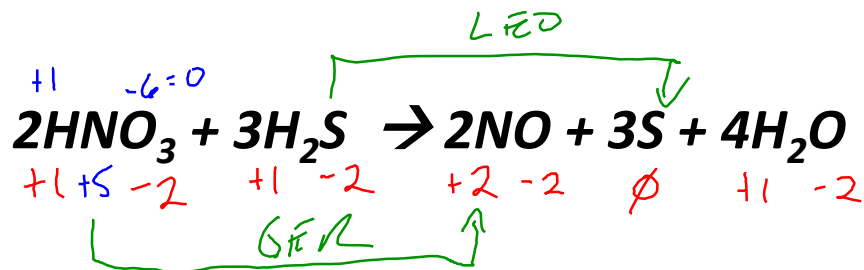


Redox reactions involve the **TRANSFER** of **ELECTRONS** from one reactant to another.

“LEO is the lion, and GER is his roar”

- **LEO** means **LOSING ELECTRONS** is **OXIDATION**
- **GER** means **GAINING ELECTRONS** is **REDUCTION**

Example:



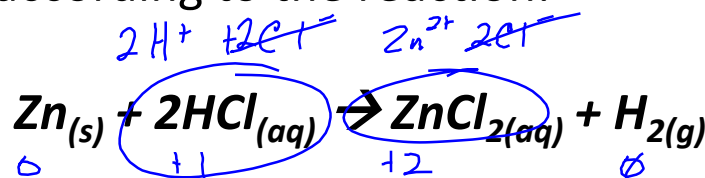
- The substance **oxidized** is: S⁻²
- The substance **reduced** is: N⁺⁵
- The **oxidizing** agent is: HNO₃
- The **reducing** agent is: H₂S

Spontaneous Reactions:

Are reactions that occur **WITHOUT** any **ADDED ENERGY**.

Example:

Zinc reacts with HCl spontaneously according to the reaction:



- Is a **SINGLE REPLACEMENT** reaction
- Zn is **OXIDIZED**, H is **REDUCED**.
- H must be a strong enough **OXIDIZING AGENT** to remove **ELECTRONS** from Zn
- Zn must have a **LOW AFFINITY** for electrons so H can **TAKE** its electrons.

If we placed **COPPER** in HCl, **NO REACTION** occurs since H is **NOT** a strong enough **OXIDIZING AGENT** to take copper's electrons.

Spontaneous Reactions:

Competition for Electrons:

When two substances react:

- The **STRONGEST OXIDIZING AGENT** will **ACCEPT** electrons, becoming **REDUCED**.
- The **STRONGEST REDUCING AGENT** will lose **ELECTRONS**, becoming **OXIDIZED**.

Activity Series (reduction potential chart):

- Through experimentation, we can set up an activity series that lists substances in order of their ability as oxidizing or reducing agents.
- The substances at the **BOTTOM LEFT (LIKE F₂)** have a **HIGH AFFINITY** for electrons.
 - Are the **EASIEST** to **REDUCE** (best **GER**)
 - Are the **STRONGEST OXIDIZING AGENTS**
- The substances at the **TOP RIGHT (LIKE Li)** have a very **LOW AFFINITY** for electrons.
 - Are the **EASIEST** to **OXIDIZE** (best **LEO**)
 - Are the **STRONGEST REDUCING AGENTS**

[→ See reduction potentials chart](#)

The Spontaneity Rule:

In order for two species to react, one must want to gain electrons **MORE** than the other.

“Any species on the left side of the activity series will react spontaneously (oxidize) with any species on the right side above it.”

