Reactivity Series of Metals Set (Ionization Tendency)

Cat. No. F35-8112-W0

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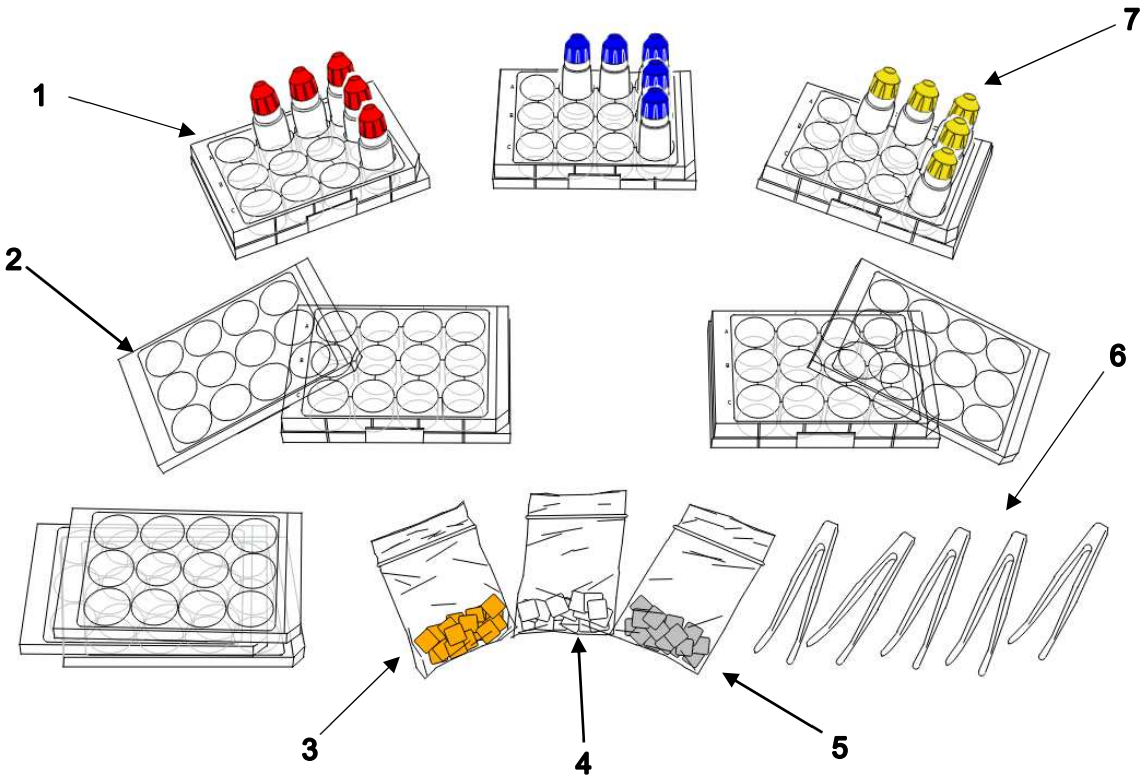
Safety Precautions

- Wear safety glasses and safety gloves during experiments.
- Always carry students' experiments under the supervision of teachers/trainers.
- Instruct students about the operation procedure and the safe ways of conducting experiments with this product prior to actual experiments.
- Read thoroughly Safety Data Sheet (SDS) of the chemicals used for your students' safety.
- Handle the Microplates with care.
- When you find any cracks or breaks in Microplates, stop using them. Check the condition of the Microplates every time before carrying out an experiment. Should you find crack in them, do not use and throw them away.

Contents



1. Microplate (12 wells) x 5 pcs
2. Lid for Microplate x 5 pcs
3. Metal pieces of Copper (10 x 10 x t 0.5mm) x 20 pcs
4. Metal pieces of Magnesium (10 x 10 x t0.5mm) x 20 pcs
5. Metal pieces of Zinc (10 x 10 x t 0.5 mm) x 20 pcs
6. Tweezers x 5 pcs
7. Dropper bottle (10ml) x 5 pcs (each red, blue, yellow) [Not included, prepare by yourself]

Introduction

All-in-one and at a glance type set for students' experiment of reactivity series (ionization tendency) of metals including metal pieces commonly used for experiments of this kind and a microplate that requires minimum quantity of chemicals.

Some students' experiments using chemicals are troublesome in terms of the time and cost required for treating chemical waste resulted from their experiments. On the other hand, this product achieves easier and minimized waste disposal after students' experiments.

In theory, reactivity series (ionization tendency) of metal is determined based on the state of ions in infinitely diluted solution where no interactions between metal ions exist. That is why, students' experiments often result in an ionization sequence (reactivity series) different from publicly available one. Therefore, some science textbooks refer only to the oxidation-reduction (redox) reactions of three types of metals (Mg, Zn, and Cu).

As an approach to promoting microchemistry, those three metals and a microplate are included in this product because redox reactions of those types of metals are supposed to proceed speedy and result is clear even with small amounts of the particular sulfate solutions at room temperature.

