

## WARNING NOTICE

The experiments described in these materials are potentially hazardous. Among other things, the experiments should include the following safety measures: a high level of safety training, special facilities and equipment, the use of proper personal protective equipment, and supervision by appropriate individuals. You bear the sole responsibility, liability, and risk for the implementation of such safety procedures and measures. MIT and Dow shall have no responsibility, liability, or risk for the content or implementation of any of the material presented. [Legal Notice](#)

## Midas' Magic

### Abstract

Two clear colorless solutions are mixed together resulting in the formation of a thick yellow precipitate.

### Materials

Lead Nitrate  $\text{Pb}(\text{NO}_3)_2$   
Potassium Iodide KI  
1000 mL beaker  
2- 500 mL containers  
glass stir rod

### Safety

Lead nitrate and potassium iodide should both be considered hazardous. Both chemicals can cause skin, eye and respiratory irritation. Prolonged exposure to lead nitrate can result in burns and can be toxic to the central nervous system and the peripheral nervous system. When working with these compounds work in a vented hood and avoid breathing in any dust particles.

### Procedure

Preparation of Stock Solutions:

0.1M lead nitrate solution—dissolve 16.6 g  $\text{Pb}(\text{NO}_3)_2$  in distilled water and dilute to 500 mL.

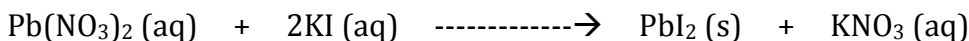
0.1M potassium iodide solution—dissolve 8.3 g KI in distilled water and dilute to 500 mL.

## Presentation:

To an empty 1000 mL beaker add about 100 mL of the first colorless solution  $\text{Pb}(\text{NO}_3)_2$ , and then about 100 mL of the second colorless solution KI and a dense yellow precipitate forms instantly.

## Discussion

This experiment is dramatic in that it shows the creation of a colorful product from two colorless solutions. The reaction is a classic example of a precipitation reaction, which results in the formation of an insoluble product. In this example, when an aqueous solution of lead nitrate  $\text{Pb}(\text{NO}_3)_2$  is added to an aqueous solution of potassium iodide KI, a yellow precipitate of lead iodide  $\text{PbI}_2$  is formed as well as some potassium nitrate  $\text{KNO}_3$  which stays in solution:



The reaction is an example of a metathesis reaction, which involves the exchange of ions between the  $\text{Pb}(\text{NO}_3)_2$  and KI. The  $\text{Pb}^{+2}$  ends up going after the  $\text{I}^-$  resulting in the formation of  $\text{PbI}_2$ , and the  $\text{K}^+$  ends up combining with the  $\text{NO}_3^-$  forming  $\text{KNO}_3$ .

Ion	General Solubility Rule
$\text{NO}_3^-$	All nitrates are soluble.
$\text{C}_2\text{H}_3\text{O}_2^-$	All acetates are soluble ( $\text{AgC}_2\text{H}_3\text{O}_2$ only moderately.)
$\text{Cl}^-$ , $\text{Br}^-$ , $\text{I}^-$	All chlorides, bromides, and iodides are soluble except $\text{Ag}^+$ , $\text{Pb}^+$ , and $\text{Hg}_2^{2+}$ . ( $\text{PbCl}_2$ is slightly soluble in cold water and moderately soluble in hot water.)
$\text{SO}_4^{2-}$	All sulfates are soluble except those of $\text{Ba}^{2+}$ , $\text{Pb}^{2+}$ , $\text{Ca}^{2+}$ and $\text{Sr}^{2+}$ .
$\text{CO}_3^{2-}$ and $\text{PO}_4^{3-}$	All carbonates and phosphates are insoluble except those of $\text{Na}^+$ , $\text{K}^+$ , and $\text{NH}_4^+$ . (Many acid phosphates are soluble.)
$\text{OH}^-$	All hydroxides are insoluble except those of $\text{Na}^+$ and $\text{K}^+$ . Hydroxides of $\text{Ba}^{2+}$ and $\text{Ca}^{2+}$ are slightly soluble.
$\text{S}^{2-}$	All sulfides are insoluble except those of $\text{Na}^+$ , $\text{K}^+$ , $\text{NH}_4^+$ , and those of the alkaline earths: $\text{Mg}^{2+}$ , $\text{Ca}^{2+}$ , $\text{Sr}^{2+}$ , and $\text{Ba}^{2+}$ . (Sulfides of $\text{Al}^{3+}$ and $\text{Cr}^{3+}$ hydrolyze and precipitate as the corresponding hydroxides.)
$\text{Na}^+$ , $\text{K}^+$ , and $\text{NH}_4^+$	All salts of sodium ion, potassium ion and ammonium ion are soluble except several uncommon ones.

A quick glance at a solubility table shows that all nitrates are always soluble and all iodides are soluble except those formed with  $\text{Pb}^{+2}$ ,  $\text{Ag}^{+}$  and  $\text{Hg}_2^{2+}$

### **Disposal**

The products of the reaction should be poured out into a properly labeled waste container for proper disposal.

### **References**

Shakhashiri, B. Z. *Chemical Demonstrations: A Handbook for Teachers of Chemistry*; University of Wisconsin: Madison, WI, **1983**; Vol. 1, pp. 286-292

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