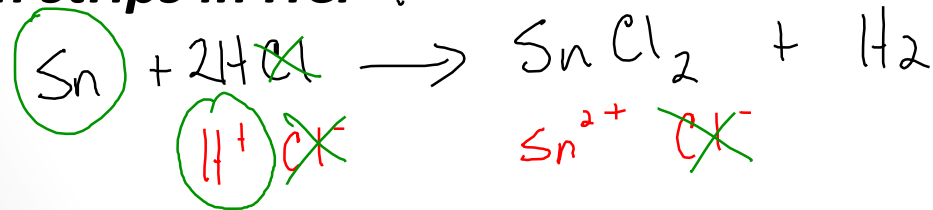
→ They are **“UP RIGHT SPONTANEOUS”**

Example:

Determine if the following will react spontaneously, if so, write the net reaction.

Compare Sn & H⁺ → up right Spont.

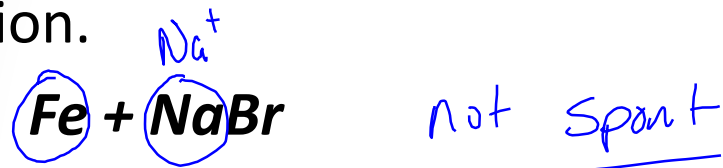
Tin strips in HCl_(aq)



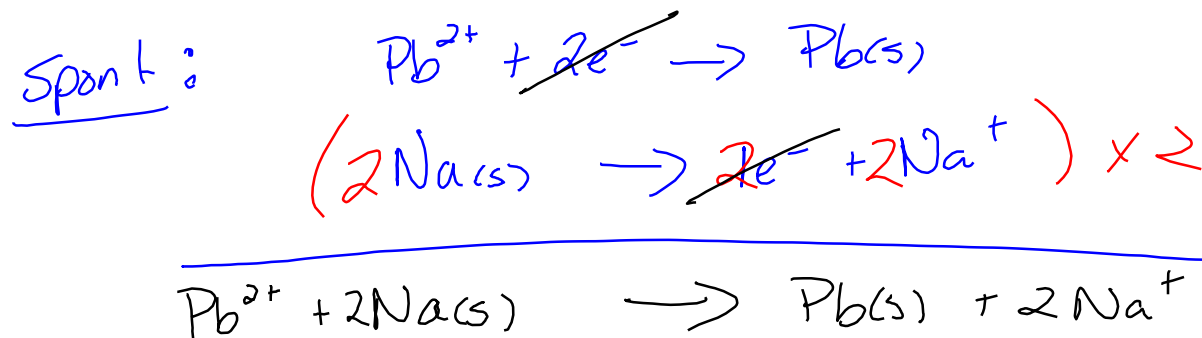
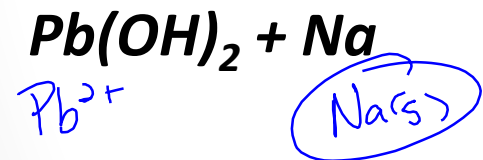
The Spontaneity Rule:

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Determine if the following will react spontaneously, if so, write the net reaction.



Try this one...



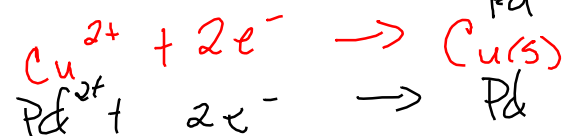
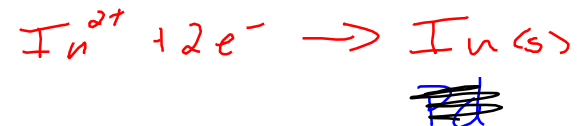
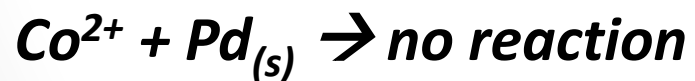
Predicting an Activity Series:

We can construct an activity series (reduction potential chart) given experimental data

- Look at **ONE REACTION** at a time.
- Determine **LEO** and **GER HALF-REACTIONS** for each
- If **SPONTANEOUS**, the LEO should be **ABOVE** the GER
- **REVERSE** the **LEO** reaction (all reactions need to be **REDUCTION** reactions)

Example:

Given the following experimental data, construct an activity series.



Predicting an Activity Series:

Try this one...

Construct an activity series given the following reactions.