How to use

Preparation

1. Prepare chemical reagents for the experiment:

- Copper sulfate solution ($CuSO_4$) : 5% concentration
- Zinc sulfate solution ($ZnSO_4$) : 5% concentration
- Mangesium sulfate solution ($MgSO_4$) : 5% conc entration

  Prepare above solutions in your laboratory and split them into small amounts using eye dropper bottles is recommended). Then, put droplets of each solution on metals. When diluting all types of hydrates for example Copper sulfate hydrate, carefully calculate their mass beforehand, not to make a mistake in concentration of the solution

2. What elese is needed:

Droppers or eye drop bottle	Safety glasses or goggles
Safety gloves	Plastic tray
Lab wear	Cleaning cloth (Dust cloth)

Experiment

1. Set up the microplate and the dropper bottles containing the chemical regents in a tray.
2. Put a piece of each type of the metals, using tweezers, in each of the nine wells (A1~C3) of a microplate (see Fig. 1).
3. Drop a few droplets of copper sulfate solution onto one corner of each metal piece in row "A". Similarly, thereafter, drop a few droplets of zinc/magnesium sulfate solutions onto one corner of each metal piece in row “B” and “C” respectively (see Fig. 2).
4. Observe overall reactions occurring in the wells. Then, record the presence or absence of precipitated metal generated by the redox reaction in each cell of Table 1.

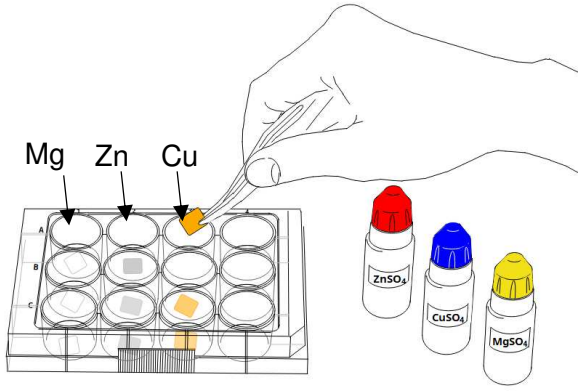


Fig. 1

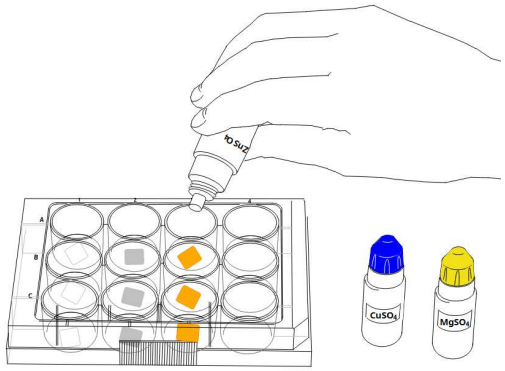


Fig. 2

Table 1. Presence or absence of metal precipitations:

		Magnesium	Zinc	Copper
Copper sulfate solution				
Zinc sulfate solution				
Magnesium sulfate solution				

✓: Presence of metal precipitation - : Absence of metal precipitation

Descriptions

Before the experiment of reactivity series (ionization tendency) of metals, students should learn not only about the reaction that proceeds between some types of metals and acid such as hydrochloric acid but also about the principle of cell reaction such as Volta or Daniell cells where several types of metal are used as electrodes.

Combination of a simple substance and ions of another type of element in a solution causes a redox reaction, where a simple substance is oxidized, ionized, and dissolved, while the other type of element is reduced and precipitated as a simple substance. This phenomenon implies that the oxidized element has a higher ionization tendency than the reduced element. Difference in redox potential between two elements determines the element to be oxidized and the other one to be reduced. The reactivity series (ionization series) represents the order of ionization tendency when arranging elements in the order of redox potential.

This approach can also be used to the metals (magnesium, zinc and copper) included in this product.

Presence or absence of the metal precipitation in the microplate wells is as shown in Table 2 and Photo 1.

Table 2. Presence or absence of the metal precipitation:

	Magnesium	Zinc	Copper
Copper sulfate solution	✓	✓	-
Zinc sulfate solution	✓	-	-
Magnesium sulfate solution	-	-	-

✓: Presence of metal precipitation - : Absence of metal precipitation

Photo 1

Reactions occurring in column 1 of the microplate indicate that, in the combination with magnesium and copper/zinc sulfate solutions, magnesium is oxidized to its ions, whereas copper/zinc sulfates

are reduced and precipitated as metallic copper and metallic zinc respectively. Thus, magnesium is more easily ionized than copper and zinc.

Reactions occurring in column 2, in the combination with zinc and copper sulfate solution, zinc is oxidized to its ions, whereas copper sulfate is reduced and precipitated as metallic copper. Thus, zinc is more easily ionized than copper.

In column 3, no reaction occurs. Thus, copper has the lowest ionization tendency among the three types of metal.

Conclusion:

Reactivity series (ionization series) for this combination of metals is as follows Mg > Zn > Cu.

Cleanup after experiments

- Absorb chemical solution (waste) left in each well of the microplate using tissues paper and dispose of them as an ordinary trash.
- Remove used metal pieces from the microplate. For reuse and/or storage, wash, dry and polish them to remove the stains using sandpaper (not included).
- Wash the used microplate with water and dry it.

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